Foundations of Learning and Instructional Design Technology

Historical Roots and Current Trends

Richard E. West

Table of Contents

Acknowledgements 1

Introduction 3

List of Authors 7

Author Index 27

I. Definitions and History 47

1. The Proper Way to Become an Instructional Technologist
Lloyd Rieber
49

2. What Is This Thing Called Instructional Design?
Ellen D. Wagner
59

3. History of LIDT
Association for Educational Communications & Technology
63

4. A Short History of the Learning Sciences
Victor Lee
67

5. LIDT Timeline 79

6. Programmed Instruction
Michael Molenda
81

7. Edgar Dale and the Cone of Experience
Sang Joon Lee & Thomas C. Reeves
93

8. Twenty Years of EdTech
Martin Weller
101

II. Learning and Instruction 113

9. Memory
Rose Spielman, Kathryn Dumper, William Jenkins, Arlene Lacombe, Marilyn Lovett, & Marion Perlmutter
115

10. Intelligence
Rose Spielman, Kathryn Dumper, William Jenkins, Arlene Lacombe, Marilyn Lovett, & Marion Perlmutter
125

11. Behaviorism, Cognitivism, Constructivism
Peggy A. Ertmer & Timothy Newby

133

12. Sociocultural Perspectives of Learning
Drew Polly, Amanda R. Casto, Jessica Norwood, & Bohdana Allman
151

13. Learning Communities
Gregory S. Williams & Richard E. West
167

14. Communities of Innovation
Richard E. West
177

15. Motivation Theories and Instructional Design
Seung Won Park
193

16. Motivation Theories on Learning
Kelvin Seifert & Rosemary Sutton
207

17. Informal Learning
Tim Boileau
225

18. Overview of Problem-Based Learning
John R. Savery
237

19. Connectivism
George Siemens
247

20. An Instructional Theory for the Post-Industrial Age
Charles M. Reigeluth
255

21. Using the First Principles of Instruction to Make Instruction Effective, Efficient, and Engaging
M. David Merrill
265

III. Design
275

22. Instructional Design Models
Tonia A. Dousay
277

23. Design Thinking and Agile Design
Vanessa Svihla
295

24. What and how do designers design?
Andrew Gibbons
309

25. The Development of Design-Based Research

Kimberly Christensen & Richard E. West
323

26. A Survey of Educational Change Models
James B. Ellsworth
339

27. Performance Technology
Jill E. Stefaniak
345

28. Defining and Differentiating the Makerspace
Tonia A. Dousay
359

29. User Experience Design
Yvonne Earnshaw, Andrew A. Tawfik, & Matthew Schmidt
369

IV. Technology and Media
391

30. United States National Educational Technology Plan
U.S. Office of Educational Technology
393

31. Technology Integration in Schools
Randall S. Davies & Richard E. West
421

32. K-12 Technology Frameworks
Royce Kimmons
445

33. What Is Technological Pedagogical Content Knowledge?
Matthew J. Koehler & Punya Mishra
453

34. The Learner-Centered Paradigm of Education
Sunnie Lee Watson & Charles M. Reigeluth
465

35. Distance Learning
Florence Martin & Beth Oyarzun
479

36. Old Concerns with New Distance Education Research
Barbara Lockee, Mike Moore, & John Burton
495

37. Open Educational Resources
David Wiley
503

38. The Value of Serious Play
Lloyd Rieber, Lola Smith, & David Noah
511

39. Video Games and the Future of Learning
David Williamson Shaffer, Richard Halverson, Kurt Squire, & James P. Gee
525

40. Educational Data Mining and Learning Analytics
Ryan S. Baker & Paul Salvador Inventado
539

41. Opportunities and Challenges with Digital Open Badges
Tadd Farmer & Richard E. West
553

V. Becoming an LIDT Professional 561

42. The Moral Dimensions of Instructional Design
Russell T. Osguthorpe, Richard Osguthorpe, W. James Jacob, & Randall S. Davies
563

43. Creating an Intentional Web Presence
Patrick R. Lowenthal, Joanna C. Dunlap, & Patricia Stitson
573

44. Where Should Educational Technologists Publish Their Research?
Albert D. Ritzhaupt, Christopher D. Sessums, & Margeaux C. Johnson
591

45. Rigor, Influence, and Prestige in Academic Publishing
Peter J. Rich & Richard E. West
609

46. Educational Technology Conferences
Patrick R. Lowenthal
617

47. Networking at Conferences
Jered Borup, Abby Hawkins, & Tanya Gheen
627

48. PIDT, the Important Unconference for Academics
Richard E. West
633

VI. Preparing for an LIDT Career 637

49. What Are the Skills of an Instructional Designer?
William Sugar, Abbie Brown, Lee Daniels, & Brent Hoard
639

50. Careers in Academia: The Secret Handshake
Ana Donaldson & Sharon E. Smaldino
657

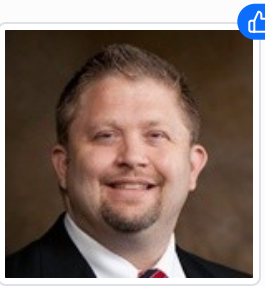
51. Careers in K-12 Education
Drew Polly & Kay Persichitte
667

52. Careers in Museum Learning
Stephen Ashton, Kari Ross Nelson, & Lorie Millward
677

53. Careers in Consulting
Barbara M. Hall & Yvonne Earnshaw
689

Final Reading Assignment 701

Index of Topics 703



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What I like best about this book is that it does a great job of comprehensively covering all of the important topics in educational technology today, without claiming to do so. And the open nature of the book means that it is quite literally open for more chapters on emerging ideas and concepts, and chapter updates... so it can continue to be a comprehensive source for those teaching a course in the foundations of learning and instructional design technology. Moreover, its chapter format makes it easy to assign individual chapters as readings for more specifically focused courses. I highly recommend this resource for any educational technology faculty but also for general education faculty who may want to use some of the chapters for their own courses.

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Introduction

Like most, I had a serendipitous beginning to my career in this field. I knew I loved to teach but did not know what subject. I loved to read and study theory as a literature major but did not want to spend my life writing another literary analysis of Chaucer. I loved to write as a former newspaper reporter and use visual design technologies to lay out newspapers but knew that was not quite right either. What was the answer? Luckily for me, a colleague mentioned instructional design, and I jumped feet first into a field that I knew very little about.

I've learned over the years that my experience is more common than not, as there is not "a proper way" (see Lloyd Rieber's Peter Dean lecture, republished in this book) to come into this field. People with a wide rainbow of academic and professional backgrounds come into this field and leave to occupy a similarly wide variety of employment options. For this reason, many have called our field a "meta" field that is integrated into many other disciplines. For what could be more ubiquitous than the need to educate? And where there is education, there must be designers to create it.

Because we work in a meta-discipline, editing a book on the "foundations" of the field is very difficult. No matter how many chapters are included, inevitably there will be important topics left out. For this reason, curious readers are recommended to seek out any of the other excellent foundation textbooks available, including the following:

- Trends and Issues in Instructional Design and Technology (Reiser and Dempsey)
- Foundations of Educational Technology (Spector)
- The Instructional Design Knowledge Base (Richey, Klein, and Tracey)

I repeat, this book will not cover everything a student in the field should know. No book will. What I do hope, however, is that this book will provide enough of an overview of the key topics, discussions, authors, and vocabulary in the field that you will be able to start navigating and understanding other books, articles, and conference presentations as you continue your educational journey. I also hope to spark an interest in studying more on any one of these topics that may be interesting to you. There are rich bodies of literature underneath each of these topics, just waiting to be explored.

What's in a Name?

Scholars disagree on what we should even call our field. In the textbooks I mentioned above, our field is called educational technology, instructional design, and instructional design and technology. My academic department is called the Department of Instructional Psychology and Technology, although it used to go by the Department of Instructional Science. In this book I have sought for what I considered to be the most inclusive name: learning and instructional design technology (LIDT). I chose this also to emphasize that as designers and technologists, we not only affect instruction but also learners and learning environments. In fact, sometimes, that may be our greatest work.

Organization of This Book

This book reflects a suggested strategy for teaching new graduate students in the LIDT field. First, the book begins with definitions about what the LIDT field is. Second it surveys some key historical concepts that lay the foundation of the field, including an overview of learning theory and some brief history of the LIDT field and of the Association for

Educational Communications Technology (AECT)—a main professional organization for the field. This section also provides some key concepts in design, programmed instruction, and instructional media.

The third section of the book focuses on current trends and issues, using the concept of "current" fairly liberally. Here we review topics such as the learning sciences, online learning, design-based research, K-12 technology integration, instructional gaming, and school reform. The fourth and fifth sections of the book I consider to represent the future of the field—or the future of you, the student just beginning your career! You are the future of the field, so this section of the book is dedicated to you. In it, you will find chapters related to successfully navigating graduate school, launching your career, and integrating yourself into the professional community.

Online vs. Print Version

Some people like to read online; others do not. For that reason this book is available as a pdf download and soon print on demand. However, the book is too large as a pdf download, so some chapters are only available in the online version. Usually I made this choice if a chapter was much too long (the national educational technology plan by the U.S. Department of Education) or if I felt the chapter was partially duplicated by another. Most of the core chapters remain in the pdf verson, but be aware that there are additional readings available in the online version.

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Remixing Book Content

As an open book, my assumption was that other instructors might remix the content to fit their course. Readers may notice that there is a strong Brigham Young University influence in my version of the book, and other departments may want to emphasize their departments in versions of the book for their students. In fact, I believe it is good for students to become well acquainted with the foundations of their own department, and the current trending topics among their own faculty.

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Reflection

What do you hope to learn from this textbook? Write down any questions you have about the field and as you read through the chapters, note any answers you may have found or add any additional questions.

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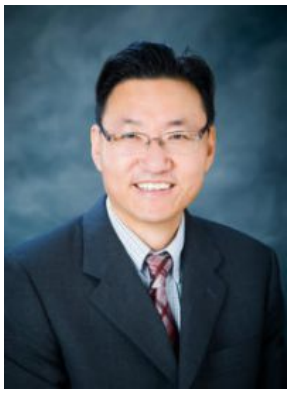

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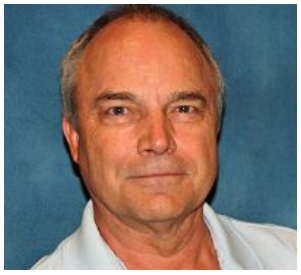

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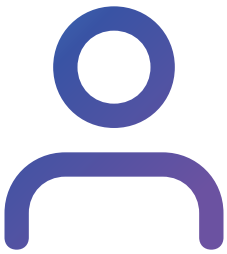

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Author Index

This index provides the name of each author with their accompanying chapter(s).

Association for Educational Communications & Technology

AECT

From http://aect.org: "AECT has become a major organization for those actively involved in the design of instruction and the development of a systematic approach to learning. It provides an int...

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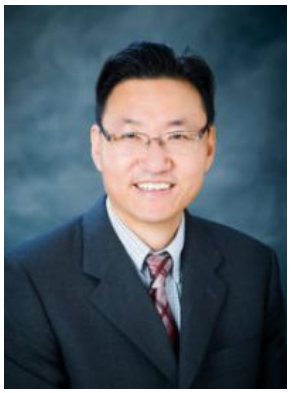

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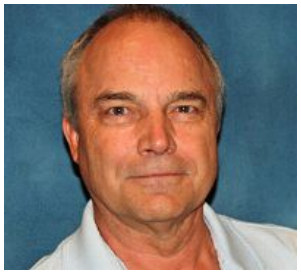

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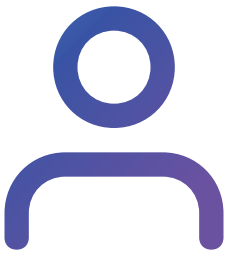

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I. Definitions and History

The ritual is a common one, every fall semester. Students knock on my door, introduce themselves as interested in studying *Learning and Instructional Design Technology* for a graduate degree, ask how they can prepare themselves. Should they study psychology for their undergraduate degree? Education? Sociology? Media and technology? Research methods? Design of some sort?

The answer would be, of course, yes! But this does not mean one must know everything to be successful in LIDT. Rather, this means that there are many successful and "proper" paths into our field. Lloyd Rieber explains this very well in his Peter Dean Lecture essay that is the first chapter of this section and book. I find that this essay often puts students at ease, explaining that whatever their path might have been, they belong in the field.

This section also includes several chapters on the history of the LIDT field. Because the field of LIDT could be defined broadly, any aspect of the history of education and learning could be considered a history of this field. However, there is generally consensus that the field of LIDT began in earnest with the development of digital technologies, programmed instruction, and systemic thinking, and then grew to include newer developments such as the learning sciences and evolving perspectives on teaching and learning. These points of view are reflected in these chapters, but students are encouraged to think about the history of the field more broadly as well. What perspectives are not included in these historical chapters that should be? What other theories, ideas, and voices helped to form a foundation for how we look at the field of LIDT?

The Proper Way to Become an Instructional Technologist
What Is This Thing Called Instructional Design?
History of LIDT
A Short History of the Learning Sciences
LIDT Timeline
Programmed Instruction
Edgar Dale and the Cone of Experience
Twenty Years of EdTech

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1

The Proper Way to Become an Instructional Technologist

Lloyd Rieber

Instructional Design AECT

Editor's Note

In 1998, Rieber was invited to give the 1998 Peter Dean Lecture for AECT and later published his remarks on Rieber's own website. It is republished here by permission of the author.

Rieber, L. (1998). The proper way to become an instructional technologist. Retrieved from https://edtechbooks.org/-An

Prologue

I wrote this essay to support my Peter Dean Lecture at the 1998 AECT convention. The invitation to present this lecture came only several weeks before the scheduled presentation at AECT. Consequently, there was little time to put these ideas into written form for the ITFORUM discussion that traditionally follows this lecture. Interestingly, though the lecture and discussion have long past, I have not felt it necessary to revise the essay. Despite the fact that it lacks the "scholarship polish" of a refined work, I think it still captures well my thoughts and feelings that I initially struggled to organize and convey. I presented my essay and conducted the ITFORUM discussion in the spirit of sharing some ideas as works in progress. I think this is a style that takes full advantage of electronic media—to offer a set of ideas that lead to more questions than answers and to engage a group of thoughtful people in a discussion of the ideas to tease out what is and is not important.

The purpose of the Peter Dean Lecture, as I understand it, is to choose someone who has been around long enough to appreciate the struggles of the field and to give that person the opportunity to give a critical analysis of where we are and where we might go. This presents a nice opportunity, but a presumptuous one in my opinion, for the person chosen. Are my experiences and points of view a valid cross section of the field? Obviously not. Nevertheless, I used this opportunity to speak to some issues that interest and concern me, in the hope that they might trigger some reflection and comment—I still hope that is the case for those who now happen upon this essay.

Introduction

The inspiration for the topic of my AECT presentation and this essay comes from an article published by Robert Heinich in 1984 called “The Proper Study of Educational Technology.” At the time I first read the article (around 1986), its title rubbed me the wrong way. There was something unduly pretentious about it—that there was, in fact, a proper study of instructional technology (IT). When I first read the article, I must admit that I incorrectly interpreted it. Heinich warned strongly against the “craft” of IT which I wrongly interpreted as “art.” I have long been sensitive to our field disavowing the artistic side of IT and instead overemphasizing, I felt, its scientific aspects. Having just reread the article, I am very impressed with how forward looking Heinich’s thinking was at the time, especially regarding the role of research. The purpose of this essay, therefore, is not to take issue with Heinich’s ideas, but to use them to motivate another question: What is the proper way to become an instructional technologist?

Many would quickly argue that the proper way is to go to a university and get a degree in IT. This reminds me of the scene from the Wizard of Oz in which the wizard tells the scarecrow that he has as much brains as anyone else, but what he needs is a diploma to prove it. (L. Frank Baum was no stranger to sarcasm.) Of course, there is definitely a formal side to getting an education in our profession, but I believe that the best of our field have learned that our theories and models must be grounded in the actual context of the problem. More about this later. I have also long been struck by the many paths taken by people who now find themselves called instructional technologists. Our profession consists of individuals with an amazing diversity of backgrounds, goals, and education. It is also common for many people to say they didn’t even know the field existed until they were already a practicing member of it.

Take my background, for example. I started off my undergraduate education as an engineering student. In the summer of my freshman year, I traveled in Latin America working with several youth groups. The experience convinced me that I didn’t want to become an engineer, but instead I wanted to know more about the complexity of people and their cultures. I took several paths from there, at one point actually completing the paperwork to declare a major in anthropology. I came to the education field most unexpectantly. I eventually became an elementary school teacher—trained in a large urban university in the northeast of the USA, but got my first job in a very small rural school in the American Southwest (New Mexico). This was 1980 which, coincidentally, was about the time that desktop computers were introduced into mainstream education. I found myself thrust into a position where technology, education, and different cultures were rapidly mixing.

In a lot of ways, this was perfect position for a person like me. There were few formal ideas in force about how to use computers in education (at least in my district) and the school administration actually encouraged “early adopters” such as myself to explore different ideas and take some risks. I later discovered, when I entered graduate school, that many of the things I had learned on my own in those years about technology, instructional design, and learning theory actually had formal names in the literature (one example is the concept of rapid prototyping).

Elementary school teachers are, as a group, very sensitive to the student point of view (though don’t take this as an insult to other groups). It’s just that the complexity of domains (e.g. math, science, language arts, etc.) is not as demanding to the adult as they are to the student. Consequently, the adult teacher is somewhat freed from the

demands of the content, but forced to consider what it must be like for a 10 year old to learn something like fractions. Most elementary school teachers are also faced with teaching a broad array of subjects, so the concept of integrating subjects in meaningful ways is familiar to us. (Heck, I also taught music—the elementary school was one of the few places where my accordion was truly appreciated!) My education to become a teacher was heavily rooted in Piagetian learning theory, so it is easy to see how I came to use LOGO with students and to understand the facilitative role it demanded of teachers. In hindsight, I can't think of a better place than the elementary school classroom for me to have received my first education as an Instructional Technologist. ("Holmes, my good man, what school did you attend to become an Instructional Technologist?" "Elementary, my dear Watson, elementary.") I wonder how many of you have backgrounds exactly like mine. Few, I wager. So, while studying engineering and culture, traveling, followed by being an elementary classroom teacher in a context where technology was introduced with no training was the proper way for me to become an instructional technologist, I know it is a path not to be exactly duplicated by anyone.

Instructional Technologist as Computer Scientist

Heinich's article discusses the frustration of IT being considered a service arm of education. Our role, to many people outside the field, is to "connect the pipes" and to fix the machines. The advent, growth, and semi-dependency of education on computing has reinforced this position in many ways. Let's face it, most people outside our field equate us —and respect us—for our mastery of technologies such as the computer. So, perhaps the proper way to become an instructional technologist is first to become a computer wizard, that is, to master the tools first and to assume that the knowledge of how to apply the tool in education will come merely as a consequence. However, I like to point out that "A power saw does not a carpenter make." Owning a power saw coupled even with the knowledge of how to use it safely to cut wood does not make one a carpenter. For example, consider the contrast between two carpenters who appear on American public television shows—Roy Underhill and Norm Abrams. For those of you not familiar with these two, Roy appears on *The Woodwright's Shop*, a show dedicated to preserving carpentry skills practiced before the advent of electricity. In contrast, Norm Abrams, a self-professed power tool "junkee," appears in *This Old House* and *The New Yankee Workshop*. Despite their different approaches and attitudes to the use of technology, I'm quite sure that both would thoroughly enjoy the other's company and wile away the hours discussing what they both love best, namely, carpentry. However, despite my respect for Roy's skills and philosophy, when I try my hand at even mid-size woodworking projects, such as building a patio deck or storage shed, you can bet that I prefer to use the power tools available to me. Likewise, in education, I prefer to take advantage of the opportunities that the available "power tools" afford, such as the computer. But underlying it all, is a profound core of, and respect for, the essential skills, strategies, and experiences akin to those possessed by the master carpenter.

Instructional Technologist as Philosopher

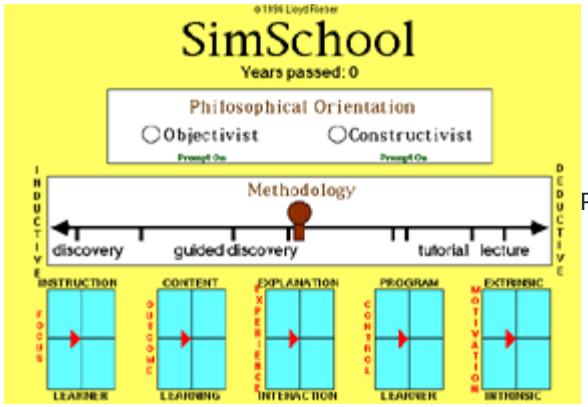
Has anyone else noticed how much of our literature in recent years has been devoted to philosophy? So, perhaps the proper way to become an instructional technologist is to become a philosopher and first unravel the mysteries of what it means to "be" and what it means to "know." The field seems quite preoccupied with uncovering if there is a "real" world or whether reality exists solely in the mind of the individual. I have come to the conclusion that Instructional Technologists are not well equipped to handle philosophical problems such as these and question if it is a good use of our time.

The debate between objectivism vs. constructivism, though a healthy and necessary one, has also had the tendency for people to believe that there is a "right answer" to what their philosophy "should be." It's almost as though they were taking some sort of test that they need to pass. I suppose most just want to be associated with the dominant paradigm instead of digging down deep to better understand their own values, beliefs, and biases. I've also noticed it is in vogue to question others about their philosophical camp, not in order to enter into a dialogue of how one's philosophy informs one's design, but more to sort people in a convenient manner. (This resembles to me how Dorothy was questioned by Glinda: "Are you a good witch or a bad witch?" The answer, of course is "Why, I'm not a witch at all.")

Don't mistake my meaning. I believe strongly in each professional developing a strong philosophical stance (I myself have tried to do so in several places, such as Rieber, 1993). It's just that we have tried, at times, to misapply the business of philosophy or to try to tackle philosophical questions that have remained unresolved for thousands of years. There are productive uses for philosophy in our field, but there is the danger of sliding into philosophical quagmires, or worse, trying to use philosophical positions to inappropriately judge people. (Click here for an example of a little exercise I like to use in some of my classes that gets at the importance of considering one's philosophical points of view.)

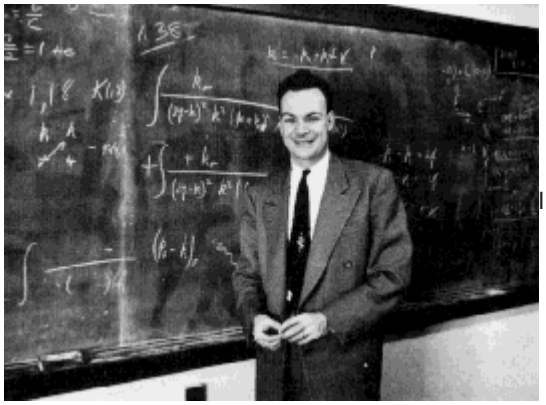
Not being a philosopher, I have found it difficult to effectively raise and lead discussions on philosophical issues in my classes. I had always joked about wanting some sort of simulation that embedded these issues in a way that one could "experience" them rather than just talk about them. You know, something like 'SimCity' or 'SimLife.' Wouldn't it be great, I thought, to also have a similar simulation to help one play with these complicated issues as well as understand what the educational system would be like 50 or 100 years from now if a major paradigm shift really took place today! Ha ha, it was a quaint inside joke. Well, one day I decided to put a working prototype of 'SimSchool' together for my next class. I have "shocked" Simschool and offer it here for you to try out (of course, you will first need access to the web, have enough RAM, and be able to download and install the right plug-in from Macromedia, etc.). If you do take a look, don't take it too seriously. This simulation has not been validated. It is just a little exercise to get my students to "try out" the philosophical implications on education, from my point of view. What is most useful is when people take issue with my interpretation and instead put forward how THEY would design SimSchool. These are the discussions that really matter.

Instructional Technologist as Physicist or Mathematician



Perhaps the proper way to become an instructional technologist is to first become a physicist or mathematician. Many of the leading scholars in the field began this way. Seymour Papert is a mathematician by training, Alfred Bork is a physicist. Sometimes I wonder if our field suffers from "physics envy"—we want desperately, it seems, to be considered a science. Well, I actually enjoy reading about theoretical physics (at least as far I can without knowing the mathematics).

One physicist I have become fascinated with is the late Nobel laureate, Richard Feynman. Some of you might know him due to his role on the committee investigating the Space Shuttle Challenger disaster. (My daughter was in first grade at the time. The whole school was gathered in the school's cafeteria to watch the lift-off. I recall my daughter coming home after school telling us that it was her job to go find the principal to tell her that the "shuttle blew up.") I have become interested in Feynman for lots of reasons, but of relevancy here was his apparent genuine concern about his teaching. While other physicists and mathematicians-turned-educators often come across to me thinking they know all the answers to the problems of education—I'm not saying Papert and Bork are like this ;)—Feynman remained quite reflective (not to mention baffled) by the entire teaching/learning process. In the preface to The Feynman Lectures, a set of well-known readings to introductory physics, Feynman expressed his frustration in not being able to meet the needs of students known not to be the brightest or most motivated (in other words, those like me). Rather than just blame the students, he publicly took his share of the responsibility.



I also liked the way Feynman talked about his teaching in a very reflective, almost constructivistic way. That is, he seemed to understand that teaching was a way for him to understand problems in new and important ways. He once wrote about turning down the opportunity to go and work at Princeton at the Institute for Advanced Study BECAUSE he would not have to teach. Here is an excerpt (go to https://edtechbooks.org/-ST for the complete quote):

> *I don't believe I can really do without teaching. . . . If you're teaching a class, you can think about the elementary things that you know every well. These things are kind of fun and delightful. It doesn't do any harm to think them over again. Is there a better way to present them? The elementary things are easy to think about; if you can't think of a new thought, no harm done; what you thought about it before is good enough for the class. If you do think of something new, you're rather pleased that you have a new way of looking at it. The questions of the students are often the source of new research. They often ask profound questions that I've thought about at times and then given up on, so to speak, for a while. It wouldn't do me any harm to think about them again and see if I can go any further now. The students may not be able to see the thing I want to answer, or the subtleties I want to think about, but they remind me of a problem by asking questions in the neighborhood of that problem. It's not so easy to remind yourself of these things. So I find that teaching and the students keep life going, and I would never accept any position in which somebody has invented a happy situation for me where I don't have to teach. Never.*

While I don't know how much his students may have learned, his willingness to admit how vital teaching was to his own professional development is refreshingly straightforward.

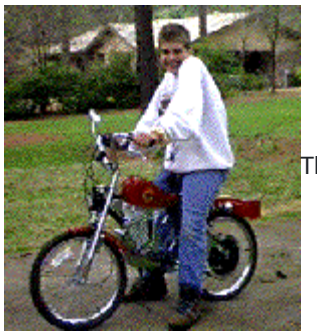
Instructional Technologist as a Graduate of an Instructional Technologist Program

I finally come to the time honored tradition of going to a university and getting a degree. The diploma becomes one's "membership card" with all the rights and privileges therein to participate as a member of the profession (though it does not, of course, guarantee a job!). I feel I must tread lightly here so as not to be misinterpreted, especially considering I

am a member of a university's faculty. Nevertheless, I have long been frustrated with the way in which instructional technologists are educated at universities (notice my deliberate avoidance of the term "train"). There are many areas to be considered here, so I will only focus on one in any depth: The congruency between instructional design as written and taught, and how it is actually done in practice. Related to this is the role played by theory and research in guiding, or even informing, practice.

One of the most problematic relationships in our field is that which exists between theory, research, and practice. The problem is shared by professors, researchers, students, and practitioners alike. That is, a professor who is unable (or unwilling) to connect theory with practice is just as guilty as a student who avoids confronting or demeans theoretical implications of practice. The textbooks make the relationship seem so clear and straightforward, yet my experience with actually doing instructional design has been messy and very idiosyncratic. Michael Streibel (1991, p. 12) well articulated what I had felt as I tried to reconcile instructional design as it was written and talked about versus how I had actually done it:

> *I first encountered the problematic relationship between plans and situated actions when, after years of trying to follow Gagné's theory of instructional design, I repeatedly found myself, as an instructional designer, making ad hoc decisions throughout the design and development process. At first, I attributed this discrepancy to my own inexperience as an instructional designer. Later, when I became more experienced, I attributed it to the incompleteness of instructional design theories. Theories were, after all, only robust and mature at the end of a long developmental process, and instructional design theories had a very short history. Lately, however, I have begun to believe that the discrepancy between instructional design theories and instructional design practice will never be resolved because instructional design practice will always be a form of situated activity (i.e. depend on the specific, concrete, and unique circumstances of the project I am working on).*



This idea that instructional design is largely contextual and relies so heavily on creative people working with unique problems resonates with me even more due to my experience of being the parent of a child with special needs. My son Thomas has mental retardation as well as a wide array of other problems, including language and behavior disorders (the term "pervasive developmental disorder" is used to vaguely characterize the diversity of the disability). There is a not so great movie titled "Dog of Flanders" involving a poor Dutch boy who desires to become a painter. One day he visits the studio of a master painter and is shocked to learn that this painter sometimes uses a knife to paint with. In response, the painter responds matter of factly that "I would use my teeth if I thought it would help." There have been countless times I have felt the same thing about how I might improve my teaching or instructional design, despite of what I think I know about learning theory, etc.—I, too, would do just about anything if I thought it would help. My work with my son points to situations where the distinction between cognitive/behavioral or objectivistic/constructivistic becomes quite gray and rather unimportant. Click here to play a shocked version of a simple game called "Super Hero". I like to say that I designed this game *with* Thomas, not *for* Thomas. He has contributed to its construction in so many ways that I feel he deserves to be called a "co-designer." I think this notion is useful to any designer. Work with end users to such an extent that you feel you owe them co-ownership of what you design.

My current interest in play theory is also an example of my struggle with how our field characterizes the interplay between research, theory, and practice. On one hand, my interest in play is derived by working with children and

watching the intensity with which they engage in activities they perceive to be worthwhile. However, I also wanted to explain more thoroughly my own experiences of being so involved in activities that nothing else seemed to matter. My curiosity led me to themes I had first encountered when I was a "short lived" student of anthropology, namely games and their cultural significance. I also found out about Flow theory and saw how well it described the play phenomena.

I have come to see the story of the Wright Brothers' invention of the airplane as a good metaphor for understanding the proper relationship between theory, research, and practice in our field (it is even a good metaphor if you live in a country that takes issue with them getting credit for being declared the first to invent the airplane!). That the Wright Brothers were technologists, inventors, and tinkerers is not questioned, but people do not realize that they were also scientists who asked the right questions about the theory of the day and crafted ingenious experiments to get at the answers. Most of all, people forget that they were also the world's most experienced pilots at the time. They took their findings into the field and practiced what they studied. These experiences likewise informed their scientific side of the enterprise, culminating in a controllable aircraft. (Incidentally, it's the "controllable" part of the invention that is the real genius of the brothers.)

In broaching the subject of the adequacy of graduate programs in preparing people to become instructional technologists, I hope I do not unleash the floodgate of individual criticisms or personal war stories. Instead, I wish us to look more broadly at the aims and goals of graduate programs as compared to what is needed or actually done in the field. For example, I think the distinction between education and training is useful here. I can't name one technical skill I learned in a graduate course that I still use exactly as taught. Instead, all of the technical skills I now use were learned either on my own, through professional development, or by preparing to teach others (mostly the latter). In my opinion, universities are not supposed to prepare technicians to perform a specific job, but rather should prepare people for a life's study. It is fair to ask how well we, at the University of Georgia, are doing. To our credit, I will tell you that our faculty has openly discussed among ourselves and with students what we are doing and whether there is a better way. I am proud to report that we will be trying a new approach at the Master's level that we are referring to as a "studio-based approach." We are also quite nervous about it because it represents an approach with which none of us have much experience. However, we all seem to agree that it will be an approach more closely (and honestly) aligned with our beliefs about how people learn and what people need.

Many issues on this topic remain, such as the proper role of research. (I see at least two, by the way. One is the traditional role of research contributing to the literature. A second role for research, though less recognized, is how it informs the researcher. The act of doing research becomes a source of ideas and invention, leading to a much deeper conceptual understanding of the topic or problem being studied. Even if the research itself goes wrong in some way, the researcher grows intellectually and emotionally from the experience. I'm not sure how to characterize this research purpose since it does not fit any traditional category (e.g. basic, applied, etc.), so perhaps we should just call it "constructive or reflective research.") Another topic worth pursuing is the way universities assess student achievement. This is not an indictment of testing per se, but I admit I find it strange that we still assign letter grades in most of our graduate courses. (That one should bring in the mail.)

Closing

So, what is the proper way to become an instructional technologist? Obviously, my position is that there is not one way and that we should value the diversity of the people who make up our profession. I also challenge each faculty member and student to stand back from their graduate curricula and question the purpose and relevance of the experiences that are contained there. However, this is all too easy, so I end by offering two lists. The first is one I posted on ITFORUM awhile back. It's my way of "reverse engineering" what I do in language that people outside the field can understand (such as my parents):

I'm an instructional technologist……

- I help people learn new things.
- I solve problems in education and training, or find people who can.
- I use lots of different tools in my job; some are 'things' like computers and video, other tools are ideas, like knowing something about how people learn and principles of design.
- I know a lot about these tools, but I know I have to use them competently and creatively for the task at hand before they will work.
- I consider using all of the resources available to me, though sometimes I have to go and find additional resources.
- I am most interested in helping children, but many of my colleagues work with adults.
- I resist doing things only because "we've always done it that way," but I'm also careful not to fall for fads or gimmicks.
- I always try to take the point of view of the person who is going to be using the stuff I make while I'm making it; that's really hard, so I get people to try out my stuff as soon as I can to see what I am doing wrong.
- I'm not afraid to say, "Yes, that's a better way to do it."

Finally, here is a list of things I feel one needs to do to become, and remain, an instructional technologist and represents, I hope, the best of what we are doing in our graduate programs:

- Do Instructional Technology: Work with people; take a genuine interest in their interests; listen.
- Study the design process, study how people learn individually and collectively, and study media's role in learning.
- Strive to understand the interdependency of theory, research, and practice.
- Learn the "how's and what's" of media.
- Play

I'm sure you can add to this list.

I hope you have been able to follow this roughly written essay. Here are a few questions, offered with the hope that a few of you will consider posting your thoughts to the list:

1. What is your story about how you came to be an instructional technologist? What is unique about it? I am especially curious about individuals who do not hold graduate degrees in instructional technology.
2. How well prepared were you to face the problems you now encounter in your jobs?
3. Those of you who have a formal degree in IT, how satisfied are you as to how well you were prepared to do the job you now have? How well aligned were issues surrounding theory, research, and practice? I know that many non-American programs are not so reliant on course-driven models (and this is part of our redesign), so I am anxious to hear more about them.
4. What would you add to my list of things that characterize what Instructional Technologists actually do, as a profession?
5. What would you add to my list of what one needs to do to adequately prepare to become an Instructional Technologist?

Acknowledgements

I'd like to give Steve Tripp and Ron Zellner some credit for some of the ideas here, since some were derived from some long, enjoyable (and independent) conversations with them over the years.

Application Exercises

- Reflect on your experiences and how they have brought you to the field of instructional design. How are they similar to the paths described in this chapter and how do they provide you with a unique perspective on instructional design?
- Based on your individual goals, and what you understand of the field today, create your own list (see Rieber's in the "Closing" section) outlining how you envision your role as an Instructional Technologist/Instructional Designer.

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2

What Is This Thing Called Instructional Design?

Ellen D. Wagner

Instructional Design

Editor's Note

The following is an excerpt from Ellen Wagner's article entitled "In Search of the Secret Handshakes of Instructional Design," published in the Journal of Applied Instructional Design. The title for this chapter comes from a portion of Wagner's essay to better represent the portion of her article that is republished here.

Wagner, E. (2011). Essay: In search of the secret handshakes of ID. *The Journal of Applied Instructional Design, 1*(1), 33–37.

Practitioners and scholars working in the professions clustered near the intersection of learning and technology have struggled to clearly and precisely define our practice for a long time—almost as long as technologies have been used to facilitate the creation, production, distribution, delivery and management of education and training experiences.

As a professional group, instructional designers—IDs—often bemoan the fact that it is hard to tell "civilians" what it is that we actually do for a living. Ironically this inability to clearly describe our work is one of the "secret handshakes" that unites us in our quest to better define our professional identity.

One of my favorite examples of this definitional challenge was described in a recent blog post by Cammy Bean, vice-president of learning for Kineo, a multinational elearning production company:

> *You're at a playground and you start talking to the mom sitting on the bench next to you. Eventually, she asks you what you do for work. What do you say? Are you met with comprehension or blank stares? This was me yesterday:*
>
> *Playground Mom: So, what do you do?*
>
> *Me: I'm an instructional designer. I create eLearning.*
>
> *Playground Mom: [blank stare]*
>
> *Me: …corporate training…*

Playground Mom: [weak smile]

Me: I create training for companies that's delivered on the computer….

Playground Mom: weak nod…"Oh, I see."

I see that she really doesn't see and I just don't have the energy to go further. I'm sort of distracted by the naked boy who just ran by (not mine). We move on.

Is it me? Is it the rest of the world?
http://cammybean.kineo.com/2009/05/describing-whatyou-do-instructional.html

AECT has actively supported work on the definitions of big overarching constructs that offer people working at the intersections of learning and technology with a sense of identity, purpose and direction. Lowenthal and Wilson (2007) have noted that AECT has offered definitions in 1963, 1972, 1977, 1994, and 2008 to serve as a conceptual foundation for theory and practice guiding "The Field." But they wryly observe that our definitional boundaries can be a bit fluid. For example, after years of describing what we do as "educational technology," Seels and Richey (1994) made a case for using the term "instructional technology" as the foundational, definitional descriptor. Januszewski and Molenda (2008) returned us to the term "educational technology" as being broader and more inclusive. All seemed to agree that the terms educational technology and instructional technology are often used interchangeably. In discussing these implications for academic programs, Persichitte (2008) suggested that labels—at least the label of educational technology or instructional technology—do not seem to matter very much. And yet, I wonder—without precision—do we not contribute to the confusion about what it is that people like us actually do?

And what about this thing we do called instructional design? That seems to be an even harder domain to adequately define and describe. A definition of instructional design offered by the University of Michigan (Berger and Kaw, 1996) named instructional design as one of two components (the other being instructional development) that together constitute the domain of instructional technology. Instructional design was then further described in the following four ways:

Instructional Design-as-Process: Instructional Design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities.

Instructional Design-as-Discipline: Instructional Design is that branch of knowledge concerned with research and theory about instructional strategies and the process for developing and implementing those strategies.

Instructional Design-as-Science: Instructional design is the science of creating detailed specifications for the development, implementation, evaluation, and maintenance of situations that facilitate the learning of both large and small units of subject matter at all levels of complexity.

Instructional Design as Reality: Instructional design can start at any point in the design process. Often a glimmer of an idea is developed to give the core of an instruction situation. By the time the entire process is done the designer looks back and she or he checks to see that all parts of the "science" have been taken into account. Then the entire process is written up as if it occurred in a systematic fashion. https://edtechbooks.org/-Lj

Ten years later, Reiser & Dempsey (2007) defined instructional design as a "systematic process that is employed to develop education and training programs in a consistent and reliable fashion" (pg. 11). They noted that instructional technology is creative and active, a system of interrelated elements that depend on one another to be most effective. They suggested that instructional design is dynamic and cybernetic, meaning that the elements can be changed and communicate or work together easily. They posited that characteristics of interdependent, synergistic, dynamic, and cybernetic are needed in order to have an effective instructional design process. In their view, instructional design is centered on the learned, is oriented on a central goal, includes meaningful performance, includes a measurable

outcome, is self-correcting and empirical, and is a collaborative effort. They concluded that instructional design includes the steps of analysis, design, development, implementation, and evaluation of the instructional design.

Continue reading Wagner's essay on JAID's website.

Application Exercises

- Write a brief description of a real-world example of instructional design as a process, a discipline, a science, and/or a reality.
- Think of a time you were involved in the instructional design either as a teacher or learner. How did you work through each of these pieces? 1. Centers on the learner 2. oriented on central goal 3. includes meaningful performance & measurable outcome 4. self-correcting and empirical 5. collaborative

Please complete this short survey to provide feedback on this chapter: http://bit.ly/WhatIsID

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3

History of LIDT

Association for Educational Communications & Technology

AECT

Editor's Note

The following was originally published on https://edtechbooks.org/-kz.

Today, the field is fascinated with the instructional possibilities presented by the computer as a medium of communication and as a tool for integrating a variety of media into a single piece of instruction. Video has replaced the educational film, and television can be two-way and interactive.

At the turn of this century a number of technological inventions and developments were made that provided new, and in some cases, more efficient means of communication. In the 1920s, the motion picture passed through the stage of being a mere curiosity to a serious medium of expression, paralleling live theater. Its usefulness and influence on learning was explored. This educational research continued into the 1930s, when new instructional projects such as teaching by radio were implemented. Within 20 years both film and radio became pervasive communication systems, providing both entertainment and information to the average citizen.

The advent of World War II created many demands for a new skilled workforce. Media took a prominent place in educational and training systems attempting to fill such needs, and much research centered on the use of these media in a wide variety of teaching and learning situations. Media were among the innovations that made possible the changes and growth in the industrial complex that were so essential to the defense of the western world.

After the war, schools and industry alike attempted to settle back into the old, familiar methods of operation. Within a few years, however, the increase in the birth rate and public school enrollment forced a re-evaluation of the older and slower approaches to education. Again, media were employed, this time to upgrade the curriculum of the public schools.

With the late 1940s and early 1950s came considerable experimentation with television as an instructional tool. Industry was expanding and began to develop its own in-house educational systems. Simultaneously, a search was begun for more efficient and effective means by which such education could be accomplished.

Concurrent with the introduction and development of the study of instructional media, the notion of a science of instruction was evolving. The educational psychologists provided a theoretical foundation which focused on those variables which influenced learning and instruction. The nature of the learner and the learning process took precedence over the nature of the delivery media.

Some of the early audiovisual professionals referred to the work of Watson, Thorndike, Guthrie, Tolman, and Hull. But it was not until the appearance of Skinner's (1954) work with teaching machines and programmed learning that professionals in the field felt that they had a psychological base. Skinner's work in behavioral psychology, popularized by Mager (1961), brought a new and apparently more respectable rationale for the field. Lumsdaine (1964) illustrated the relationship of behavioral psychology to the field, and Wiman and Meierhenry (1969) edited the first major work that summarized the relationship of learning psychology to the emerging field of instructional technology. Bruner (1966) offered new insights that eventually led to broader participation of cognitive psychologists like Glaser (1965) and Gagné (1985). Today, the field not only seems convinced of the importance of the various aspects of cognitive processing of information, but is placing new emphasis upon the role of instructional context, and the unique perceptions and views of the individual learner.

Perhaps one of the most profound changes in instructional technology has come in the expansion of the arenas in which it is typically practiced. From its beginnings in elementary and secondary education, the field was later heavily influenced by military training, adult education, post-secondary education, and much of today's activity is in the area of private sector employee training. Consequently, there is increased concentration on issues such as organizational change, performance improvement, school reform, and cost benefits.

Use of the principles, products, and procedures of instructional technology, however, continue to be vital to school effectiveness, especially in times of school restructuring. In addition, the new technologies and new delivery media offer expanded ways of meeting the special needs of learners and schools.

Instructional technology, and instructional design procedures in particular, are also becoming more common in health care education, training, and non-formal educational settings. Each of these instructional contexts highlight the diverse needs of learners of many ages and interests, and of organizations with many goals. The many settings also provide laboratories for experimenting with and perfecting the use of the new technologies.

However, the disparate contexts also highlight a wide range of organizational, cultural, and personal values and attitudes. Cultures vary among the different communities, creating new issues and possibilities for new avenues of disciplinary growth and development.

The historical context which has surrounded the development of the field has implications that reach beyond the actual events themselves. This is equally true of the development of modern technology responsible for an increasing number of new media and new uses for existing media. Such developments have redirected the energies of many people, causing today's society to be much broader and richer than was ever contemplated in the early 1900s.

Prior to the twentieth century, the only formal means of widespread communication was the printing press. The technological developments since then have provided many different modes of expression, enabling ideas, concepts, and information gained from experience to be conveyed in ways and with contextual richness never before possible.

The unique means of expression that have expanded with each new medium have added new dimensions through which creative talents can be applied. For example, the photographic and cinematographic media have long been accepted as legitimate avenues for creative work in the arts, and television has provided new avenues for expanding views of society.

Still photography, motion picture photography, television, and the computer have proved to be excellent tools for a variety of academic endeavors. Historians consider film coverage of public events to be important primary documentation. Psychologists now use film, computers, and interactive video to control experiences and to collect data on a wide variety of problems in human behavior. Medical researchers employ both color photography and color

television in their studies. In fact, it would be difficult for modern scholars to maintain a position of leadership in their fields of investigation without the assistance from media that present day technology makes possible. Further, the future of humanity's understanding of the universe and the pursuit of greater self knowledge depends upon increasingly sophisticated applications and utilizations of these technologies.

Alternative modes for teaching and learning are most important in today's educational environment. Opportunities for self-directed learning should be provided by institutions of higher education. Other forms of alternative teaching and learning patterns which require increased student involvement and higher levels of learning (application, synthesis, evaluation) also rely upon media as an invaluable tool in the preparation of students.

Teaching and communication, though not synonymous, are related. Much of what the teacher does involves communication. From the spoken word to the viewing of the real world, directly or by means of some technological invention, communication permeates instructional activities.

Media, materials, and interactive technologies, though not the exclusive ingredients in learning, are an integral part of almost every learning experience. The raw materials for scholarship increasingly reside in these means. The scholarly experiences for the student can often be afforded only through these options. The young scholar, the college student, is a deprived scholar without access to these learning tools.

The scholar must have available all that modern technology can provide. Media, materials, and interactive technologies have a crucial role to play in any teacher education program if that program hopes to meet the needs of our dynamic, sophisticated world.

Application Exercise

Think about the technology you are surrounded by every day (e.g. smartphones, tablets, digital assistants, wearable technology, VR/AR, etc.). Discuss how one or two of these technologies can be used in the field of instructional design or how they could have a future impact in the field.

Please complete this short survey to provide feedback on this chapter: http://bit.ly/LIDTHistory

Association for Educational Communications & Technology

AECT

From http://aect.org:

"AECT has become a major organization for those actively involved in the design of instruction and the development of a systematic approach to learning. It provides an international forum for the dissemination and exchange of ideas among its members and target audiences; it is the national and international advocate for the improvement of instruction; and it is the most widely recognized source of information concerning a wide range of instructional and educational technology. AECT and its members have numerous state and international affiliates, all of which are passionate about finding better ways to help people learn. AECT is the oldest professional home for this topic and continues to maintain a central position in the field, promoting high standards of scholarship and practice. AECT has 10 divisions and a Graduate Student Assembly that span the breadth and depth of the field. The association produces two print bimonthly journals, *Educational Technology Research and Development* and *TechTrends*, and three electronic journals, *Journal of Formative Design in Learning*, *The Journal of Applied Instructional Design*, and *International Journal of Designs for Learning*."

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4

A Short History of the Learning Sciences

Victor Lee

It is inevitable that someone studying learning and instructional design and technology (LIDT) will come across the term Learning Sciences. Yet, for many, that moniker is fundamentally ambiguous and misunderstood, and questions abound about this thing called Learning Sciences. Are there multiple learning sciences or is there one dedicated and official field referred to with the plural of Learning Sciences? Is one supposed to capitalize both words when writing about it? Is it essentially classic educational psychology with a new name? Does it involve things beyond the mental phenomenon of learning? Is it actually a science? Are there points of convergence, divergence, or redundant overlap with other fields, including those that would be seen in the field of instructional design and technology? Are those who call themselves learning scientists best seen as friends, rivals, or innocuous others to those who consider themselves instructional designers? There are so many questions. There are also many answers. And a lack of a one-to-one correspondence between questions and answers has persisted in the roughly 30 years (see Figure 1) since the term began to see heavy use (assuming we are concerned with the capitalized L and capitalized S version, which will be the default for this chapter).

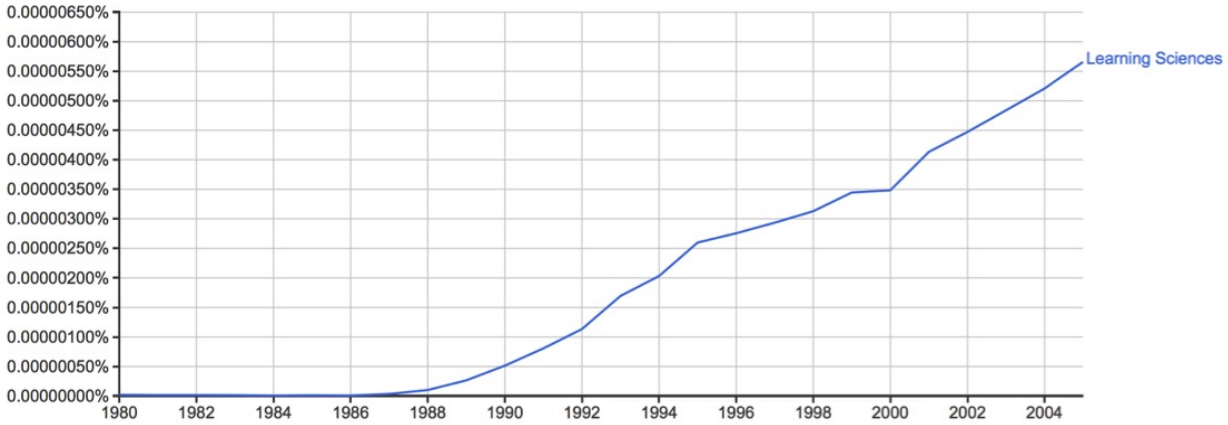


Figure 1. Use of the term Learning Sciences as depicted in Google's Ngram viewer. A major continuous increase appears to occur around 1990.

No article, book, nor chapter has been written that gives authoritative and definitive answers to these questions. The current chapter is no exception. Others have made noteworthy efforts, including contributors to a special issue of Educational Technology (Hoadley, 2004; Kolodner, 2004), those who have edited handbooks of the Learning Sciences (Fischer, Hmelo-Silver, Goldman, & Reimann, in press; Sawyer, 2006), and those who have prepared edited volumes that gather and publish firsthand reports from a number of seminal learning scientists (Evans, Packer, & Sawyer, 2016). In a sense, all of the above are snapshots of a still-unfolding history, and I recommend them all for the interested reader. This chapter exists as an effort to crudely present Learning Sciences to the LIDT community as it exists at this point in time from one point of view. The current point of view is presumably legitimized because the author of this chapter has

the words Learning Sciences on his diploma and serves professionally for Learning Sciences conferences, journals, and academic societies. As the author, I do lead with the caveat that some of what I have to say here is an approximation and inherently incomplete. However, I present the following with confidence that it helps one make some progress on understanding what this thing is called Learning Sciences.

To Understand, We Must Look Backwards

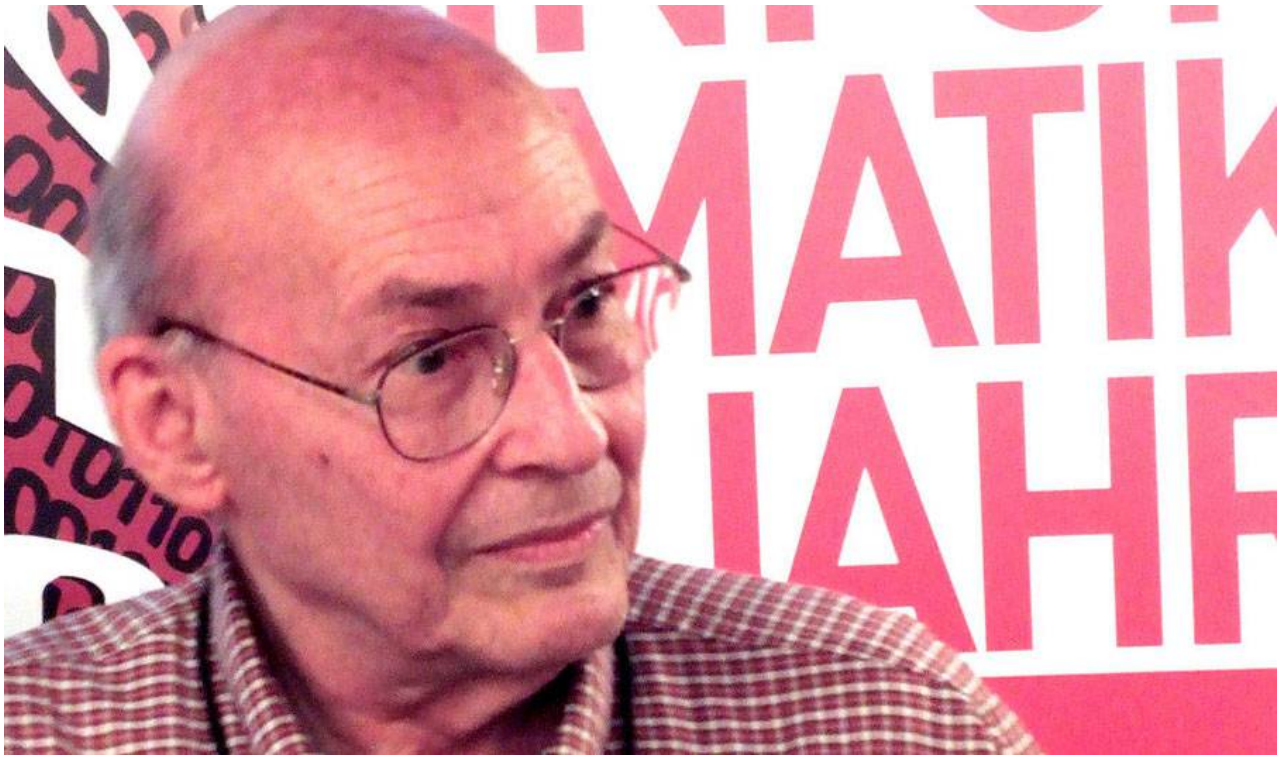
There seems to be consensus that Learning Sciences is a relatively young[1], interdisciplinary academic field. (The word learning is obviously important.) Yet the same could be said for other fields, including many that are more prominently known as LIDT fields. In addition, many seemingly related questions and problems touching on teaching, learning, and technology are addressed by both Learning Sciences and LIDT fields. Yet some people will adamantly maintain that the fields are, at their core, fundamentally different bodies who do different things. Others will argue that those differences are inconsequential and that, functionally, they are the same. So in response to these differing views, I suggest we consider the similarities between Learning Sciences and other LIDT fields as analogous to convergent evolution in evolutionary biology—the process by which dolphins and sharks evolved similar traits but were preceded by different genetic histories. There is certainly much overlap in what each field does and the spaces each inhabits, but the histories leading up to each are markedly different. Those histories matter, because they formed the skeletons for the bodies that exist today and help us understand why there may be some underlying differences coupled with functional similarities.

Cognitive and Artificial Intelligence Roots

If Figure 1 is any indication, the recent history of Learning Sciences goes back about 30 years, and it can be traced to some important locations and events[2]: namely, the first International Conference of the Learning Sciences (ICLS), which took place in 1991 and was connected to the Artificial Intelligence in Education (AIED) community. No formal society nor publication venue for Learning Sciences existed at that time. The first ICLS was hosted in Evanston, Illinois, in the United States, home of what was then the Institute for the Learning Sciences and the first degree program in Learning Sciences, at Northwestern University. The year 1991 was also when the first issue of the Journal of the Learning Sciences was published.

The connection to the AIED community is central to the historic identity of Learning Sciences. In the 1980s, cognitive science had emerged as an interdisciplinary field that, along with segments of computer science, was concerned with the workings of the human mind. The so-called “cognitive revolution” led to interdisciplinary work among researchers to build new models of human knowledge. The models would enable advances in the development of artificial intelligence technologies, meaning that problem solving, text comprehension, and natural language processing figured prominently. The concern in the artificial intelligence community was on the workings of the human mind, not immediately on issues of training or education. The deep theoretical commitments were to knowledge representations (rather than to human behaviors) and how computers could be used to model knowledge and cognitive processes.

Of course, as work in the years leading up to the first ICLS progressed in how to model and talk about (human) cognition, many had also become interested in using these new understandings to support learning and training. Intelligent tutoring systems gained prominence and became an important strand of work in Learning Sciences. That work continues to this day, with much of the work having ties historically to institutions like Carnegie Mellon University and the University of Pittsburgh. These tutoring systems were informed by research on expertise and expert-novice differences along with studies of self-explanation, worked examples, and human tutoring. Many of those who did original work in those areas still remain in Pittsburgh, but their students, colleagues, postdoctoral fellows, and others have since established their own careers in other institutions.



Marvin Minsky

Another locus of work on artificial intelligence was at the Massachusetts Institute of Technology, home to the Artificial Intelligence Laboratory (now known as the Computer Science and Artificial Intelligence Laboratory [CSAIL]) founded by the late Marvin Minsky. Also at MIT was Seymour Papert, who was named co-director of the AI Lab. Papert was a mathematician who contributed significantly to early AI research with Minsky. Papert saw early on the tremendous power of computers and their potential for learning and knowledge construction and became a passionate advocate for learning through computation, expressed largely through his theory of constructionism (Papert, 1980) and in the creation of the Logo programming language with Wallace Feurzig. Papert's research program migrated away from classical AI research and more toward issues of epistemology and learning. His efforts later led to the creation of the MIT Media Lab. A number of scholars trained with him, and the ideas and technologies generated at the Media Lab would spread with students who went on to positions at other institutions. As a result, constructionism, computational thinking, and Papert's sense of "powerful ideas" continue to be major strands of Learning Sciences to this day.

Papert was not the only one interested in how people learned to do computer programming[3]. Relatedly, programming was a concern for the Pittsburgh tutoring systems and also for others involved in the field, such as Elliot Soloway, who was initially at Yale before later relocating to University of Michigan. Others influential in the field were asking questions about what cognitive benefits result from learning to program. One such person was Roy Pea, who had been doing work in new educational technology and media with Jan Hawkins at the Bank Street College in New York. In Cambridge, educational technology endeavors informed by recent cognitive science were being pursued at places like Bolt, Beranek, and Newman (BBN) by the likes of John Seely Brown and Allan Collins, among other talented social scientists and technologists. These early scholars represented a part of the new educational media and computer programming sphere of research and development.

Text comprehension was another important area of initial research in artificial intelligence, with research on text and reading taking pace in numerous places, including Yale, University of Illinois, and Vanderbilt to name a few. There are numerous scholars of major influence who were involved at these different institutions, and any effort on my part to name them all would certainly fail to be exhaustive. A few to note, however, include Roger Schank, who relocated from Yale to Northwestern University, established the Institute for the Learning Sciences, and amassed faculty who would

subsequently establish what has become the oldest academic program in the field; Janet Kolodner, who studied case-based reasoning in AI text-comprehension systems at Yale, proceeded to move on to a successful professorship at Georgia Tech, and was founding editor of the field's first journal; John Bransford at Vanderbilt University; and Ann Brown at University of Illinois, who then moved with her husband, Joseph Campione, to University of California, Berkeley. Schank and Bransford, with their respective teams at their institutions, were developing new ways to integrate narrative story structures into technology-enhanced learning environments based on the discoveries that were being made in text-comprehension and related cognition research. Brown, with her student Annemarie Palincsar (who moved on to University of Michigan), worked on extending seminal work on reciprocal teaching (Palincsar & Brown, 1984) to support improvement in text comprehension in actual real-world classroom contexts. The desire to use the new tools and techniques that were being developed from this cognitive research in actual learning settings rather than laboratories had been growing at all the aforementioned locations and led to the development of a methodological staple in Learning Sciences research: design-based research (Brown, 1992; Collins, 1992), to be elaborated upon more below.

Thus far, what one should be able to see from this gloss of Learning Sciences history is the major areas of research. For instance, cognitive science and artificial intelligence figured prominently. Understanding how to best model knowledge and understanding in complex domains continued to be a major strand of research. New technological media and a focus on children expressing and exploring new ideas through computer programming played prominently. There were also inclinations to look at story structure as it related to human memory in order to improve the design of tools and technologies for learning. Finally, there was a desire to take all these discoveries and findings and try to get them to work in actual learning settings rather than laboratories. These were not unified positions but rather all core areas of research and interest in the group that was coming together to establish the field of Learning Sciences. With that list in mind, and knowing that academic conference keynote lectures are usually given to high-profile or aspirational figures in the field, we have some context for the following list of invited keynote addresses at the first ICLS in 1991.

- Cognition and Technology Group at Vanderbilt—Designing Environments that Invite Thinking and Innovation
- Allan Collins—Design Issues for Interactive Learning Environments
- Andrea diSessa—Computational Media as a Foundation for New Learning Cultures
- James Greeno—Environments for Situated Conceptual Learning
- Marlene Scardamalia—An Architecture for the Social Construction of Knowledge
- Elliot Soloway—"Fermat's Last Theorem? I Learned About It on Star Trek"

In that list, we can see the Vanderbilt group represented along with Collins and Soloway. Andrea diSessa, a prominent and frequently cited scholar in Learning Sciences (Lee, Yuan, Ye, & Recker, 2016) and in other fields, had completed his PhD at MIT in physics and worked closely with Seymour Papert. diSessa's areas of research included students learning to program and how physics is learned. His academic career is largely associated with the institution where he spent most of his time as a professor: the University of California, Berkeley. Other important scholars at this point were Greeno and Scardamalia, who will be covered in the sections below.

Sociocultural Critiques and Situative Perspectives

Cognitive science and artificial intelligence were major influences in Learning Sciences, but contemporary work in the field is not exclusively intelligent tutoring systems, research on students' mental models, or how people learn to program or use new digital media. A major, if not primary, strand of Learning Sciences research is based on a sociocultural perspective on learning. At times, this maintains an ongoing tension with the cognitive- and AI-oriented perspectives, and active dialogue continues (diSessa, Levin, & Brown, 2016).

John Seely Brown, mentioned previously as being a key figure in the New England area, was later brought to the West Coast to work for Xerox PARC (Palo Alto Research Center) and head the new Institute for Research on Learning (IRL). Part of the activities of the IRL team at PARC involved studying how to support learning, including in the photocopying business (Brown & Duguid, 1991). Importantly, the Bay Area location positioned PARC near the University of California, Berkeley, where scholars like Alan Schoenfeld, Peter Pirolli, Marcia Linn, Ann Brown, Andrea diSessa, and James Greeno had all been hired into a new program focusing on education in mathematics, science, and technology.

Of great importance was the presence of Jean Lave, who was also on the faculty at Berkeley. Lave, an anthropologist by training, had studied how mathematics was done in everyday life, discovering that what mathematics looked like in practice was very different from how mathematics understanding was conceptualized by the cognitive psychologists (e.g., Lave, Murtaugh, & de la Rocha, 1984). Additionally, Lave and Wenger published a seminal monograph, Situated Learning (1991), summarizing several cases of learning as it took place in actual communities of practice. The learning involved much more than knowledge acquisition and instead was better modeled as changes from peripheral to central participation in a community. Adequately encapsulating the extensive work of Lave, Wenger, and colleagues is well beyond what can be done in a chapter. However, they earned the attention of Greeno (Greeno & Nokes-Malach, 2016) and others by suggesting that entirely different units of analysis were necessary for people to study learning. These perspectives were largely cultural and social in nature, taking talk and interaction and material artifacts as they were taken up in practice as critical. At the time, there were also groundbreaking works published, such as the translation of Lev Vygotsky's work (1978), Barbara Rogoff's studies of real-world apprenticeship (Rogoff, 1990), and Edwin Hutchins's bold proposal that AI approaches to cognitive science were being far too restrictive in recognizing and understanding cognition as it happened "in the wild" (Hutchins, 1995).

These ideas had a great deal of influence on the emerging community of learning scientists, and the close proximity of the scholars and their ideas led to major public debates about how learning could best be understood (Anderson, Reder, & Simon, 1996; Greeno, 1997). The establishment and acceptance of cultural-historical activity theory and the work of Michael Cole (an institutional colleague of Hutchins) and Yrjo Engestrom also figured prominently as CHAT found a place in education and other scholarly communities. Also influential was James Wertsch, an anthropologically oriented, cultural historical educational scholar.

In essence, a critique of mainstream cognitive science and an alternative perspective had emerged and attracted a contingent. Graduate programs and major research centers formed, and still the networks of scholars that existed continued to dialogue with one another and produce trainees who would later continue developing the newly created field of Learning Sciences. Those individuals would shape the scholarly agenda and produce theoretical innovations for how learning was conceptualized that were different from what had been dominant in previous academic discourse.

Much of contemporary Learning Sciences research has extended these ideas. Rather than focusing on knowledge, many learning scientists focus on social practices, whether they be scientific or mathematical practices, classroom practices, or informal practices. Identity as a socially constructed and continually mediated construct has become a major concern. Seeking continuities between cultures (with cultures not necessarily being geographical nor ethnic in nature) and discovering how to design activities, tools, or routines that are taken up by a culture or give greater understanding of how cultures operate remain ongoing quests. Other concerns include historicity, marginalization of communities, cultural assets rather than cultural deficits, equity, social justice, and social and material influences on spaces that are intended to support learning.

Helping people learn and using new technologies remain important themes, but rather than focusing on computers solely as tutoring systems or spaces where simulations of complex phenomena can be run, current learning sciences technologies with a sociocultural bent allow for youth to collect data about their cities and critically examine equity and opportunity; to become community documentarians and journalists so that local history is valued and conserved in line with the individual interests of participating youth; to build custom technologies of students' own design that better the circumstances of their peers, homes, and communities; and to obtain records of everyday family or museum or after-school activities that have embedded within them germs of rich literary, mathematical, historical, or scientific thought. Current technologies also act as data- and knowledge-sharing tools that help make invisible practices and routines in schools more visible to teachers and other educators.

Computer-supported Collaborative Learning

In the early days of Learning Sciences, cognitive and sociocultural perspectives figured prominently, in addition to the opportunity to look at and modify intact educational systems rather than relegating research to strictly the laboratory. The relationships being built and dialogues taking place were critically important, as was the proximity of research

centers to universities that were establishing associated degree programs. However, according to Stahl (2016), some distance grew after the first ICLS conference. Some of this distance was geographic, but it also had a great deal to do with what got spotlighted as internally sanctioned Learning Sciences research. The community that participated in the first ICLS that began to feel a rift was the Computer Supported Collaborative Learning (CSCL) community. Many, but not all, scholars in this area were located in Europe.

CSCL, like the rest of the Learning Sciences community, was also seriously interested in cognition, new technologies, and social contexts of learning. However, if there were some distinguishing features of the CSCL community, the focus on technology-mediated group cognition figured prominently. Several topics were important for looking at how people learned together online in designed spaces. Examining conceptual change as it became a reciprocal and negotiated process between multiple parties using a technology was also part of this group emphasis. Scripting that informed implicit expectations for how students would interact and move through collaborative learning activities became a major focus. Online knowledge building environments with asynchronous participation and online discourse were also a big focus of CSCL. Ideas about collaborative learning from Naomi Miyake (Chukyo University, then University of Tokyo, Japan), Jeremy Roschelle (SRI International, USA), Stephanie Teasley (SRI International, now at University of Michigan, USA), Claire O'Malley (University of Nottingham, UK), Frank Fischer (Ludwig-Maximilian University of Munich, Germany), Pierre Dillenbourg (University of Geneva and later at École Polytechnique Fédérale de Lausanne, Switzerland), Paul Kirschner (Open University, Netherlands), Gerry Stahl (Drexel University, USA), Marlene Scardamalia and Carl Bereiter (Ontario Institute for Studies in Education, Canada), and Timothy Koschmann (Southern Illinois University, USA) were formative.[4] Sometimes classrooms were the focus, but other learning settings, such as surgical rooms or online forums, became important research sites as well.

CSCL became a distinct enough strand of research that its own workshop was held in 1992 and then its own conference in 1995. Analyses of networks of collaboration and conference topics appear in Kienle and Wessner (2006). There were scholars who consistently appeared at both ICLS and CSCL conferences. Activity in one conference was in no way mutually exclusive from activity in the other. However, there were eventually contingents that were more drawn to one community over the other. Ultimately, given deep overlaps and crossover between CSCL and ICLS, a formal society that oversaw both conference series, the International Society of the Learning Sciences (ISLS), was established in 2002. Many of the aforementioned CSCL scholars were elected president of that society as the years proceeded, and many early graduate students who participated in the formation of these communities and the Learning Sciences field, who went on to become established scholars themselves, were elected as well. In 2006, the International Journal of Computer-Supported Collaborative Learning was established as a leading publication venue, with Gerry Stahl as founding editor. This was officially sponsored by the ISLS, as was the society's other flagship journal that had been operating since 1991, Journal of the Learning Sciences, with Janet Kolodner as the founding editor.

Learning Sciences Organizations, Academic Venues, and Resources

- **Professional Organizations**
  - International Society of the Learning Sciences
  - American Educational Research Association SIGs Learning Sciences and Advanced Technologies for Learning
- **Conference Venues**
  - International Conference of the Learning Sciences
  - Computer-Supported Collaborative Learning
- **Academic Journals**
  - Journal of the Learning Sciences
  - International Journal of Computer-Supported Collaborative Learning
- **Academic Programs and Online Resources**
  - Network of Academic Programs in the Learning Sciences (NAPLeS)

Design-based Research

As an interdisciplinary field with a mix of cognitive, computational, sociocultural, and anthropological traditions all in dialogue, the methodological palette began with and maintained a great deal of diversity. Controlled experiments, think-aloud protocols, interview studies, field work, and computational modeling all appear in Learning Sciences research along with other methods and methodological approaches. However, Learning Sciences strongly associates itself also with the articulation of design-based research as a methodology.

The nature of design-based research has been described in many places elsewhere (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; The Design-Based Research Collective, 2003; Sandoval & Bell, 2004), and new innovations to support that paradigm have been developed in the over two and a half decades since it was first introduced in academic publication (e.g., Sandoval, 2013). The simplest articulation of design-based research is that it involves researchers working with real educational settings and introducing new tools, practices, or activities that embody a set of assumptions that exist based on prior research.

For example, one might know from the existing literature that metacognitive support can improve learning outcomes during laboratory text-comprehension tasks. Rather than accept that as a given and hope that this finding gets translated on its own into classroom practice, the aspiring design-based researcher may then design and develop a new software tool that helps students continually monitor their own understanding and reflect on their own progress when reading science texts at school. The researcher would then test it informally to make sure it is usable and make arrangements with a local school to have some of their English classes use it. Upon bringing it into a school classroom, they discover that the metacognitive supports are actually confusing and counterproductive in the classroom because so much depends on whether students find the topic engaging and whether the teacher can orchestrate a classroom activity to split instructional time such that students begin by using the tool, participate in a reflective discussion with the teacher, and then return to the tool. The design-based researcher may discover that, unlike the 15-minute sessions reported in the existing literature when metacognitive training was done in the lab, a week is actually required to smoothly implement the tool in the classroom. The teachers need some help noticing what student comments to build upon in the reflection discussions. Texts need to be modified to immediately connect more to topics students already know.

In this experience, a well-meaning researcher attempted to take the best of what was known from prior research and ended up taking participants on a much more complicated journey than intended. That journey began to reveal how metacognitive activity works in a real education setting, how software tools should be designed and used in school

settings, and what sorts of things classroom teachers need to do with the software to make it maximally effective. To verify that these new discoveries are actually valid ones, the researcher implements some revisions and sees if the expected outcomes emerge. If not, the design-based researcher repeats, or reiterates, the design work with that classroom.

That cycle is a very general summary of how design-based research unfolds. The researcher may have varying levels of involvement in the educational setting, where they may provide some initial professional development or training to a facilitator and then watch what unfolds later or where they may directly lead the classroom activities by their self. Design-based research can be a solo endeavor or a major team one. The benefit of this type of research is that it puts theoretical assertions (e.g., metacognitive supports improve text comprehension) in harm's way by allowing for the complexity of the real world to be introduced. This helps to refine (or even establish) stronger theory that speaks to complexities of how learning works in different systems. The intact unit could be a single student, a single classroom, a group of teachers, multiple classrooms, multiple grade bands in a school, a museum exhibit, a museum floor, an after-school program, a university course, or an online course. The outcomes of design-based research are articulated especially nicely by Edelson (2002), who argues that design-based research ultimately produces new knowledge about domain theories, design frameworks, and design methodologies. diSessa and Cobb (2004) have also suggested that design-based research can be the locus for new theoretical constructs to emerge.

As design-based research has matured, some have pushed to broaden its scope to speak to larger educational systems. Rather than working with individual students or classrooms, design-based implementation research (DBIR) promotes partnership with educational institutions such as entire schools or school districts (Penuel, Fishman, Cheng, & Sabelli, 2014). Related design-based approaches also appear as improvement science (Lewis, 2015) and in research-practice partnerships (Coburn & Penuel, 2016). As of late, these have been receiving more attention. Optimistically, we could see this as the desire of funding agencies and academic communities to scale important findings from the past decades of design-based research and to understand what enables new and powerful tools and activities to support learning and impact more learners.

As such, it is common for design-based research to appear in Learning Sciences research, whether in a single study or across a multi-year research program that may involve dozens of researchers and multiple academic institutions working in partnership with educational systems. Again, even though design-based research is prominent, effective and successful learning scientists need not claim design involvement in order to be considered as meaningfully contributing to the field. It does help, however, to be aware of the methodological approach, its history, warrants for arguments made through design-based research, and the kinds of knowledge that the field develops from design-based studies. It is also important to consider that design-based research has broadened in its appeal such that other fields are participating in design-based research without having prior historical ties to the Learning Sciences.

Learning Sciences and LIDT Fields

To summarize, Learning Sciences has a history that gives it its unique character. That history is tied to cognitive science and artificial intelligence, to new forms of educational media, to sociocultural and situative critiques and studies of learning, to group cognition as it involves multiple learners and technology mediation, and to an appreciation for what design can do in service of advancing academic knowledge. At its surface, this looks much like what LIDT fields also care about and also pursue. In broad strokes, that is true. However, the histories of Learning Sciences and LIDT fields have differences, and those origins ripple unintentionally in terms of what conferences and what journals are favored. The argument has been made that LIDT and Learning Sciences have much to gain from more cross talk, and that is likely true. However, that cross talk has not always happened (Kirby, Hoadley, & Carr-Chellman, 2005), and perceptions remain that fundamental barriers exist that discourage such cross talk. In some cases, strong academic departments have split because faculty in them felt that LIDT and Learning Sciences were incompatible.

However, there have since been deliberate efforts to close perceived rifts. For example, Pennsylvania State University made a deliberate effort to hire individuals trained in Learning Sciences (Chris Hoadley, Brian K. Smith) into their already

strong LIDT-oriented department, and that promoted dialogue and relationship building, although the LS-oriented faculty composition has since changed. Utah State University hired Mimi Recker, an early student of the Berkeley program that emerged in the 1990s and subsequently took on a blended departmental identity (USU ITLS Faculty, 2009). Members of the University of Georgia Learning and Performance Systems Laboratory (Daniel Hickey and Kenneth Hay) took positions in a new Learning Sciences program established at Indiana University. The push for more relationship building is now there.

The future of the relationship between LIDT and Learning Sciences organizations and programs is ultimately up to those who are currently training as students in those fields. As someone who has been operating in both spaces, although I was explicitly trained in one, I understand many barriers are actually illusory. There are different foci and theoretical commitments and expectations in each field, but both communities deeply care about learning and how we can build knowledge to improve the tools, practices, and environments that support it. To gain traction in the other field, people simply start by reserving judgment and then reading the other field's core literatures. They start conversations with individuals who are connected to the other field and initiate collaborations. They get excited about ideas that other parties are also currently thinking about, and they have dialogue. In fact, that's the simplified version of how Learning Sciences began. It could be the beginning of the history for a new multidisciplinary field in the future as well.

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Footnotes

1. Compared to, say, Philosophy, Mathematics, or History ↵
2. The prehistory of Learning Sciences is presented quite compellingly by Pea (2016) and Schank (2016). ↵
3. A true Papert perspective would likely not privilege computer programming so much as rich and generative representational media embedded in contexts that allow the exploration, construction, and sharing of powerful ideas. ↵
4. Of course, there were far more highly influential CSCL scholars than are in this list, and many were also participating in ICLS primarily. ↵

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5

LIDT Timeline

Editor's Note

The following timeline was created by students in the Instructional Psychology and Technology department at Brigham Young University.

Click on the image or website link below to go to the timeline.

http://bit.ly/2yk76lf

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6

Programmed Instruction

Michael Molenda

Editor's Note

The following was originally published by Michael Molenda in *TechTrends* with the following citation:

Molenda, M. (2008). The Programmed Instruction Era: When effectiveness mattered. *TechTrends*, *52*(2), 52-58.

Programmed instruction (PI) was devised to make the teaching-learning process more humane by making it more effective and customized to individual differences. B.F. Skinner's original prescription, although it met with some success, had serious limitations. Later innovators improved upon the original notion by incorporating more human interaction, social reinforcers and other forms of feedback, larger and more flexible chunks of instruction, and more attention to learner appeal. Although PI itself has receded from the spotlight, technologies derived from PI, such as programmed tutoring, Direct Instruction, and Personalized System of Instruction have compiled an impressive track record of success when compared to so-called conventional instruction. They paved the way for computer-based instruction and distance learning. The success of the PI movement can be attributed largely to the commitment of its proponents to relentless, objective measurement of effectiveness.

Origins of the Programmed Instruction Movement

During the first half of the 20th century, research and theory in American psychology tended to revolve around the perspective of behaviorism, and Thorndike's (1911) theorems—the law of recency, the law of effect, and the law of exercise—remained at the center of discussion for decades. In the 1920s Sidney Pressey, a psychology professor at Ohio State University, invented a mechanical device based on a typewriter drum, designed primarily to automate testing of simple informational material (1926). As he experimented with the device he realized that it could also provide control over drill-and-practice exercises, teaching as well as testing. In explaining why his device was successful he explicitly drew upon Thorndike's laws of recency, effect, and exercise as theoretical rationales (Pressey, 1927). Unfortunately, despite the fact that Pressey continued to develop successful self-teaching devices, including punchboards, that had all the qualities of later "teaching machines," his efforts were essentially a dead end in terms of a lasting effect on education. However, Pressey lived and worked long enough to participate in the discussions surrounding the new generation of teaching machines that came along in the 1950s.

The movement that had a more enduring impact on education and training was animated by a reframing of Thorndike's behaviorist principles under the label of radical behaviorism. This school of thought proposed a more rigorous definition

of the law of effect, adopting the term *reinforcer* to refer to any event that increases the frequency of a preceding behavior. Operant conditioning, the major operationalization of this theory, involves the relationships among stimuli, the responses, and the consequences that follow a response (Burton, Moore & Magliaro, 2004, p. 10). The leading proponent of radical behaviorism, B.F. Skinner, demonstrated that by manipulating these three variables experimenters could elicit quite complex new behaviors from laboratory animals (Ferster & Skinner, 1957).

Skinner's Invention of Programmed Instruction

Skinner was led to apply the principles of operant conditioning to academic tasks by a personal experience with one of his own children. As reported by his older daughter, Julie:

> *When the younger [daughter, Deborah] was in fourth grade, on November 11, 1953, Skinner attended her math class for Father's Day. The visit altered his life. As he sat at the back of that typical fourth grade math class, what he saw suddenly hit him with the force of an inspiration. As he put it, 'through no fault of her own the teacher was violating almost everything we knew about the learning process. '(Vargas, n.d.)*

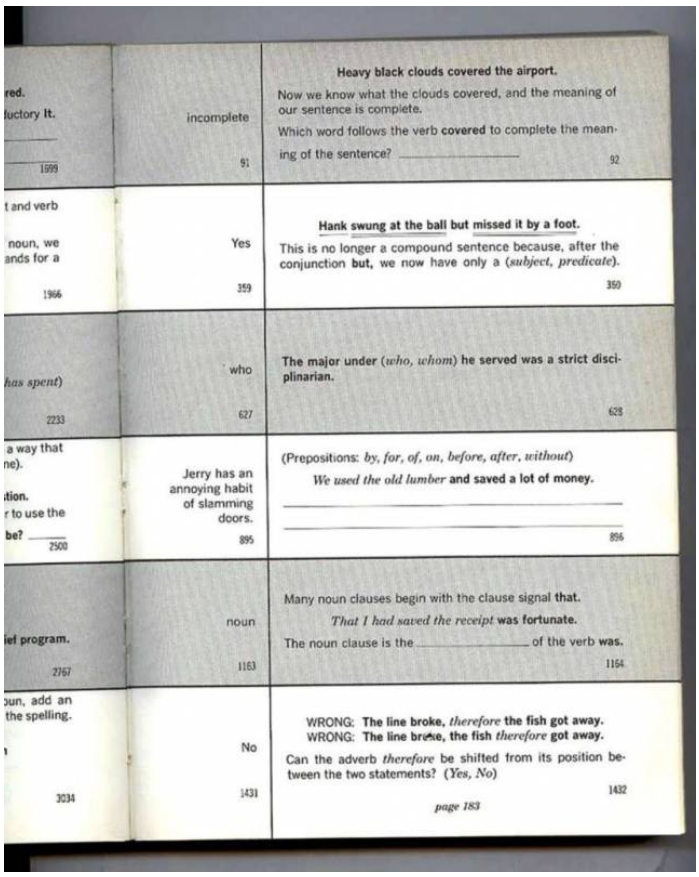
Having analyzed the deficiencies of group-based traditional instruction, Skinner (1954) proceeded to develop a mechanical device (shown in Figure 1) that could overcome the limitations of lock-step group presentation, replacing it with individually guided study in which the contingencies of reinforcement could be carefully controlled. In Skinner's new format the content was arranged in small steps, or frames, of information. These steps lead the learner from the simple to the complex in a carefully ordered sequence, and, most importantly, at each step the learner is required to make a response—to write or select an answer. The program then judges whether the response is correct. The theory dictated that the learner should then receive some sort of reinforcer if the response were correct. In Skinner's method, the reinforcer took the form of "knowledge of correct response," that is, telling the learner the right answer or confirming that they got the right answer. The main purpose of the mechanical elements of the system was to ensure that users could not peek ahead at the correct answers. The next step in the sequence could only take place after a response was written inside a little window frame and a lever pulled to cover the learner's response with a transparent cover while revealing the correct answer. The device, referred to by others as a *teaching machine*, soon gained national attention and attracted a following of eager software authors.

Figure 1. A teaching machine of the Skinner type. Used with permission of AECT, successor to DAVI.

Further Development of Programmed Instruction

The instructional format used in teaching machines became known as programmed instruction (PI), and this new technology became a popular subject of educational research and development by the late 1950s. Within a few years developers were dispensing with the elaborate mechanical apparatus, instead relying on users (rightly or wrongly) to

discipline themselves and refrain from peeking ahead at the correct answer. Thus PI lessons could be published in book format, with short instructional units ("frames") followed by a question, with the correct answer lower on the page (to be covered up by the user) or on the next page. Released from the necessity of providing hardware along with the software, publishers rushed to produce books in programmed format. They offered programmed books that appealed to mass audiences, such as *Goren's Easy Steps to Winning Bridge* (1963) by the famous bridge master Charles Goren, and those that aimed at the school market, such as *English 2600* (Blumenthal, 1961), which taught the fundamentals of grammar in a step-by-step linear program, illustrated in Figure 2.



red.
luctory **It.**
1999

incomplete
91

Heavy black clouds covered the airport.
Now we know what the clouds covered, and the meaning of our sentence is complete.
Which word follows the verb **covered** to complete the meaning of the sentence? _____
92

t and verb
noun, we
ands for a
1966

Yes
359

Hank swung at the ball but missed it by a foot.
This is no longer a compound sentence because, after the conjunction **but,** we now have only a (*subject, predicate*).
360

has spent)
2233

who
627

The major under (*who, whom*) **he served was a strict disciplinarian.**
628

a way that
ne).
tion.
to use the
be? _____
2500

Jerry has an annoying habit of slamming doors.
895

(Prepositions: *by, for, of, on, before, after, without*)
We used the old lumber **and saved a lot of money.**
_____
_____
896

ef program.
2767

noun
1163

Many noun clauses begin with the clause signal **that.**
That I had saved the receipt **was fortunate.**
The noun clause is the _____ of the verb **was.**
1164

un, add an
the spelling.
3034

No
1431

WRONG: **The line broke,** *therefore* **the fish got away.**
WRONG: **The line broke, the fish** *therefore* **got away.**
Can the adverb *therefore* be shifted from its position between the two statements? (*Yes, No*)
1432

page 183

Figure 2. Example of page layout of a linear programmed instruction book: English 3200 by Joseph Blumenthal, New York: Harcourt Brace & World, 1962.

Linear vs. Intrinsic Programming

The original programs devised by B.F. Skinner and his followers led users through a pre-specified sequence of small steps. Shortly after Skinner's invention, Norman Crowder introduced a variation that was not founded on any particular theory of learning, but only on practicality. It featured a more flexible programmed lesson structure that allowed learners to skip ahead through material that was easy for them or to branch off to remedial frames when they had difficulty. Crowder (1962) labeled his method *intrinsic programming*, but it was quickly dubbed *branching programming* because a schematic outline of the program resembled a tree trunk (the prime path) with multiple branches (the remedial sequences). Skinner's method was thereafter known as *linear programming*. The two approaches are contrasted in Figure 3.

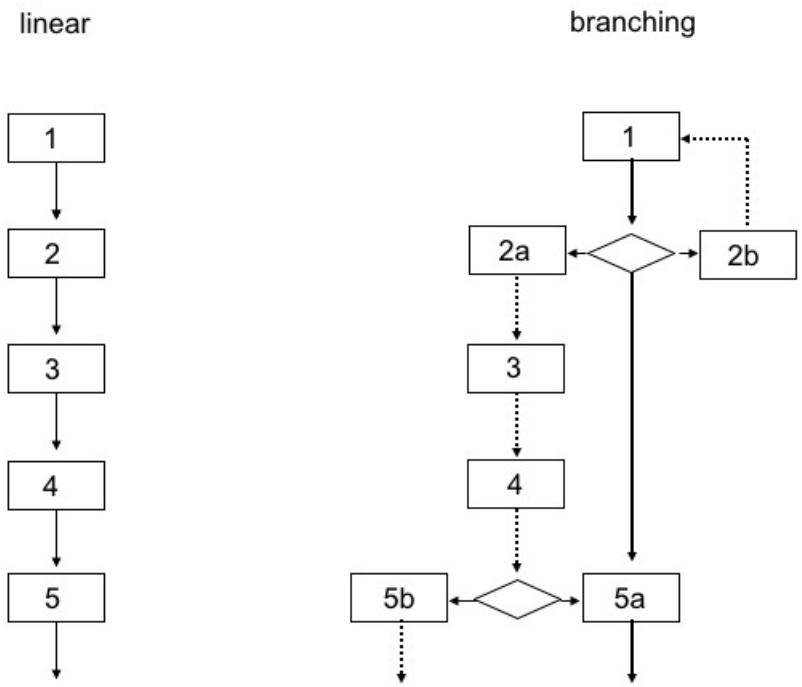


Figure 3. Comparison of the organization of a linear vs. branching programmed text. © Michael Molenda. Used with permission.

Initially, Crowder's programs were incorporated into the *AutoTutor*, a desktop teaching machine which used his branching technique to tailor the lesson to the responses of the learner. The original *AutoTutor*, released in the early 1960s, provided individualized instruction long before general-purpose desktop computers were feasible. But Crowder also joined the rush to convert programs to book form. His *TutorText* series became one of the best-known series of programmed materials. In the print format, readers encountered multiple-choice questions and each alternative answer led to a different "next page" in the book.

Pi in Formal Education

PI was first employed in formal education in the college courses taught by Skinner and his colleagues in the late 1950s. Experiments in schools began with teaching spelling to second- and third-graders in 1957 and teaching mathematics in high schools in 1959 (Saettler, 1990, p. 297). Large-scale school implementation projects were conducted in the early 1960s in Denver and Long Island, NY. The major lesson learned in these experiments was that although the materials themselves were effective, PI could not make a substantial impact on the efficiency or effectiveness of schooling without extensive restructuring of classroom routines and school organization. Schools then, as now, were resistant to systemic restructuring (Saettler, 1990, pp. 297-302).

The Programmed Instruction Boom

Authors and publishers unleashed a flood of programmed materials both in linear and branching formats. Between the early 1960s and 1966, new titles proliferated at an accelerating rate as publishers vied with each other for market dominance. Figure 4 illustrates this boom, showing the growth curve of programmed materials in the United Kingdom, which was paralleled in the U.S. As with other technological innovations, the upward slope did not continue indefinitely. After 1966 the publication of new titles declined rather rapidly and then leveled off. Although there is little fanfare today,

programmed materials are still distributed and used by learners, many of whom continue to feel empowered by the ability to work through material methodically with frequent checks for comprehension.

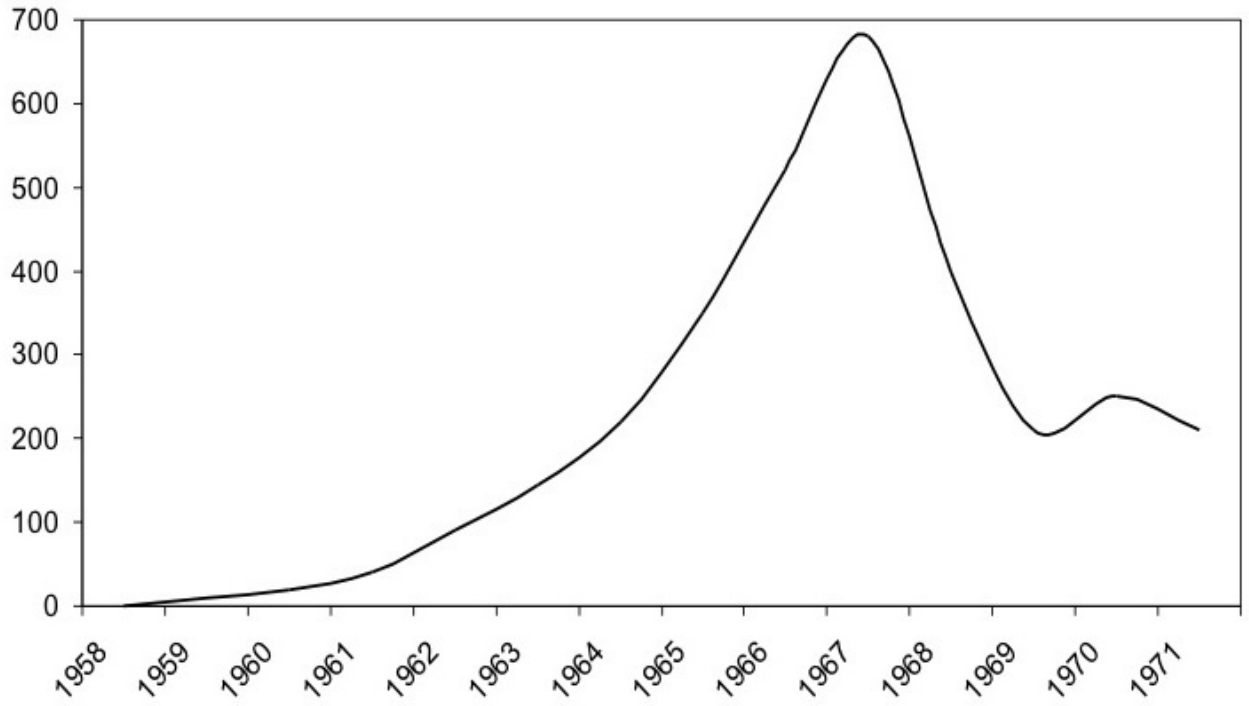


Figure 4. Number of programmed instruction titles available in the market each year in the United Kingdom. Adapted from Figure 1 in Hamer, J.W., Howe, A. & Romiszowski, A.J. (1972). Used with permission of SEDA, successor to APLET.

Striving for Effectiveness

One of the major tenets of PI was that learners should practice mainly correct responses, so that they could experience frequent reinforcement. The only way of assuring this was to test and revise each program during development. In fact, *developmental testing* was a mandatory specification for materials destined for the military training market. The US Air Force required that "at least 90% of the target population will achieve 90% of the objectives" (Harris, p. 142). This was known as the 90/90 criterion and was widely accepted as the standard benchmark of effectiveness. One of the consequences of this practice was to promote the flowering of a systematic procedure for designing, testing, and revising programmed materials, a precursor to later instructional design models.

Another consequence was to encourage an empirical, data-based approach to instruction, since each PI development project was similar to a controlled experiment. The professional literature of the 1960s carried hundreds of reports on testing of PI programs and comparisons of programmed treatments with other sorts of treatments. One of the first casualties of this research was Skinner's set of specifications. Small steps did not prove to be essential, nor linear sequencing…as demonstrated by Crowder's branching method. The immediacy of reinforcement did not prove to be critical for a great many types of learning tasks. Indeed, the efficacy of "knowledge of results" as a reinforcer did not stand up under scrutiny. In retrospect, it was predictable that "knowledge of correct response" would not work as a universal reinforcer. Researchers (and lay people) already knew that different people respond to different reinforcers at different times. When a person is satiated with ice cream, ice cream is no longer reinforcing. The same is true of being told the correct answer. At some point curiosity is satiated. Researchers rediscovered that there are no universal reinforcers.

Interestingly, even though the individual hypotheses making up PI did not prove to be robust, experiments comparing PI to so-called *conventional instruction* (a construct that needs to be critically deconstructed in its own right!) tended to

show PI as superior (Walberg, 1984; Ellson, 1986). Why was that? In retrospect, we can surmise that PI did have several advantages over so-called conventional instruction. First, in many educational experiments, the experimental treatment simply received more time and effort in its preparation and delivery. Second, users are often attracted to the novelty of any new treatment—at least until the novelty wears off. Finally, the PI treatments not only had more time and attention, they were designed through a rigorously thought-out, systematic process, which included not only precise specification of objectives but also testing, revision, and re-testing. Indeed, it was the realization that the *design process* was the valuable part of programmed instruction that led to the emergence of systematic instructional design as a powerful tool (Markle, 1967).

Programmed Instruction in Davi

It was not inevitable that PI would become a factor in the field then known as audiovisual (AV) communications, represented by AECT's predecessor, the Department of Audio-Visual Instruction (DAVI), a unit of the National Education Association. In the late 1950s and early 1960s DAVI was enjoying a growth spurt stimulated, first, by the mushrooming of new schools in the post-World War II expansion period and, second, by the largest ever federal infusion of money into public education, the National Defense Education Act (NDEA) of 1958. Schools and colleges, like the rest of American society, lived under the shadow of the Cold War, and the feeling of a life-or-death struggle with the Soviet Union was palpable. With the Soviet launch of Sputnik I in 1957, America confronted the prospect of a dangerous technological inferiority. Education—especially in mathematics, science, and engineering—became an urgent priority.

The DAVI community benefited from the reinvigorated march to expand and improve education through the NDEA. *New educational media* became the hot topic of ramped-up research and development activity as well as the beneficiary of enhanced school-equipment budgets. Attendance at DAVI conventions zoomed from the hundreds to the thousands as school AV administrators, many newly assigned, flocked to see and buy the new hardware and software exhibited there: film, slide and filmstrip, phonograph and audio tape, opaque and overhead projection, radio, and television (Godfrey, 1967).

The 1959 DAVI convention program was primarily devoted to these audiovisual media. It had a single research paper devoted to PI, "Teaching Machines and Self-Instructional Materials: Recent Developments and Research Issues," but by 1960 there were several sessions devoted to PI, including a major one entitled "Programmed Instructional Materials for Use in Teaching Machines" (Sugar & Brown, n.d.). This title gives a clue to the connection between AV administrators and PI: mechanical devices were initially used to deliver the programmed lessons. When schools and colleges acquired teaching machines someone had to take care of them. Who was more suited to this task than the AV coordinator who already took care of film, filmstrip, slide, and overhead projectors? The focus on hardware is indicated by the name that marked this new special interest group at the next several DAVI conventions: the Teaching Machine Group.

DAVI's commitment to this new phenomenon was signaled by the publication of a collection of key documents on PI (Lumsdaine & Glaser) in 1960, and then a follow-up compilation of later research and commentary in 1965 (Glaser). Attention at the annual DAVI convention grew; by the late 1960s the convention offered about a dozen sessions a year on PI, representing about a one-tenth share of the stage. The conversation was still predominantly about AV media, but PI had a visible, sustained presence. PI was even more visible in scholarly circles, as indicated by Torkelson's (1977) analysis of the contents of *AV Communication Review*, which showed that between 1963 and 1967 the topics of teaching machines and programmed instruction represented a plurality of all articles published in that journal.

DAVI was not the only, or even the primary professional association interested in PI. When Air Force experiments in 1961 demonstrated the dramatic time and cost advantages of PI (efficiency as well as effectiveness) military trainers and university researchers quickly formed an informal interest group, which by 1962 became a national organization, the National Society for Programmed Instruction (NSPI). The organization grew to encompass over 10,000 members in the U.S., Canada, and forty other countries. As the interests of members also grew and evolved to include all sorts of technological interventions for improved human performance, the name, too, evolved to its current form, International Society for Performance Improvement (ISPI).

The Emergence of a Concept of Educational Technology

Gradually, throughout the 1960s the central focus of the field was shifting from the production and use of AV materials to designing and utilizing interactive self-instructional systems. B.F. Skinner coined the term *technology of teaching* in 1968 to describe PI as an application of the science of learning to the practical task of instruction. Other authors used the term *educational technology*; an early example being *Educational technology: Readings in programmed instruction* (DeCecco, 1964). This idea supported the notion promoted by James D. Finn (1965) that *instructional technology* could be viewed as *a way of thinking* about instruction, not just a conglomeration of devices. Thereafter, more and more educators and trainers came to accept *soft* technology, the "application of scientific thinking" as well as *hard* technology, the various communications media. And when the time came to reconsider the name of the association in the late 1960s, one of the names offered to the membership for vote combined elements of both. The vote in June 1970 showed a three-to-one preference for the hybrid name, Association for Educational Communications and Technology (AECT).

Other Soft Technologies Derived From Programmed Instruction

Over the decades since Sidney Pressey's and B.F. Skinner's bold innovations in self-instruction, many other concerned educators have tried their hands at improving upon the format initially incorporated into teaching machines. Obviously, computer-assisted instruction was heavily influenced by PI. In addition, a number of other technological spin-offs from PI have gone on to chart a record of success in improving the effectiveness of education. Three will be examined in some detail—programmed tutoring, Direct Instruction, and Personalized System of Instruction.

Programmed Tutoring

A psychology professor at Indiana University, Douglas Ellson, had a life-long consuming interest in improving the teaching-learning process. He examined PI very closely, detected its weaknesses, and in 1960 developed a new approach to address those weaknesses (Ellson, Barber, Engle & Kampwerth, 1965). Programmed tutoring (PT) puts the learner together with a tutor who has been trained to follow a structured pattern for guiding the tutee. Like PI, students work at their own pace and they are constantly active—reading, solving problems, or working through other types of materials. The tutor watches and listens. When the tutee struggles to complete a step, the tutor gives hints, taking the learner back to something he already knows, then helps him to move forward again. Thus, learners are usually generating their own answers. And instead of receiving "knowledge of correct response" as reinforcement, they receive *social* reinforcers from the tutor—praise, encouragement, sympathy, or at least some attention.

Of course, giving every student a tutor is a labor-intensive proposition, but Ellson solved this problem by using *peers*as tutors—students of the same age or a little older, a role they proved able to play after a little training in how to follow the specified procedures. Not only did tutors serve as "free manpower," but research showed that it was a win-win situation because tutors showed learning gains even greater than the tutees'! By going through the material repeatedly and teaching it to someone else, they strengthened their own grasp of the material.

During the early 1980s PT gained credibility due to its track record in comparison studies (Cohen, J.A. Kulik & C. C. Kulik, 1982). It was recognized by the U.S. Department of Education as one of the half-dozen most successful innovations and it was widely disseminated (although not as widely as it deserves, as with many of the other soft technologies that have been developed over the years).

Direct Instruction

Direct Instruction (DI) was actually not derived explicitly from programmed instruction. Its originator, Siegfried "Zig" Engelmann was an advertising executive with a degree in philosophy. He developed DI as a way to help disadvantaged children succeed academically. He was an eager experimenter, and, through trial, he worked out an instructional framework that produced rapid learning gains. It consists of fast-paced, scripted, teacher-directed lessons with teacher

showing-and-telling punctuated by group responses in unison. As the method evolved it happened to incorporate many features that coincided with behaviorist principles:

- overt practice—students respond to teacher cues in unison
- social reinforcers—teacher attention, praise, and encouragement
- ongoing feedback and correction from the teacher
- lessons developed through extensive testing and revision.

DI has been extensively used and tested since the 1960s. A large-scale comparison of twenty different instructional models implemented with at-risk children showed DI to be the most effective in terms of basic skills, cognitive skills, and self-concept (Watkins, 1988). More recently it has been found to be one of three comprehensive school reform models "to have clearly established, across varying contexts and varying study designs, that their effects are relatively robust and … can be expected to improve students' test scores" (Borman, Hewes, Overman & Brown, 2002, p. 37).

Personalized System of Instruction

Fred Keller devised the Personalized System of Instruction (PSI) or "Keller Plan" in 1963 for the introductory psychology course at a new university in Brasilia. He was seeking a course structure that would maximize students' success and satisfaction. He and his collaborators were inspired by Skinner's programmed course at Harvard and Ferster's at the Institute for Behavioral Research (Keller, 1974). In PSI, all the content material of a course is divided into sequential units (such as textbook chapters or specially created modules). These units are used independently by learners, progressing at their own pace. At the end of a unit, learners take a competency test and immediately afterward they receive feedback from a proctor with any coaching needed to correct mistakes. This procedure prevents ignorance from accumulating so that students to fall further and further behind if they miss a key point (Keller, 1968). During the period it was being tested at many colleges and universities, the 1960s and 1970s, PSI was found to be the most instructionally powerful innovation evaluated up to that time (J.A. Kulik, C. C. Kulik & Cohen, 1979; Keller, 1977). Although "pure PSI" courses are not common nowadays, the mastery-based, resource-centered, self-paced approach has been incorporated into many face-to-face courses in schools, universities, and corporate training centers…and it set the pattern for what was to become "distance education."

Conclusion

The programmed instruction movement was born as a radical reconstruction of the traditional procedures for teaching. It aimed to free learners (and teachers!) from the misery of the lock-step group lecture method. The innovators who followed were similarly motivated to expand human freedom and dignity by giving learners more customized programs of instruction in a humane, caring context with frequent one-to-one contact. They developed methods of instruction that were amenable to objective examination, testing, and revision. They viewed caring instruction as synonymous with effective instruction. In the words of Zig Engelmann:

My goal for years has been to do things that are productive and that help make life better for kids, particularly at-risk kids. I don't consider myself a kinderphile…. For me it's more an ethical obligation. Certainly kids are enchanting, but they also have a future, and their future will be a lot brighter if they have choices. We can empower them with the capacity to choose between being an engineer, a musician, an accountant, or a vagrant through instruction (Engelmann, n.d.).

They welcomed empirical testing of their products and demanded it of others. Instruction that was wasting students' time or grinding down their enthusiasm was simply malpractice. Their legacy lives on, mainly in corporate and military training, where efficiency and effectiveness matter because savings in learning time and learning cost have direct bearing on the well-being of the organization. As public purse strings tighten, the day may come when learning time and learning costs are subjected to close accountability in public school and university education also.

Application Exercises

1. Think about Programmed Instruction, Programmed Tutoring, Direct Instruction, and Personalized System of Instruction. What type of instruction would you prefer to receive? What type would you prefer to give?
2. What aspects of Skinner's programmed instruction are still used in instructional design today?

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Is Programmed Instruction Still Relevant Today?

Hack Education is a collection of essays by Audrey Watters that discuss the fascination in our field and society with automizing teaching and learning, from Skinner's teaching machines to modern day MOOCs.

Can you think of any other examples of the principles of Programmed Instruction still being discussed today?

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7

Edgar Dale and the Cone of Experience

Sang Joon Lee & Thomas C. Reeves

Editor's Note

The following chapter was based on the following article, previously published in *Educational Technology*.

Lee, S. J., & Reeves, T. C. (2007). Edgar Dale: A significant contributor to the field of educational technology. *Educational Technology, 47*(6), 56.

How can teachers use audiovisual materials to promote learning that persists? How can audiovisual materials enable students to enjoy learning through vicarious experience? These were two of the many important research and development questions addressed by an extraordinary educational technology pioneer, Edgar Dale. Although he is perhaps best remembered today for his often misinterpreted "Cone of Experience," Dale made significant contributions in many areas as evidenced by just a few of the titles of the many books he wrote during his long lifespan (1900-1988), including: *How to Appreciate Motion Pictures* (1933), *Teaching with Motion Pictures* (1937), *How to Read a Newspaper* (1941), *Audiovisual Methods in Teaching* (1946, 1954, 1969), *Techniques of Teaching Vocabulary*(1971), *Building a Learning Environment* (1972), *The Living Word Vocabulary: The Words We Know* (1976), and *The Educator's Quotebook* (1984).

Background

Born in 1900 at the dawn of a new millennium, Edgar Dale's work continues to influence educational technologists in the 21st Century. Dale grew up on a North Dakota farm, and according to Wagner (1970), he retained the no-nonsense thinking habits and strong work ethic of his Scandinavian forebears throughout his illustrious career. While working on the family farm and later as a teacher in a small rural school, Dale earned both his Bachelors and Masters degrees from the University of North Dakota partially through correspondence courses.

In 1929, he completed a Ph.D. at the University of Chicago, and then joined the Eastman Kodak Company where he collaborated on some of the earliest studies of learning from film. Interestingly, although many of these early studies were experimental ones designed to compare learning from film with other media, Dale later expressed distain for such studies. According to De Vaney and Butler (1996):

> *When Dale was asked why he did not do experimental research in which a scholar attempted to prove over and over that students learn from radio or film, he replied: "It always bothers me, because anybody knows*

> *that we learn from these things (media). There's no issue about that. . . . Well I suppose in any field, to be respectable you have to do a certain kind of research. (p. 17)*

In addition to his own prolific scholarship, Edgar Dale mentored an outstanding cadre of doctoral students during his long role as a professor at Ohio State University (1929-1973), including Jeanne Chall and James Finn. Dale also served as President of the Division of Visual Instruction (DVI) of the National Education Association (NEA) from 1937-38, the professional association that is now known as the Association for Educational Communications and Technology (AECT).

Influences

Although he traced his ideas back as far as Pestalozzi (1746 – 1827), who pioneered the concept of learning through activity, and Froebel (1782 – 1852), who first promoted the principle that children have unique needs and capabilities, Edgar Dale's work was most heavily influenced by John Dewey (1859-1952). Dewey stressed the importance of the continuity of learning experiences from schools into the real world and argued for a greater focus on higher order outcomes and meaningful learning.

In his first edition of *Audiovisual Methods in Teaching* (1946), Dale expanded Dewey's concept of the continuity of learning through experience by developing the "Cone of Experience" which relates a concrete to abstract continuum to audiovisual media options (Seels, 1997). Dale (1969) regarded the Cone as a "visual analogy" (p. 108) to show the progression of learning experiences from the concrete to the abstract (see Figure 1) rather than as a prescription for instruction with media. In the last edition of *Audiovisual Methods in Teaching* (1969), Dale integrated Bruner's (1966) three modes of learning into the Cone by categorizing learning experiences into three modes: enactive (i.e., learning by doing), iconic (i.e., learning through observation), and symbolic experience (i.e., learning through abstraction).

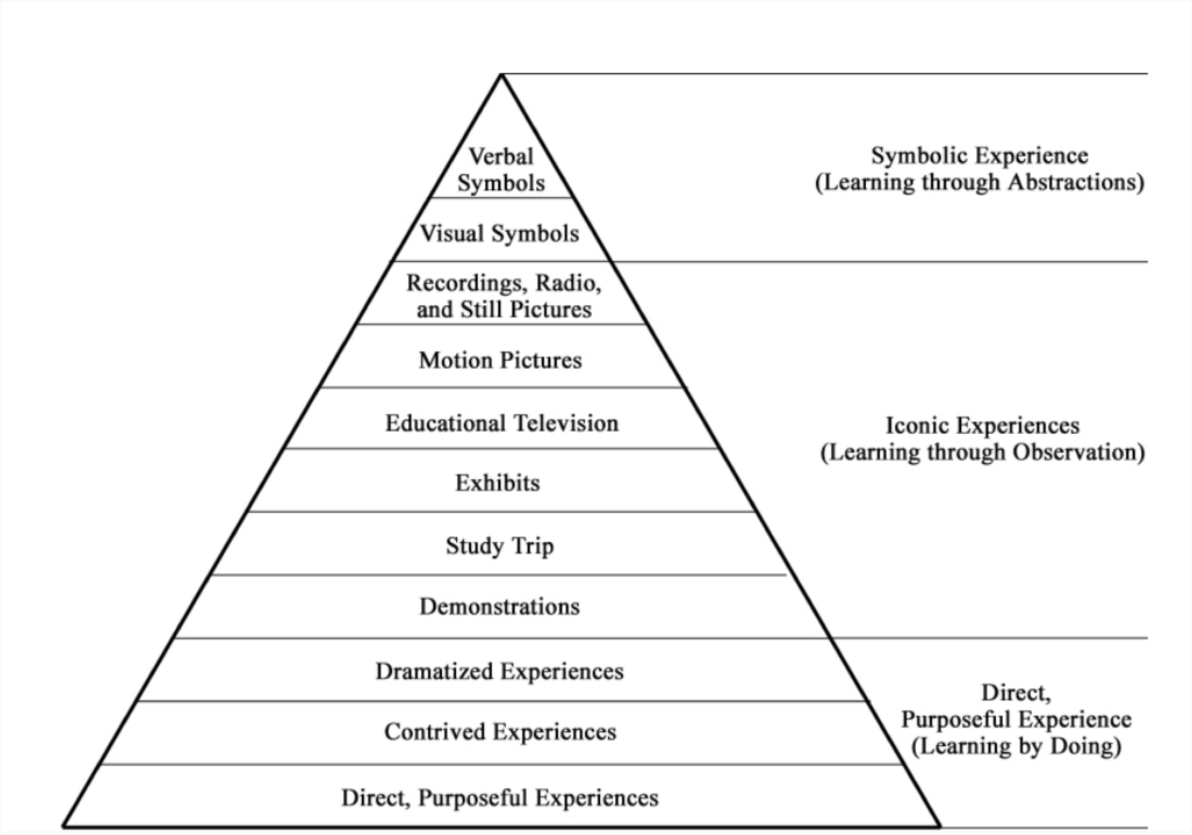

Figure 1. Dale's Cone of Experience.

In moving toward the pinnacle of the Cone from direct, purposeful experiences to verbal symbols, the degree of abstraction gradually increases. As a result, learners become spectators rather than participants (Seels, 1997). The bottom of the Cone represented "purposeful experience that is seen, handled, tasted, touched, felt, and smelled" (Dale, 1954, p. 42). By contrast, at the top of the Cone, verbal symbols (i.e., words) and messages are highly abstract. They do not have physical resemblance to the objects or ideas. As Dale (1969) wrote, "The word *horse* as we write it does not look like a horse or sound like a horse or feel like a horse" (p. 127).

Dale (1969) explained that the broad base of the cone illustrated the importance of direct experience for effective communication and learning. Especially for young children, real and concrete experiences are necessary to provide the foundation of their permanent learning. The historical importance of Dale's Cone rests in its attempt to relate media to psychological theory (Seels, 1997) and the Cone has shaped various sets of media selection guidelines ever since. For example, influenced by Dale, Briggs (1972) delineated general principles for media selection according to the age of learners, the type of learners, and the type of task.

Current Application

Dale's Cone of Experience continues to influence instructional designers today in both theory and practice. For example, Baukal, Auburn, and Ausburn built upon Dale's ideas in developing their Multimedia Cone of Abstraction, available at https://edtechbooks.org/-Yq.

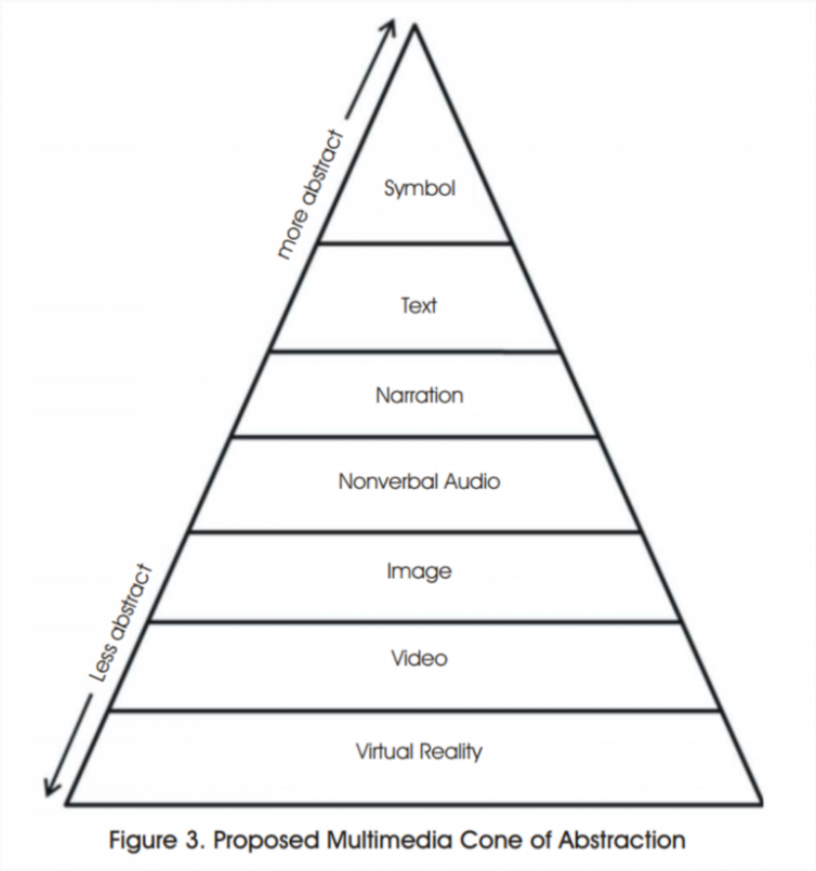

Figure 3. Proposed Multimedia Cone of Abstraction

Multimedia Cone of Abstraction

As noted above, Dale's Cone has been frequently misunderstood and misused. Dale's Cone is often confounded with the "Remembering Cone" or "Bogus Cone" (Subramony, 2003, p. 27) which claims that learners will generally remember 10 percent of what they read, 20 percent of what they hear, 30 percent of what they see, 50 percent of what they hear and see, 70 percent of what they say, and 90 percent of what they both say and do. Even though Dale did not mention the relationship between the level of the Cone and a learner's level of recall, many practitioners mistakenly believe that the bogus "Remembering Cone" was Dale's work. A Google search reveals an astonishing number of attributions of the "Bogus Cone" to Edgar Dale. Molenda (2003) concludes that the so-called empirical evidence for the "Remembering Cone" appears to have been fabricated by petroleum industry trainers in the 1960s.

In addition to this confusion, the implications of Dale's Cone have been misunderstood or misapplied. For example, Dale's Cone has been used to maintain that more realistic and direct experience is always better. However, Dale (1969) demurred, writing that, "Too much reliance on concrete experience may actually obstruct the process of meaningful generalization" (p. 130). Also, Dale noted that providing realistic learning experiences may not be efficient in terms of cost, time, and efforts. Instead, Dale suggested that teachers should balance combinations of concrete and abstract learning experiences.

Further Reading

For a thorough analysis of the prevalence of the "Remembering Cone" myth in instructional design, along with analysis tracing the history of this myth and the evidence against it, see the final issue in 2014 of Educational Technology, which presented a special issue on the topic.

Application Exercises

While learning by doing (direct, purposeful experience) may be better than learning through abstraction (symbolic experience), explain why you think Dale (1969) felt that "Too much reliance on concrete experience may actually obstruct the process of meaningful generalization."

Experiential Learning Environments

In another book *Can You Give The Public What It Wants* (1967), Dale reiterated Dewey's influence on his ideas by writing: "As I return to *Democracy and Education* [published by Dewey in 1916] I always find a new idea that I had not seen or adequately grasped before" (p. 186). Dale (1969) described learning as a "fourfold organic process" (p. 42) which consisted of needs, experiences, incorporation of the experiences, and the use of them. To promote permanent learning, Dale asserted that teachers should help students identify their *needs* for learning and set clearly defined learning goals related to their needs. A learning *experience* must be personally meaningful with respect to students' backgrounds and developmental stages and the nature of the experience should be logically arranged to help students *incorporate* new knowledge with what they already have. Later, students should have opportunities to *practice and try out* their new knowledge in real life as well as in learning contexts. Dale (1972) wrote:

> *To experience an event is to live through it, to participate in it, to incorporate it, and to continue to use it. To experience is to test, to try out. It means to be a concerned participant, not a half-attentive observer. (p. 4)*

Thus, effective learning environments should be filled with rich and memorable experiences where students can see, hear, taste, touch, and try. Dale (1969) articulated the characteristics of rich experiences. In a rich experience:

- students are immersed in it and use their eyes, ears, noses, mouths and hands to explore the experience,
- students have a chance to discover new experiences and new awareness of them,
- students have emotionally rewarding experiences that will motivate them for learning throughout their lives,
- students have chances to practice their past experiences and combine them to create new experiences,
- students have a sense of personal achievement, and
- students can develop their own dynamic experiences.

In Dale's perspective (1972), most students in schools did not learn how to think, discover, and solve real problems. Rather, students were forced to memorize facts and knowledge in most schools, and as a result, any knowledge they acquired was inert in their real lives. For this reason, he argued that we should have revolutionary approaches to improve the quality of educational learning environments. To build learning environments infused with rich experiences, Dale argued for the development of new materials and methods of instruction. Dale promoted the potential of audiovisual materials, believing that they could provide vivid and memorable experiences and extend them regardless of the limitations of time and space. Dale (1969) argued:

> *Thus, through the skillful use of radio, audio recording, television, video recording, painting, line drawing, motion picture, photograph, model, exhibit, poster, we can bring the world to the classroom. We can make*

> *the past come alive either by reconstructing it or by using records of the past. (p. 23)*

Dale believed that audiovisual materials could help students learn from others' first-hand experience, or *vicarious*experience. Dale (1967) claimed, "Audiovisual materials furnish one especially effective way to extend the range of our vicarious experience" (p. 23). Dale concluded that audiovisual materials could provide a concrete basis for learning concepts, heighten students' motivation, encourage active participation, give needed reinforcement, widen student experiences and improve the effectiveness of other materials.

Although as noted above, Dale (1969) did not advocate comparative media studies, he did recommend evaluating combinations of media and instructional materials in actual learning environments. Amazingly, Dale anticipated the direction of media research as if he had been privy to the Great Media Debate between Clark (1994) and Kozma (1994). Dale (1969) provided an analogy:

> *As we think about freight cars and their contents we can and do distinguish them. But the vehicle and its contents are closely linked. The gondola car is linked with coal: we do not haul oil in it. The piggy-back conveyances for transporting automobiles are not used to transport wheat. In all communicating of messages, therefore, we must consider the kind of vehicle used to transport them, realizing that medium-message characteristics will influence what can be "sent" to a receiver. (p. 133)*

Dale recommended that researchers should look at the effects of combinations of media in the environment where they will be used rather than the testing of a single, isolated medium in the laboratory. By conducting research in real classrooms, the varied combinations of possible factors such as attributes of audiovisual materials, how to use and administer them, learners' characteristics, and learning environments could be examined because learning occurs through dynamic interaction among the learner, the context, and the media. Although the experimental methods of educational and psychological research were focused on testing the tenets of behaviorism and pitting one media against another throughout most of his career, Dale was prescient in his recognition that the complexities of learning render most such studies fruitless.

Final Remarks

Dale was much more than a scholar isolated in the ivory towers of academe. As described by Wagner (1970), "He actively fought for better schools, academic freedom, civil rights, and other causes long before these became popular issues" (p. 94). Dale also anticipated the still-neglected importance of media education by promoting in the 1930s the then radical notion that teachers should help their students to understand the effects of media on them, their parents, and society, and to learn how to critically evaluate the contents of the radio, newspapers, and films. Dale was a socially responsible researcher, a thoughtful humanist, and dedicated educator. Any educational technologist seeking inspiration for their work in our field would find no better role model than Edgar Dale.

Application Exercises

- Think about your most memorable learning experience. How was it (or how was it not) a "rich experience" as defined by Dale?
- Dale felt that a rich experience would be "emotionally rewarding" and "motivate [learners] for learning throughout their lives." Describe an experience you have had that was emotionally rewarding and motivated you to continue learning throughout your life.
- Why does Dale suggest teachers balance their time providing concrete and abstract teaching opportunities?

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8

Twenty Years of EdTech

Martin Weller

Editor's Note

The following was originally published by *Educause* with the following citation:

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An opinion often cited among educational technology (edtech) professionals is that theirs is a fast-changing field. Thi statement is sometimes used as a motivation (or veiled threat) to senior managers to embrace edtech because if they miss out now, it'll be too late to catch up. However, amid this breathless attempt to keep abreast of new developments the edtech field is remarkably poor at recording its own history or reflecting critically on its development. When Audrey Watters recently put out a request for recommended books on the history of educational technology,[1] I couldn't come up with any beyond the handful she already had listed. There are edtech books that often start with a historical chapte to set the current work in context, and there are edtech books that are now part of history, but there are very few edtec books dealing specifically with the field's history. Maybe this reflects a lack of interest, as there has always been something of a year-zero mentality in the field. Edtech is also an area to which people come from other disciplines, so there is no shared set of concepts or history. This can be liberating but also infuriating. I'm sure I was not alone in emitting the occasional sigh when during the MOOC rush of 2012, so many "new" discoveries about online learning were reported—discoveries that were already tired concepts in the edtech field.

The twentieth anniversary of EDUCAUSE presents an opportune moment to examine some of this history. There are different ways to do so, but for this article I have taken the straightforward approach of selecting a different educatior technology, theory, or concept for each of the years from 1998 through 2018. This is not just an exercise in nostalgia (although comparing horror stories about metadata fields is enjoyable); it also allows us to examine what has change what remains the same, and what general patterns can be discerned from this history. Although the selection is largel a personal one, it should resonate here and there with most practitioners in the field. I have also been rather arbitrary i allocating a specific year: the year is not when a particular technology was invented but, rather, when it became—in my view—significant.

Looking back twenty years starts in 1998, when the web had reached a level of mainstream awareness. It was access through dial-up modems, and there was a general sense of puzzlement about what it would mean, both for society mo generally and for higher education in particular. Some academics considered it to be a fad. One colleague dismissed r

idea of a fully online course by declaring: “No one wants to study like that.” But the potential of the web for higher education was clear, even if the direction this would take over the next twenty years was unpredictable.

1998: Wikis

Perhaps more than any other technology, wikis embody the spirit of optimism and philosophy of the open web. The w —a web page that could be jointly edited by anyone—was a fundamental shift in how we related to the internet. The we democratized publishing, and the wiki made the process a collaborative, shared enterprise. In 1998 wikis were just breaking through. Ward Cunningham is credited with inventing them (and the term) in 1994. Wikis had their own mark language, which made them a bit technical to use, although later implementations such as Wikispaces made the process easier. Wikis encapsulated the promise of a dynamic, shared, respectful space—the result partly of the ethos behind them (after all, they were named after the Hawaiian word for *quick*) and partly of their technical infrastructure. Users can track edits, roll back versions, and monitor contributions. Accountability and transparency are built in.

With *Wikipedia* now the default knowledge source globally with over 5.5 million articles (counting only those in Englisl it would seem churlish to bemoan that wikis failed to fulfil their potential. Nevertheless, that statement is probably tru in terms of the use of wikis in teaching. For instance, why aren’t MOOCs conducted in wikis? It’s not necessarily that wikis as a technology have not fully realized their potential. Rather, the approach to edtech they represent—cooperativ and participatory—has been replaced by a broadcast, commercial publisher model.

1999: E-learning

E-learning had been in use as a term for some time by 1999, but the rise of the web and the prefix of “e” to everything saw it come to prominence. By 1999, e-learning was knocking on the door of, if not already becoming part of, the mainstream. Conventional and distance colleges and universities were adopting e-learning programs, often whenever the target audience would be willing to learn this way. One of the interesting aspects of e-learning was the considerati of costs. The belief was that e-learning would be cheaper than traditional distance-education courses. It wasn’t, although e-learning did result in a shift in costs: institutions could spend less in production (by not using physical resources and by reusing material), but there was a consequent increase in presentation costs (from support costs ar a more rapid updating cycle). This cost argument continues to reoccur and was a significant driver for MOOCs (see ye 2012).

E-learning set the framework for the next decade in terms of technology, standards, and approaches—a period that represents, in some respects, the golden age of e-learning.

2000: Learning Objects

E-learning was accompanied by new approaches, often derived from computer science. One of these was learning objects. The concept can be seen as arising from programming: object-oriented programming had demonstrated the benefits of reusable, clearly defined pieces of functional code that could be implemented across multiple programs. Learning objects seemed like a logical step in applying this model to e-learning. As Stephen Downes argued:

> *There are thousands of colleges and universities, each of which teaches, for example, a course in introductory trigonometry. Each such trigonometry course in each of these institutions describes, for example, the sine wave function. . . .*
>
> *Now for the premise: the world does not need thousands of similar descriptions of sine wave functions available online. Rather, what the world needs is one, or maybe a dozen at most, descriptions of sine wave functions available online. The reasons are manifest. If some educational content, such as a description of sine wave functions, is available online, then it is available worldwide.*[2]

This made a lot of sense then, and it still makes a lot of sense today. A learning object was roughly defined as "a digitized entity which can be used, reused or referenced during technology supported learning."[3] But learning objects never really took off, despite the compelling rationale for their existence. The failure to make them a reality is instructi for all in the edtech field. They failed to achieve wide-scale adoption for a number of reasons, including over-engineering, debates around definitions, the reusability paradox,[4] and the fact that they were an alien concept for many educators who were already overloaded. Nevertheless, the core idea of learning objects would resurface in different guises.

2001: E-learning Standards

By the turn of the millennium, e-learning was seeing significant interest, resulting in a necessary concentration of efforts: platforms that could be easily set up to run e-learning programs; a more professional approach to the creation of e-learning content; the establishment of evidence; and initiatives to describe and share tools and content. Enter e-learning standards and, in particular, IMS. This was the body that set about to develop standards that would describe content, assessment tools, courses, and more ambitiously, learning design. Perhaps the most significant standard wa SCORM, which went on to become an industry standard in specifying content that could be used in virtual learning environments (VLEs). Prior to this, considerable overhead was involved in switching content from one platform to another.

E-learning standards are an interesting case study in edtech. Good standards retreat into the background and just hel things work, as SCORM has done. But other standards have failed in some of their ambitions to create easily assembled, discoverable, plug-and-play content. So while the standards community continues to work, it has encountered problems with vendors[5] and has been surpassed in popular usage by the less specific but more human description and sharing approach that underlined the web 2.0 explosion (see year 2006).

2002: Open Educational Resources (OER)

Now that the foundations of modern edtech had been laid, the more interesting developments could commence. In 2001, MIT announced its OpenCourseWareinitiative, marking the initiation of the OER movement. But it was in 2002 th the first OER were released and that people began to understand licenses. MIT's goal was to make all the learning materials used in its 1,800 courses available via the internet, where the resources could be used and repurposed as desired by others, without charge.

Like learning objects, the software approach (in particular, open-source software) provides the roots for OER. The ope source movement can be seen as creating the context within which open education could flourish, partly by analogy and partly by establishing a precedent. But there is also a very direct link, via David Wiley, through the development of licenses.[6] In 1998 Wiley became interested in developing an open license for educational content, and he directly contacted pioneers in the open-source world. Out of this came the Open Content License (OCL), which he developed with publishers to establish the Open Publication License (OPL) the next year.

The OPL proved to be one of the key components, along with the Free Software Foundation's GNU license, of the Creative Commons licenses, developed by Larry Lessig and others in 2002. These went on to become essential in the open-education movement. The simple licenses in Creative Commons allowed users to easily share resources, and Ol became a global movement. Although OER have not transformed higher education in quite the way many envisaged ir 2002 and many projects have floundered after funding ends, the OER idea continues to be relevant, especially through open textbooks and open educational practice (OEP).

The general lessons from OER are that it succeeded where learning objects failed because OER tapped into existing practice (and open textbooks doubly so). The concept of using a license to openly share educational content is alien enough, without all the accompanying standards and concepts associated with learning objects. Patience is required: educational transformation is a slow burn.

2003: Blogs

Blogging developed alongside the more education-specific developments and was then co-opted into edtech. In so doing, it foreshadowed much of the web 2.0 developments, with which it is often bundled.

Blogging was a very obvious extension of the web. Once people realized that anyone could publish on the web, they inevitably started to publish diaries, journals, and regularly updated resources. Blogging emerged from a simple versic of "here's my online journal" when syndication became easy to implement. The advent of feeds, and particularly the universal standard RSS, provided a means for readers to subscribe to anyone's blog and receive regular updates. This was as revolutionary as the liberation that web publishing initially provided. If the web made everyone a publisher, RSS made everyone a distributor.

People swiftly moved beyond journals. After all, what area isn't impacted by the ability to create content freely, whene you want, and have it immediately distributed to your audience? Blogs and RSS-type distribution were akin to giving everyone superhero powers. It's not surprising that in 2018, we're still wrestling with the implications. No other edtech has continued to develop and solidify (as the proliferation of WordPress sites attests) and also remain so full of potential. For almost every edtech that comes along—e-portfolios, VLEs, MOOCs, OER, social media—I find myself thinking that a blog version would be better. Nothing develops and anchors an online identity quite like a blog.

2004: The LMS

The learning management system (LMS) offered an enterprise solution for e-learning providers. It stands as the centr e-learning technology. Prior to the LMS, e-learning provision was realized through a variety of tools: a bulletin board fo communications; a content-management system; and/or home-created web pages. The quality of these solutions wa variable, often relying on the enthusiasm of one particular devotee. The combination of tools also varied across any o higher education institution, with the medical school adopting one set of tools, the engineering school another, the humanities school yet another, and so on.

As e-learning became more integral to both blended-learning and fully-online courses, this variety and reliability becan a more critical issue. The LMS offered a neat collection of the most popular tools, any one of which might not be as good as the best-of-breed specific tool but was good enough. The LMS allowed for a single, enterprise solution with th associated training, technical support, and helpdesk. The advantage was that e-learning could be implemented more quickly across an entire institution. However, over time this has come to be seen more as a Faustian pact as institutio found themselves locked into contracts with vendors, most famously with providers (e.g., Blackboard) that attempted file restrictive patents.[7] More problematically, the LMS has become the *only* route for delivering e-learning in many institutions, with a consequent loss of expertise and innovation.[8]

2005: Video

YouTube was founded in 2005, which seems surprisingly recent, so much has it become a part of the cultural landscape. As internet access began to improve and compression techniques along with it, the viability of streaming video had reached a realistic point for many by 2005. YouTube and other video-sharing services flourished, and the realization that anyone could make a video and share it easily was the next step in the broadcast democratization tha had begun with HTML. While the use of video in education was often restricted to broadcast, this was a further development on the learning objects idea. As the success of the Khan Academy illustrates, simple video explanations key concepts—explanations that can be shared and embedded easily—met a great educational demand. However, colleges and universities for the most part still do not assess students on their use of video. In some disciplines, such as the arts, this is more common, but in 2018, text remains the dominant communication form in education. Although courses such as DS106 have innovated in this area,[9] many students will go through their education without being

required to produce a video as a form of assessment. We need to fully develop the critical structures for video in orde for it to fulfil its educational potential, as we have already done for text.

2006: Web 2.0

The "web 2.0" tag gained popularity from Tim O'Reilly's use in the first Web 2.0 Conference in 2004, but not until aroun 2006 did the term begin to penetrate in educational usage, with Bryan Alexander highlighting the relevance of social a open aspects of its application.[10] The practical term "web 2.0" gathered together the user-generated content services including YouTube, Flickr, and blogs. But it was more than just a useful term for a set of technologies; it seemed to capture a new mindset in our relation to the internet. After O'Reilly set out the seven principles of web 2.0, the web 2.0 boom took off.[11]

Just as the fascination with e-learning had seen every possible term prefixed with "e," so the addition of "2.0" to any educational term made it fashionable. But soon the boom was followed by the consequent bust (a business plan was needed after all), and problems with some of the core concepts meant that by 2009, web 2.0 was being declared dead.[12] Inherent in much of the web 2.0 approach was a free service, which inevitably led to data being the key source for revenue and gave rise to the oft-quoted line "If you're not paying for it, you're the product being sold."[13] As web 2.0 morphed into social media, the inherent issues around free speech and offensive behavior came to the fore. In educational terms, this raises issues about duty of care for students, recognizing academic labor, and marginalized groups. The utopia of web 2.0 turned out to be one with scant regard for employment laws and largely reserved for "tech bros."

Nevertheless, at the time, web 2.0 posed a fundamental question as to how education conducts many of its cherished processes. Peer review, publishing, ascribing quality—all of these were founded on what David Weinberger referred to filtering on the way in rather than on the way out.[14] While the quality of much online content was poor, there was alwa an aspect of what was "good enough" for any learner. With the demise of the optimism around web 2.0, many of the accompanying issues it raised for higher education have largely been forgotten—before they were even addressed. Fo instance, while the open repository for physics publications (arXiv) and open-access methods for publication became mainstream, the journal system is still dominant, largely based on double-blind, anonymous peer review. Integrating in the mainstream the participatory culture that web 2.0 brought to the fore remains both a challenge and an opportunity for higher education.

2007: Second Life and Virtual Worlds

Online virtual worlds and Second Life had been around for some time, with Second Life launching in 2003, but they begin to see an upsurge in popularity around 2007. Colleges and universities began creating their own islands, and whole courses were delivered through Second Life. While the virtual worlds had strong devotees, they didn't gain as much traction with students as envisaged, and most Second Life campuses are now deserted. Partly this was a result of a lack of imagination: they were often used to re-create an online lecture. The professor may have been represented by a seven-foot-tall purple cat in that lecture, but it was a lecture nonetheless. Virtual worlds also didn't manage to shrug off their nerdy, role-playing origins, and many users felt an aversion to this. The worlds could be glitchy as well, which meant that many people never made it off Orientation Island in Second Life, for example. However, with the success of games such as *Minecraft* and *Pokémon Go,* more robust technology, and more widespread familiarity with avatars and gaming, virtual worlds for learning may be one of those technologies due for a comeback.

2008: E-portfolios

Like learning objects, e-portfolios were backed by a sound idea. The e-portfolio was a place to store all the evidence a learner gathered to exhibit learning, both formal and informal, in order to support lifelong learning and career development. But like learning objects—and despite academic interest and a lot of investment in technology and

standards—e-portfolios did not become the standard form of assessment as proposed. Many of their problems were similar to those that beleaguered learning objects, including overcomplicated software, an institutional rather than a user focus, and a lack of accompanying pedagogical change. Although e-portfolio tools remain pertinent for many subjects, particularly vocational ones, for many students owning their own domain and blog remains a better route to establishing a lifelong digital identity. It is perhaps telling that although many practitioners in higher education mainta blogs, asking to see a colleague's e-portfolio is likely to be met with a blank response.

2009: Twitter and Social Media

Founded in 2006, Twitter had moved well beyond the tech-enthusiast bubble by 2009 but had yet to become what we know it as today: a tool for wreaking political mayhem. With the trolls, bots, daily outrages, and generally toxic behavic not only on Twitter but also on Facebook and other social media, it's difficult to recall the optimism that we once held for these technologies. In 2009, though, the ability to make global connections, to easily cross disciplines, and to engage in meaningful discussion all before breakfast was revolutionary. There was also a democratizing effect: forma academic status was not significant, since users were judged on the value of their contributions to the network. In educational terms, social media has done much to change the nature of the relationship between academics, student and the institution. Even though the negative aspects are now undeniable, some of that early promise remains. What v are now wrestling with is the paradox of social media: the fact that its negatives and its positives exist simultaneously

2010: Connectivism

The early enthusiasm for e-learning saw a number of pedagogies resurrected or adopted to meet the new potential of the digital, networked context. Constructivism, problem-based learning, and resource-based learning all saw renewed interest as educators sought to harness the possibility of abundant content and networked learners. Yet *connectivism* as proposed by George Siemens and Stephen Downes in 2004–2005, could lay claim to being the first internet-native learning theory. Siemens defined connectivism as "the integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements—not entirely under the control of the individual."[15] Further investigating the possibility of networked learning led to the creation of the early MOOCs, including influential open courses by Downes and Siemens in 2008 an 2009.[16] Pinning down exactly what connectivism was could be difficult, but it represented an attempt to rethink how learning is best realized given the new realities of a digital, networked, open environment, as opposed to forcing technology into the service of existing practices. It also provided the basis for MOOCs, although the approach they eventually adopted was far removed from connectivism (see 2012).

2011: PLE

Personal Learning Environments (PLEs) were an outcome of the proliferation of services that suddenly became available following the web 2.0 boom. Learners and educators began to gather a set of tools to realize a number of functions. In edtech, the conversation turned to whether these tools could be somehow "glued" together in terms of data. Instead of talking about one LMS provided to all students, we were discussing how each learner had his/her own particular blend of tools. Yet beyond a plethora of spoke diagrams, with each showing a different collection of icons, t PLE concept didn't really develop after its peak in 2011. The problem was that passing along data was not a trivial tas and we soon became wary about applications that shared data (although perhaps not wary enough, given recent news regarding Cambridge Analytica[17]). Also, providing a uniform offering and support for learners was difficult when they were all using different tools. The focus shifted from a personalized set of tools to a personalized set of resources, an in recent years this has become the goal of personalization.

2012: MOOCS

Inevitably, 2012 will be seen as the year of MOOCs.[18] In many ways the MOOC phenomenon can be viewed as the combination of several preceding technologies: some of the open approach of OER, the application of video, the experimentation of connectivism, and the revolutionary hype of web 2.0. Clay Shirky mistakenly proclaimed that MOO were the internet happening to education.[19] If he'd been paying attention, he would have seen that this had been happening for some time. Rather, MOOCs were Silicon Valley happening to education. Once Stanford Professor Sebastian Thrun's course had attracted over 100,000 learners and almost as many headlines,[20] the venture capitalist investment flooded in.

Much has been written about MOOCs, more than I can do justice to here. They are a case study still in the making. The raised profile of open education and online learning caused by MOOCs may be beneficial in the long run, but the MOO hype (only ten global providers of higher education by 2022?)[21] may be equally detrimental. The edtech field needs to learn how to balance these developments. Millions of learners accessing high-quality material online is a positive, but the rush by colleges and universities to enter into prohibitive contracts, outsource expertise, and undermine their own staff has long-term consequences as well.

2013: Open Textbooks

If MOOCs were the glamorous side of open education, all breathless headlines and predictions, open textbooks were the practical, even dowdy, application. An extension of the OER movement, and particularly pertinent in the United States and Canada, open textbooks provided openly licensed versions of bespoke written textbooks, free for the digita version. The cost of textbooks provided a motivation for adoption, and the switching of costs from production to purchase offers a viable model. As with LMSs, open textbooks offer an easy route to adoption. Exploration around op pedagogy, co-creation with students, and diversification of the curriculum all point to a potentially rich, open, edtech ecosystem—with open textbooks at the center.[22] However, the possible drawback is that like LMSs, open textbooks m not become a stepping-stone on the way to a more innovative, varied teaching approach but, rather, may become an e point in themselves.

2014: Learning Analytics

Data, data, data. It's the new oil and the new driver of capitalism, war, politics. So inevitably its role in education would come to the fore. Interest in analytics is driven by the increased amount of time that students spend in online learning environments, particularly LMSs and MOOCs. The positive side of learning analytics is that for distance education, it provides the equivalent of responding to discreet signals in the face-to-face environment: the puzzled expression, the yawn, or the whispering between students looking for clarity. Every good face-to-face educator will respond to these signals and adjust his/her behavior. If in an online environment, an educator sees that students are repeatedly going back to a resource, that might indicate a similar need to adapt behavior. The downsides are that learning analytics car reduce students to data and that ownership over the data becomes a commodity in itself. The use of analytics has on just begun. The edtech field needs to avoid the mistakes of data capitalism; it should embed learner agency and ethic in the use of data, and it should deploy that data sparingly.[23]

2015: Digital Badges

Providing digital badges for achievements that can be verified and linked to evidence started with Mozilla's open badg infrastructure in 2011. Like many other edtech developments, digital badges had an initial flurry of interest from devotees but then settled into a pattern of more laborious long-term acceptance. They represent a combination of key challenges for educational technology: realizing easy-to-use, scalable technology; developing social awareness that gives them currency; and providing the policy and support structures that make them valuable.

Of these challenges, only the first relates directly to technology; the more substantial ones relate to awareness and legitimacy. For example, if employers or institutions come to widely accept and value digital badges, then they will gai credence with learners, creating a virtuous circle. There is some movement in this area, particularly with regard to staf development within organizations and often linked with MOOCs.[24] Perhaps more interesting is what happens when educators design for badges, breaking courses down into smaller chunks with associated recognition, and when communities of practice give badges value. Currently, their use is at an indeterminate stage—neither a failed enterpris nor the mainstream adoption once envisaged.

2016: The Return of AI

Artificial intelligence (AI) was the focus of attention in education in the 1980s and 1990s with the possible developme of intelligent tutoring systems. The initial enthusiasm for these systems has waned somewhat, mainly because they worked for only very limited, tightly specified domains. A user needed to predict the types of errors people would mak in order to provide advice on how to rectify those errors. And in many subjects (the humanities in particular), people a very creative in the errors they make, and more significantly, what constitutes the right answer is less well defined.

Interest in AI faded as interest in the web and related technologies increased, but it has resurfaced in the past five yea or so. What has changed over this intervening period is the power of computation. This helps address some of the complexity because multiple possibilities and probabilities can be accommodated. Here we see a recurring theme in edtech: nothing changes while, simultaneously, everything changes. AI has definitely improved since the 1990s, but some of its fundamental problems remain. It always seems to be a technology that is just about to break out of the bo

More significant than the technological issues are the ethical ones. As Audrey Watters contends, AI is ideological.[25] T concern about AI is not that it won't deliver on the promise held forth by its advocates but, rather, that someday it will. And then the assumptions embedded in code will shape how education is realized, and if learners don't fit that conceptual model, they will find themselves outside of the area in which compassion will allow a human to alter or intervene. Perhaps the greatest contribution of AI will be to make us realize how important people truly are in the education system.

2017: Blockchain

Of all the technologies listed here, blockchain is perhaps the most perplexing, both in how it works and in why it is eve in this list. In 2016 several people independently approached me about blockchain—the distributed, secure ledger for keeping the records that underpin Bitcoin. The question was always the same: "Could we apply this in education somehow?" The imperative seemed to be that blockchain was a cool technology, and therefore there must be an educational application. It could provide a means of recording achievements and bringing together large and small, formal and informal, outputs and recognition.[26]

Viewed in this way, blockchain is attempting to bring together several issues and technologies: e-portfolios, with the a to provide an individual, portable record of educational achievement; digital badges, with the intention to recognize informal learning; MOOCs and OER, with the desire to offer varied informal learning opportunities; PLEs and personalized learning, with the idea to focus more on the individual than on an institution. A personal, secure, permanent, and portable ledger may well be the ring to bind all these together. However, the history of these technologies should also be a warning for blockchain enthusiasts. With e-portfolios, for instance, even when there is a clear connection to educational practice, adoption can be slow, requiring many other components to fall into place. In 2018 even the relatively conservative and familiar edtech of open textbooks is far from being broadly accepted. Attempting to convince educators that a complex technology might solve a problem they don't think they have is therefore unlikely to meet with widespread support.

If blockchain is to realize any success, it will need to work almost unnoticed; it will succeed only if people don't know they're using blockchain. Nevertheless, many who propose blockchain display a definite evangelist's zeal. They desire

its adoption as an end goal in itself, rather than as an appropriate solution to a specific problem.

2018: TBD

We're only halfway through 2018, so it would be premature to select a technology, theory, or concept for the year. But one aspect worth considering is what might be termed the dark side of edtech. Given the use of social media for extremism, data scares such as the Facebook breach by Cambridge Analytica, anxieties about Russian bots, concerte online abuse, and increased data surveillance, the unbridled optimism that technology will create an educational utop now seems naïve. It is not just informed critics such as Michael Caulfield[27] who are warning of the dangers of overreliance on and trust in edtech; the implicit problems are now apparent to most everyone in the field. In 2018, edtech stands on the brink of a new era, one that has a substantial underpinning of technology but that needs to build on the ethical, practical, and conceptual frameworks that combat the nefarious applications of technology.

Conclusion

Obviously, one or two paragraphs cannot do justice to technologies that require several books each, and my list has undoubtedly omitted several important developments (e.g., gaming, edupunk, automatic assessment, virtual reality, ar Google might all be contenders). However, from this brief overview, a number of themes can be extracted to help infor the next twenty years.

The first of these is that in edtech, the *tech* part of the phrase walks taller. In my list, most of the innovations are technologies. Sometimes these come with strong accompanying educational frameworks, but other times they are a technology seeking an application. This is undoubtedly a function of my having lived through the first flush of the digit revolution. A future list may be better balanced with conceptual frameworks, pedagogies, and social movements.

Second, several ideas recur, with increasing success in their adoption. Learning objects were the first attempt at maki teaching content reusable, and even though they weren't successful, the ideas they generated led to OER, which begat open textbooks. So, those who have been in the edtech field for a while should be wary of dismissing an idea by sayin "We tried that; it didn't work." Similarly, those proposing a new idea need to understand why previous attempts failed.

Third, technology outside of education has consistently been co-opted for educational purposes. This has met with varying degrees of success. Blogs, for instance, are an ideal educational technology, whereas Second Life didn't reach sustainable adoption. The popularity of—or the number of *Wired* headlines about—a technology does not automatical make it a contender as a useful technology for education.

This leads into the last point: education is a complex, highly interdependent system. It is not like the banking, record, c media industries. The simple transfer of technology from other sectors often fails to appreciate the sociocultural context in which education operates. Generally, only those technologies that directly offer an improved, or alternative, means of addressing the core functions of education get adopted. These core functions can be summarized as conte delivery and recognition.[28] OER, LMS, and online assessment all directly map onto these functions. Yet even when the is a clear link, such as between e-portfolios and recognition, the required cultural shifts can be more significant. Equal edtech has frequently failed to address the social impact of advocating for or implementing a technology beyond the higher education sector. MOOCs, learning analytics, AI, social media—the widespread adoption of these technologies leads to social implications that higher education has been guilty of ignoring. The next phase of edtech should be framed more as a conversation about the specific needs of higher education and the responsibilities of technology adoption.

When we look back twenty years, the picture is mixed. Clearly, a rapid and fundamental shift in higher education practice has taken place, driven by technology adoption. Yet at the same time, nothing much has changed, and many edtech developments have failed to have significant impact. Perhaps the overall conclusion, then, is that edtech is not game for the impatient.

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II. Learning and Instruction

Many of the activities that LIDT professionals engage in are also completed by other professionals, such as web designers, curriculum writers, multimedia developers, and teachers. A powerful difference for LIDT professionals is our understanding of learning and instructional theory, and our efforts to apply these theories to our LIDT practice. For this reason, understanding what psychology and science can teach us about how people learn, and how good instruction is provided, is critical to any effective LIDT professional. The chapters in this section serve only as a basic starting ground to your pursuit of understanding in this area. You will learn about how the mind works and remembers information, and emotional factors in learning such as motivation and self-efficacy. I have included a classic article by Peg Ertmer and Tim Newby on the "Big 3" learning theories of behaviorism, cognitivism, and constructivism and a new chapter on sociocultural learning theories which extend beyond the Big 3. Included are a few chapters on more recent theoretical developments in the areas of informal learning, internet-based learning (connectivism), learning communities, and creative learning. Finally, two chapters are included on instructional theory from Charles Reigeluth, who edited several editions of the book *Instructional-Design Theories and Models* and David Merrill, whose First Principles of Instruction summary of basic instructional principles is perhaps the most well known of instructional frameworks in our field.

Additional Reading

An excellent resource to supplement your reading of learning theories in this section is the newly released *How People Learn* book, available for free online.

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9

Memory

Rose Spielman, Kathryn Dumper, William Jenkins, Arlene Lacombe, Marilyn Lovett, & Marion Perlmutter

Editor's Notes

The following is excerpted from an OpenStax book produced by Rice University. It can be downloaded for free at https://edtechbooks.org/-Gz

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How Memory Functions

Memory is an information processing system; therefore, we often compare it to a computer. Memory is the set of processes used to encode, store, and retrieve information over different periods of time.

Encoding

We get information into our brains through a process called encoding, which is the input of information into the memory system. Once we receive sensory information from the environment, our brains label or code it. We organize the information with other similar information and connect new concepts to existing concepts. Encoding information occurs through automatic processing and effortful processing.

If someone asks you what you ate for lunch today, more than likely you could recall this information quite easily. This is known as automatic processing, or the encoding of details like time, space, frequency, and the meaning of words. Automatic processing is usually done without any conscious awareness. Recalling the last time you studied for a test is another example of automatic processing. But what about the actual test material you studied? It probably required a lot of work and attention on your part in order to encode that information. This is known as effortful processing.

What are the most effective ways to ensure that important memories are well encoded? Even a simple sentence is easier to recall when it is meaningful (Anderson, 1984). Read the following sentences (Bransford & McCarrell, 1974), then look away and count backwards from 30 by threes to zero, and then try to write down the sentences (no peeking!).

1. The notes were sour because the seams split.
2. The voyage wasn't delayed because the bottle shattered.
3. The haystack was important because the cloth ripped.

How well did you do? By themselves, the statements that you wrote down were most likely confusing and difficult for you to recall. Now, try writing them again, using the following prompts: bagpipe, ship christening, and parachutist. Next count backwards from 40 by fours, then check yourself to see how well you recalled the sentences this time. You can see that the sentences are now much more memorable because each of the sentences was placed in context. Material is far better encoded when you make it meaningful.

There are three types of encoding. The encoding of words and their meaning is known as semantic encoding. It was first demonstrated by William Bousfield (1935) in an experiment in which he asked people to memorize words. The 60 words were actually divided into 4 categories of meaning, although the participants did not know this because the words were randomly presented. When they were asked to remember the words, they tended to recall them in categories, showing that they paid attention to the meanings of the words as they learned them.

Visual encoding is the encoding of images, and acoustic encoding is the encoding of sounds, words in particular. To see how visual encoding works, read over this list of words: car, level, dog, truth, book, value. If you were asked later to recall the words from this list, which ones do you think you'd most likely remember? You would probably have an easier time recalling the words *car, dog, and book*, and a more difficult time recalling the words level, truth, and value. Why is this? Because you can recall images (mental pictures) more easily than words alone. When you read the words *car, dog, and book* you created images of these things in your mind. These are concrete, high-imagery words. On the other hand, abstract words like level, truth, and value are low-imagery words. High-imagery words are encoded both visually and semantically (Paivio, 1986), thus building a stronger memory.

Now let's turn our attention to acoustic encoding. You are driving in your car and a song comes on the radio that you haven't heard in at least 10 years, but you sing along, recalling every word. In the United States, children often learn the alphabet through song, and they learn the number of days in each month through rhyme: "Thirty days hath September, / April, June, and November; / All the rest have thirty-one, / Save February, with twenty-eight days clear, / And twenty-nine each leap year." These lessons are easy to remember because of acoustic encoding. We encode the sounds the words make. This is one of the reasons why much of what we teach young children is done through song, rhyme, and rhythm.

Which of the three types of encoding do you think would give you the best memory of verbal information? Some years ago, psychologists Fergus Craik and Endel Tulving (1975) conducted a series of experiments to find out. Participants were given words along with questions about them. The questions required the participants to process the words at one of the three levels. The visual processing questions included such things as asking the participants about the font of the letters. The acoustic processing questions asked the participants about the sound or rhyming of the words, and the semantic processing questions asked the participants about the meaning of the words. After participants were presented with the words and questions, they were given an unexpected recall or recognition task.

Words that had been encoded semantically were better remembered than those encoded visually or acoustically. Semantic encoding involves a deeper level of processing than the shallower visual or acoustic encoding. Craik and Tulving concluded that we process verbal information best through semantic encoding, especially if we apply what is called the self-reference effect. The self-reference effect is the tendency for an individual to have better memory for information that relates to oneself in comparison to material that has less personal relevance (Rogers, Kuiper & Kirker, 1977).

Storage

Once the information has been encoded, we somehow have to retain it. Our brains take the encoded information and place it in storage. Storage is the creation of a permanent record of information.

In order for a memory to go into storage (i.e., long-term memory), it has to pass through three distinct stages: Sensory Memory, Short-Term Memory, and finally Long-Term Memory. These stages were first proposed by Richard Atkinson and Richard Shiffrin (1968). Their model of human memory (Figure 1), called Atkinson-Shiffrin (A-S), is based on the belief that we process memories in the same way that a computer processes information.

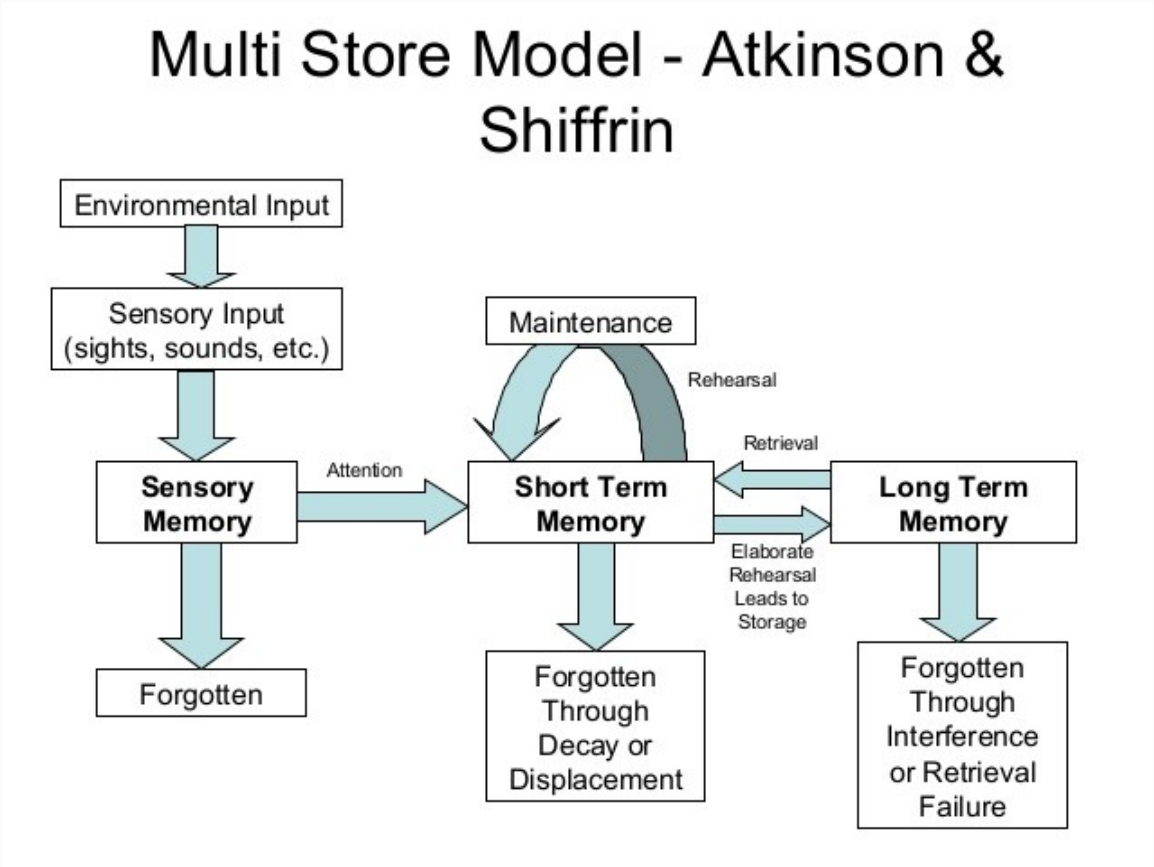

Figure 1. Atkinson & Shiffrin Memory Model. Created by Dkahng and available on Wikimedia Commons under a CC-BY, Share Alike license.

But A-S is just one model of memory. Others, such as Baddeley and Hitch (1974), have proposed a model where short-term memory itself has different forms. In this model, storing memories in short-term memory is like opening different files on a computer and adding information. The type of short-term memory (or computer file) depends on the type of information received. There are memories in visual spatial form, as well as memories of spoken or written material, and they are stored in three short-term systems: a visuospatial sketchpad, an episodic buffer, and a phonological loop. According to Baddeley and Hitch, a central executive part of memory supervises or controls the flow of information to and from the three short-term systems.

Sensory Memory

In the Atkinson-Shiffrin model, stimuli from the environment are processed first in sensory memory: storage of brief sensory events, such as sights, sounds, and tastes. It is very brief storage—up to a couple of seconds. We are constantly bombarded with sensory information. We cannot absorb all of it, or even most of it. And most of it has no impact on our lives. For example, what was your professor wearing the last class period? As long as the professor was dressed appropriately, it does not really matter what she was wearing. Sensory information about sights, sounds,

smells, and even textures, which we do not view as valuable information, we discard. If we view something as valuable, the information will move into our short-term memory system.

One study of sensory memory researched the significance of valuable information on short-term memory storage. J. R. Stroop discovered a memory phenomenon in the 1930s: you will name a color more easily if it appears printed in that color, which is called the Stroop effect. In other words, the word "red" will be named more quickly, regardless of the color the word appears in, than any word that is colored red. Try an experiment: name the colors of the words you are given in Figure 2. Do not read the words, but say the color the word is printed in. For example, upon seeing the word "yellow" in green print, you should say, "Green," not "Yellow." This experiment is fun, but it's not as easy as it seems.

Figure 2. Stroop Effect Memory Test. Available on Wikimedia Commons from "Fitness queen04," and licensed CC-By, Share Alike

Short-term Memory

Short-term memory (STM) is a temporary storage system that processes incoming sensory memory; sometimes it is called working memory. Short-term memory takes information from sensory memory and sometimes connects that memory to something already in long-term memory. Short-term memory storage lasts about 20 seconds. George Miller (1956), in his research on the capacity of memory, found that most people can retain about 7 items in STM. Some remember 5, some 9, so he called the capacity of STM 7 plus or minus 2.

Think of short-term memory as the information you have displayed on your computer screen—a document, a spreadsheet, or a web page. Then, information in short-term memory goes to long-term memory (you save it to your hard drive), or it is discarded (you delete a document or close a web browser). This step of rehearsal, the conscious repetition of information to be remembered, to move STM into long-term memory is called memory consolidation.

You may find yourself asking, "How much information can our memory handle at once?" To explore the capacity and duration of your short-term memory, have a partner read the strings of random numbers (Figure 3) out loud to you, beginning each string by saying, "Ready?" and ending each by saying, "Recall," at which point you should try to write down the string of numbers from memory.

Figure 3. Work through this series of numbers using the recall exercise explained above to determine the longest string of digits that you can store. Image available in original OpenStax chapter.

Note the longest string at which you got the series correct. For most people, this will be close to 7, Miller's famous 7 plus or minus 2. Recall is somewhat better for random numbers than for random letters (Jacobs, 1887), and also often slightly better for information we hear (acoustic encoding) rather than see (visual encoding) (Anderson, 1969).

Long-term Memory

Long-term memory (LTM) is the continuous storage of information. Unlike short-term memory, the storage capacity of LTM has no limits. It encompasses all the things you can remember that happened more than just a few minutes ago to all of the things that you can remember that happened days, weeks, and years ago. In keeping with the computer analogy, the information in your LTM would be like the information you have saved on the hard drive. It isn't there on your desktop (your short-term memory), but you can pull up this information when you want it, at least most of the time. Not all long-term memories are strong memories. Some memories can only be recalled through prompts. For example, you might easily recall a fact ("What is the capital of the United States?") or a procedure ("How do you ride a bike?") but you might struggle to recall the name of the restaurant you had dinner at when you were on vacation in France last summer. A prompt, such as that the restaurant was named after its owner, who spoke to you about your shared interest in soccer, may help you recall the name of the restaurant.

Long-term memory is divided into two types: explicit and implicit (Figure 4). Understanding the different types is important because a person's age or particular types of brain trauma or disorders can leave certain types of LTM intact while having disastrous consequences for other types. Explicit memories are those we consciously try to remember and recall. For example, if you are studying for your chemistry exam, the material you are learning will be part of your explicit memory. (Note: Sometimes, but not always, the terms explicit memory and declarative memory are used interchangeably.)

Implicit memories are memories that are not part of our consciousness. They are memories formed from behaviors. Implicit memory is also called non-declarative memory.

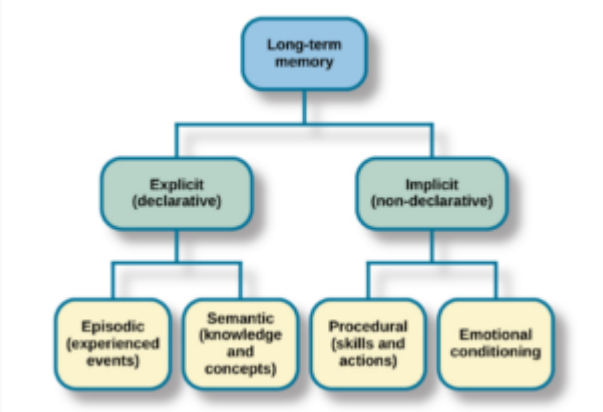

Figure 4. Available in the original OpenStax chapter.

Procedural memory is a type of implicit memory: it stores information about how to do things. It is the memory for skilled actions, such as how to brush your teeth, how to drive a car, how to swim the crawl (freestyle) stroke. If you are learning how to swim freestyle, you practice the stroke: how to move your arms, how to turn your head to alternate breathing from side to side, and how to kick your legs. You would practice this many times until you become good at it. Once you learn how to swim freestyle and your body knows how to move through the water, you will never forget how to swim freestyle, even if you do not swim for a couple of decades. Similarly, if you present an accomplished guitarist with a guitar, even if he has not played in a long time, he will still be able to play quite well.

Declarative memory has to do with the storage of facts and events we personally experienced. Explicit (declarative) memory has two parts: semantic memory and episodic memory. Semantic means having to do with language and knowledge about language. An example would be the question "what does *argumentative* mean?" Stored in our semantic memory is knowledge about words, concepts, and language-based knowledge and facts. For example, answers to the following questions are stored in your semantic memory:

- Who was the first President of the United States?
- What is democracy?
- What is the longest river in the world?

Episodic memory is information about events we have personally experienced. The concept of episodic memory was first proposed about 40 years ago (Tulving, 1972). Since then, Tulving and others have looked at scientific evidence and reformulated the theory. Currently, scientists believe that episodic memory is memory about happenings in particular places at particular times, the what, where, and when of an event (Tulving, 2002). It involves recollection of visual imagery as well as the feeling of familiarity (Hassabis & Maguire, 2007).

Watch these Part 1 (link) and Part 2 (link) video clips on superior autobiographical memory from the television news show 60 Minutes.

Retrieval

So you have worked hard to encode (via effortful processing) and store some important information for your upcoming final exam. How do you get that information back out of storage when you need it? The act of getting information out of memory storage and back into conscious awareness is known as retrieval. This would be similar to finding and opening a paper you had previously saved on your computer's hard drive. Now it's back on your desktop, and you can work with it again. Our ability to retrieve information from long-term memory is vital to our everyday functioning. You must be able to retrieve information from memory in order to do everything from knowing how to brush your hair and teeth, to driving to work, to knowing how to perform your job once you get there.

There are three ways you can retrieve information out of your long-term memory storage system: recall, recognition, and relearning. Recall is what we most often think about when we talk about memory retrieval: it means you can access information without cues. For example, you would use recall for an essay test. Recognition happens when you identify information that you have previously learned after encountering it again. It involves a process of comparison. When you take a multiple-choice test, you are relying on recognition to help you choose the correct answer. Here is another example. Let's say you graduated from high school 10 years ago, and you have returned to your hometown for your 10-year reunion. You may not be able to recall all of your classmates, but you recognize many of them based on their yearbook photos.

The third form of retrieval is relearning, and it's just what it sounds like. It involves learning information that you previously learned. Whitney took Spanish in high school, but after high school she did not have the opportunity to speak Spanish. Whitney is now 31, and her company has offered her an opportunity to work in their Mexico City office. In order to prepare herself, she enrolls in a Spanish course at the local community center. She's surprised at how quickly she's able to pick up the language after not speaking it for 13 years; this is an example of relearning.

Summary

Memory is a system or process that stores what we learn for future use.

Our memory has three basic functions: encoding, storing, and retrieving information. Encoding is the act of getting information into our memory system through automatic or effortful processing. Storage is retention of the information, and retrieval is the act of getting information out of storage and into conscious awareness through recall, recognition, and relearning. The idea that information is processed through three memory systems is called the Atkinson-Shiffrin (A-S) model of memory. First, environmental stimuli enter our sensory memory for a period of less than a second to a few seconds. Those stimuli that we notice and pay attention to then move into short-term memory (also called working memory). According to the A-S model, if we rehearse this information, then it moves into long-term memory for permanent storage. Other models like that of Baddeley and Hitch suggest there is more of a feedback loop between short-term memory and long-term memory. Long-term memory has a practically limitless storage capacity and is

divided into implicit and explicit memory. Finally, retrieval is the act of getting memories out of storage and back into conscious awareness. This is done through recall, recognition, and relearning.

Please complete this short survey to provide feedback on this chapter: http://bit.ly/TheoriesonMemory

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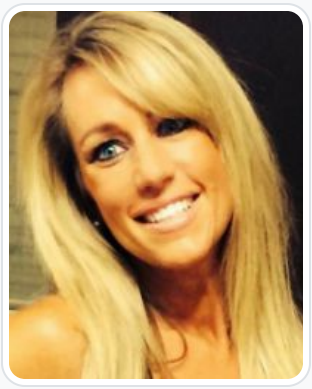

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10

Intelligence

What is Intelligence?

Rose Spielman, Kathryn Dumper, William Jenkins, Arlene Lacombe, Marilyn Lovett, & Marion Perlmutter

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Spielman, R. M., Dumper, K., Jenkins, W., Lacombe, A., Lovett, M., & Perlmutter, M. (n.d.). What are intelligence and creativity? In Psychology. Retrieved from https://edtechbooks.org/-ls

The way that researchers have defined the concept of intelligence has been modified many times since the birth of psychology. British psychologist Charles Spearman believed intelligence consisted of one general factor, called *g*, which could be measured and compared among individuals. Spearman focused on the commonalities among various intellectual abilities and de-emphasized what made each unique. Long before modern psychology developed, however, ancient philosophers, such as Aristotle, held a similar view (Cianciolo & Sternberg, 2004).

Other psychologists believe that instead of a single factor, intelligence is a collection of distinct abilities. In the 1940s, Raymond Cattell proposed a theory of intelligence that divided general intelligence into two components: crystallized intelligence and fluid intelligence (Cattell, 1963). Crystallized intelligence is characterized as acquired knowledge and the ability to retrieve it. When you learn, remember, and recall information, you are using crystallized intelligence. You use crystallized intelligence all the time in your coursework by demonstrating that you have mastered the information covered in the course. Fluid intelligence encompasses the ability to see complex relationships and solve problems. Navigating your way home after being detoured onto an unfamiliar route because of road construction would draw upon your fluid intelligence. Fluid intelligence helps you tackle complex, abstract challenges in your daily life, whereas crystallized intelligence helps you overcome concrete, straightforward problems (Cattell, 1963).

Other theorists and psychologists believe that intelligence should be defined in more practical terms. For example, what types of behaviors help you get ahead in life? Which skills promote success? Think about this for a moment. Being able to recite all 44 presidents of the United States in order is an excellent party trick, but will knowing this make you a better person?

Robert Sternberg developed another theory of intelligence, which he titled the triarchic theory of intelligence because it sees intelligence as comprised of three parts (Sternberg, 1988): practical, creative, and analytical intelligence (Figure 1).

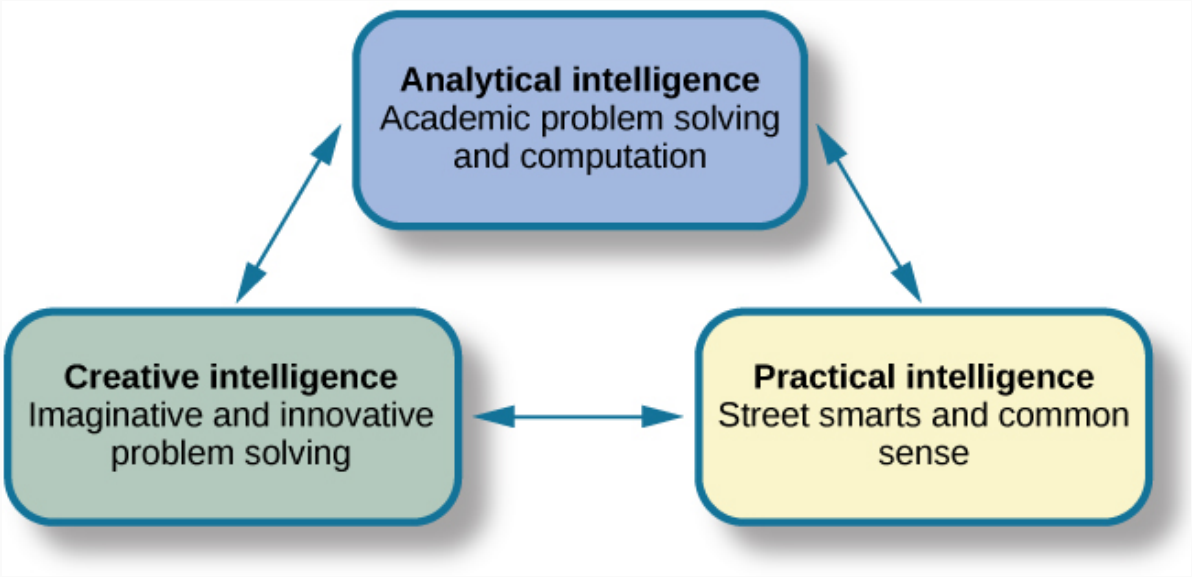

Figure 1. Sternberg's theory identifies three types of intelligence: practical, creative, and analytical. Included in original OpenStax chapter.

Practical intelligence, as proposed by Sternberg, is sometimes compared to "street smarts." Being practical means you find solutions that work in your everyday life by applying knowledge based on your experiences. This type of intelligence appears to be separate from traditional understanding of IQ; individuals who score high in practical intelligence may or may not have comparable scores in creative and analytical intelligence (Sternberg, 1988).

This story about the 2007 Virginia Tech shootings illustrates both high and low practical intelligences. During the incident, one student left her class to go get a soda in an adjacent building. She planned to return to class, but when she returned to her building after getting her soda, she saw that the door she used to leave was now chained shut from the inside. Instead of thinking about why there was a chain around the door handles, she went to her class's window and crawled back into the room. She thus potentially exposed herself to the gunman. Thankfully, she was not shot. On the other hand, a pair of students was walking on campus when they heard gunshots nearby. One friend said, "Let's go check it out and see what is going on." The other student said, "No way, we need to run away from the gunshots." They did just that. As a result, both avoided harm. The student who crawled through the window demonstrated some creative intelligence but did not use common sense. She would have low practical intelligence. The student who encouraged his friend to run away from the sound of gunshots would have much higher practical intelligence.

Analytical intelligence is closely aligned with academic problem solving and computations. Sternberg says that analytical intelligence is demonstrated by an ability to analyze, evaluate, judge, compare, and contrast. When reading a classic novel for literature class, for example, it is usually necessary to compare the motives of the main characters of the book or analyze the historical context of the story. In a science course such as anatomy, you must study the processes by which the body uses various minerals in different human systems. In developing an understanding of this topic, you are using analytical intelligence. When solving a challenging math problem, you would apply analytical intelligence to analyze different aspects of the problem and then solve it section by section.

Creative intelligence is marked by inventing or imagining a solution to a problem or situation. Creativity in this realm can include finding a novel solution to an unexpected problem or producing a beautiful work of art or a well-developed short story. Imagine for a moment that you are camping in the woods with some friends and realize that you've forgotten your camp coffee pot. The person in your group who figures out a way to successfully brew coffee for everyone would be credited as having higher creative intelligence.

Multiple Intelligences Theory was developed by Howard Gardner, a Harvard psychologist and former student of Erik Erikson. Gardner's theory, which has been refined for more than 30 years, is a more recent development among theories of intelligence. In Gardner's theory, each person possesses at least eight intelligences. Among these eight intelligences, a person typically excels in some and falters in others (Gardner, 1983). Figure 2 describes each type of intelligence.

Figure 2. Multiple intelligences theory proposed by Gardner. Image from Sajaganesandip on Wikimedia Commons and licensed CC-By, Share Alike

Gardner's theory is relatively new and needs additional research to better establish empirical support. At the same time, his ideas challenge the traditional idea of intelligence to include a wider variety of abilities, although it has been suggested that Gardner simply relabeled what other theorists called "cognitive styles" as "intelligences" (Morgan, 1996). Furthermore, developing traditional measures of Gardner's intelligences is extremely difficult (Furnham, 2009; Gardner & Moran, 2006; Klein, 1997).

Gardner's inter- and intrapersonal intelligences are often combined into a single type: emotional intelligence. Emotional intelligence encompasses the ability to understand the emotions of yourself and others, show empathy, understand social relationships and cues, and regulate your own emotions and respond in culturally appropriate ways (Parker, Saklofske, & Stough, 2009). People with high emotional intelligence typically have well-developed social skills. Some

researchers, including Daniel Goleman, the author of *Emotional Intelligence: Why It Can Matter More than IQ*, argue that emotional intelligence is a better predictor of success than traditional intelligence (Goleman, 1995). However, emotional intelligence has been widely debated, with researchers pointing out inconsistencies in how it is defined and described, as well as questioning results of studies on a subject that is difficult to measure and study empirically (Locke, 2005; Mayer, Salovey, & Caruso, 2004).

Intelligence can also have different meanings and values in different cultures. If you live on a small island, where most people get their food by fishing from boats, it would be important to know how to fish and how to repair a boat. If you were an exceptional angler, your peers would probably consider you intelligent. If you were also skilled at repairing boats, your intelligence might be known across the whole island. Think about your own family's culture. What values are important for Latino families? Italian families? In Irish families, hospitality and telling an entertaining story are marks of the culture. If you are a skilled storyteller, other members of Irish culture are likely to consider you intelligent.

Some cultures place a high value on working together as a collective. In these cultures, the importance of the group supersedes the importance of individual achievement. When you visit such a culture, how well you relate to the values of that culture exemplifies your cultural intelligence, sometimes referred to as cultural competence.

Application Exercises

- Some argue "that emotional intelligence is a better predictor of success than traditional intelligence." Discuss whether you agree and/or disagree with this statement, and support why you feel this way.
- What intelligence theory did you find most compelling? Why?

Please complete this short survey to provide feedback on this chapter: http://bit.ly/IntelligenceTheory

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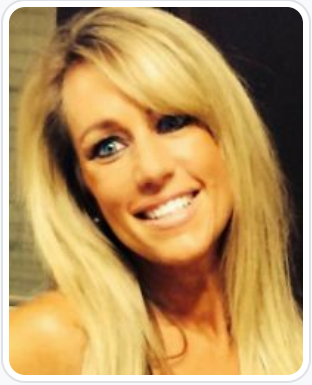

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11

Behaviorism, Cognitivism, Constructivism

Comparing Critical Features From an Instructional Design Perspective

Peggy A. Ertmer & Timothy Newby

Editor's Note

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Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 26*(2), 43-71.

The need for a bridge between basic learning research and educational practice has long been discussed. To ensure a strong connection between these two areas, Dewey (cited in Reigeluth, 1983) called for the creation and development of a “linking science”; Tyler (1978) a “middleman position”; and Lynch (1945) for employing an “engineering analogy” as an aid for translating theory into practice. In each case, the respective author highlighted the information and potential contributions of available learning theories, the pressing problems faced by those dealing with practical learning issues, and a general lack of using the former to facilitate solutions for the latter. The value of such a bridging function would be its ability to translate relevant aspects of the learning theories into optimal instructional actions. As described by Reigeluth (1983, p. 5), the field of Instructional Design performs this role.

Instructional designers have been charged with “translating principles of learning and instruction into specifications for instructional materials and activities” (Smith & Ragan, 1993, p. 12). To achieve this goal, two sets of skills and knowledge are needed. First, the designer must understand the position of the practitioner. In this regard, the following questions would be relevant: What are the situational and contextual constraints of the application? What is the degree of individual differences among the learners? What form of solutions will or will not be accepted by the learners as well as by those actually teaching the materials? The designer must have the ability to diagnose and analyze practical learning problems. Just as a doctor cannot prescribe an effective remedy without a proper diagnosis, the instructional designer cannot properly recommend an effective prescriptive solution without an accurate analysis of the instructional problem.

In addition to understanding and analyzing the problem, a second core of knowledge and skills is needed to "bridge" or "link" application with research–that of understanding the potential sources of solutions (i.e., the theories of human learning). Through this understanding, a proper prescriptive solution can be matched with a given diagnosed problem. The critical link, therefore, is not between the design of instruction and an autonomous body of knowledge about instructional phenomena, but between instructional design issues and the theories of human learning.

Why this emphasis on learning theory and research? First, learning theories are a source of verified instructional strategies, tactics, and techniques. Knowledge of a variety of such strategies is critical when attempting to select an effective prescription for overcoming a given instructional problem. Second, learning theories provide the foundation for intelligent and reasoned strategy selection. Designers must have an adequate repertoire of strategies available, and possess the knowledge of when and why to employ each. This knowledge depends on the designer's ability to match the demands of the task with an instructional strategy that helps the learner. Third, integration of the selected strategy within the instructional context is of critical importance. Learning theories and research often provide information about relationships among instructional components and the design of instruction, indicating how specific techniques/strategies might best fit within a given context and with specific learners (Keller, 1979). Finally, the ultimate role of a theory is to allow for reliable prediction (Richey, 1986). Effective solutions to practical instructional problems are often constrained by limited time and resources. It is paramount that those strategies selected and implemented have the highest chance for success. As suggested by Warries (1990), a selection based on strong research is much more reliable than one based on "instructional phenomena."

The task of translating learning theory into practical applications would be greatly simplified if the learning process were relatively simple and straightforward. Unfortunately, this is not the case. Learning is a complex process that has generated numerous interpretations and theories of how it is effectively accomplished. Of these many theories, which should receive the attention of the instructional designer? Is it better to choose one theory when designing instruction or to draw ideas from different theories? This article presents three distinct perspectives of the learning process (behavioral, cognitive, and constructivist) and although each has many unique features, it is our belief that each still describes the same phenomena (learning). In selecting the theory whose associated instructional strategies offers the optimal means for achieving desired outcomes, the degree of cognitive processing required of the learner by the specific task appears to be a critical factor. Therefore, as emphasized by Snelbecker (1983), individuals addressing practical learning problems cannot afford the "luxury of restricting themselves to only one theoretical position… [They] are urged to examine each of the basic science theories which have been developed by psychologists in the study of learning and to select those principles and conceptions which seem to be of value for one's particular educational situation' (p. 8).

If knowledge of the various learning theories is so important for instructional designers, to what degree are they emphasized and promoted? As reported by Johnson (1992), less than two percent of the courses offered in university curricula in the general area of educational technology emphasize "theory" as one of their key concepts. It appears that the real benefits of theoretical knowledge are, at present, not being realized. This article is an attempt to "fill in some of the gaps" that may exist in our knowledge of modern learning theories. The main intent is to provide designers with some familiarity with three relevant positions on learning (behavioral, cognitive, and constructivist) which should provide a more structured foundation for planning and conducting instructional design activities. The idea is that if we understand some of the deep principles of the theories of learning, we can extrapolate to the particulars as needed. As Bruner (1971) states, "You don't need to encounter everything in nature in order to know nature" (p. 18). A basic understanding of the learning theories can provide you with a "canny strategy whereby you could know a great deal about a lot of things while keeping very little in mind" (p. 18).

It is expected that after reading this article, instructional designers and educational practitioners should be better informed "consumers"of the strategies suggested by each viewpoint. The concise information presented here can serve as an initial base of knowledge for making important decisions regarding instructional objectives and strategies.

Learning Defined

Learning has been defined in numerous ways by many different theorists, researchers and educational practitioners. Although universal agreement on any single definition is nonexistent, many definitions employ common elements. The following definition by Shuell (as interpreted by Schunk, 1991) incorporates these main ideas: “Learning is an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience” (p. 2).

Undoubtedly, some learning theorists will disagree on the definition of learning presented here. However, it is not the definition itself that separates a given theory from the rest. The major differences among theories lie more in interpretation than they do in definition. These differences revolve around a number of key issues that ultimately delineate the instructional prescriptions that flow from each theoretical perspective. Schunk (1991) lists five definitive questions that serve to distinguish each learning theory from the others:

1. How does learning occur?
2. Which factors influence learning?
3. What is the role of memory?
4. How does transfer occur? and
5. What types of learning are best explained by the theory?

Expanding on this original list, we have included two additional questions important to the instructional designer:

6. What basic assumptions/principles of this theory are relevant to instructional design? and
7. How should instruction be structured to facilitate learning?

In this article, each of these questions is answered from three distinct viewpoints: behaviorism, cognitivism, and constructivism. Although learning theories typically are divided into two categories–behavioral and cognitive–a third category, constructive, is added here because of its recent emphasis in the instructional design literature (e.g., Bednar, Cunningham, Duffy, & Perry, 1991; Duffy & Jonassen, 1991; Jonassen, 1991b; Winn, 1991). In many ways these viewpoints overlap; yet they are distinctive enough to be treated as separate approaches to understanding and describing learning. These three particular positions were chosen because of their importance, both historically and currently, to the field of instructional design. It is hoped that the answers to the first five questions will provide the reader with a basic understanding of how these viewpoints differ. The answers to the last two questions will translate these differences into practical suggestions and recommendations for the application of these principles in the design of instruction.

These seven questions provide the basis for the article’s structure. For each of the three theoretical positions, the questions are addressed and an example is given to illustrate the application of that perspective. It is expected that this approach will enable the reader to compare and contrast the different viewpoints on each of the seven issues.

As is common in any attempt to compare and contrast similar products, processes, or ideas, differences are emphasized in order to make distinctions clear. This is not to suggest that there are no similarities among these viewpoints or that there are no overlapping features. In fact, different learning theories will often prescribe the same instructional methods for the same situations (only with different terminology and possibly with different intentions). This article outlines the major differences between the three positions in an attempt to facilitate comparison. It is our hope that the reader will gain greater insight into what each viewpoint offers in terms of the design and presentation of materials, as well as the types of learning activities that might be prescribed.

Historical Foundations

Current learning theories have roots that extend far into the past. The problems with which today’s theorists and researchers grapple and struggle are not new but simply variations on a timeless theme: Where does knowledge come

from and how do people come to know? Two opposing positions on the origins of knowledge-empiricism and rationalism have existed for centuries and are still evident, to varying degrees, in the learning theories of today. A brief description of these views is included here as a background for comparing the "modern" learning viewpoints of behaviorism, cognitivism, and constructivism.

Empiricism is the view that experience is the primary source of knowledge (Schunk, 1991). That is, organisms are born with basically no knowledge and anything learned is gained through interactions and associations with the environment. Beginning with Aristotle (384-322 B.C.), empiricists have espoused the view that knowledge is derived from sensory impressions. Those impressions, when associated contiguously in time and/or space, can be hooked together to form complex ideas. For example, the complex idea of a tree, as illustrated by Hulse, Egeth, and Deese (1980), can be built from the less complex ideas of branches and leaves, which in turn are built from the ideas of wood and fiber, which are built from basic sensations such as greenness, woody odor, and so forth. From this perspective, critical instructional design issues focus on how to manipulate the environment in order to improve and ensure the occurrence of proper associations.

Rationalism is the view that knowledge derives from reason without the aid of the senses (Schunk, 1991). This fundamental belief in the distinction between mind and matter originated with Plato (c. 427-347 B.C.), and is reflected in the viewpoint that humans learn by recalling or "discovering" what already exists in the mind. For example, the direct experience with a tree during one's lifetime simply serves to reveal that which is already in the mind. The "real" nature of the tree (greenness, woodiness, and other characteristics) becomes known, not through the experience, but through a reflection on one's idea about the given instance of a tree. Although later rationalists differed on some of Plato's other ideas, the central belief remained the same: that knowledge arises through the mind. From this perspective, instructional design issues focus on how best to structure new information in order to facilitate (1) the learners' encoding of this new information, as well as (2) the recalling of that which is already known.

The empiricist, or associationist, mindset provided the framework for many learning theories during the first half of this century, and it was against this background that behaviorism became the leading psychological viewpoint (Schunk, 1991). Because behaviorism was dominant when instructional theory was initiated (around 1950), the instructional design (ID) technology that arose alongside it was naturally influenced by many of its basic assumptions and characteristics. Since ID has its roots in behavioral theory, it seems appropriate that we turn our attention to behaviorism first.

Behaviorism

How Does Learning Occur?

Behaviorism equates learning with changes in either the form or frequency of observable performance. Learning is accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus. For example, when presented with a math flashcard showing the equation "2 + 4 = ?" the learner replies with the answer of "6." The equation is the stimulus and the proper answer is the associated response. The key elements are the stimulus, the response, and the association between the two. Of primary concern is how the association between the stimulus and response is made, strengthened, and maintained.

Behaviorism focuses on the importance of the consequences of those performances and contends that responses that are followed by reinforcement are more likely to recur in the future. No attempt is made to determine the structure of a student's knowledge nor to assess which mental processes it is necessary for them to use (Winn, 1990). The learner is characterized as being reactive to conditions in the environment as opposed to taking an active role in discovering the environment.

Which Factors Influence Learning?

Although both learner and environmental factors are considered important by behaviorists, environmental conditions receive the greatest emphasis. Behaviorists assess the learners to determine at what point to begin instruction as well as to determine which reinforcers are most effective for a particular student. The most critical factor, however, is the arrangement of stimuli and consequences within the environment.

What is the Role of Memory?

Memory, as commonly defined by the layman, is not typically addressed by behaviorists. Although the acquisition of "habits" is discussed, little attention is given as to how these habits are stored or recalled for future use. Forgetting is attributed to the "nonuse" of a response over time. The use of periodic practice or review serves to maintain a learner's readiness to respond (Schunk, 1991).

How Does Transfer Occur?

Transfer refers to the application of learned knowledge in new ways or situations, as well as to how prior learning affects new learning. In behavioral learning theories, transfer is a result of generalization. Situations involving identical or similar features allow behaviors to transfer across common elements. For example, the student who has learned to recognize and classify elm trees demonstrates transfer when (s)he classifies maple trees using the same process. The similarities between the elm and maple trees allow the learner to apply the previous elm tree classification learning experience to the maple tree classification task.

What Types of Learning Are Best Explained by This Position?

Behaviorists attempt to prescribe strategies that are most useful for building and strengthening stimulus-response associations (Winn, 1990), including the use of instructional cues, practice, and reinforcement. These prescriptions have generally been proven reliable and effective in facilitating learning that involves discriminations (recalling facts), generalizations (defining and illustrating concepts), associations (applying explanations), and chaining (automatically performing a specified procedure). However, it is generally agreed that behavioral principles cannot adequately explain the acquisition of higher level skills or those that require a greater depth of processing (e.g., language development, problem solving, inference generating, critical thinking) (Schunk, 1991).

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

Many of the basic assumptions and characteristics of behaviorism are embedded in current instructional design practices. Behaviorism was used as the basis for designing many of the early audio-visual materials and gave rise to many related teaching strategies, such as Skinner's teaching machines and programmed texts. More recent examples include principles utilized within computer-assisted instruction (CAI) and mastery learning.

Specific assumptions or principles that have direct relevance to instructional design include the following (possible current ID applications are listed in italics and brackets following the listed principle):

1. An emphasis on producing observable and measurable outcomes in students [behavioral objectives, task analysis, criterion-referenced assessment]
2. Pre-assessment of students to determine where instruction should begin [learner analysis]
3. Emphasis on mastering early steps before progressing to more complex levels of performance [sequencing of instructional presentation, mastery learning]
4. Use of reinforcement to impact performance [tangible rewards, informative feedback]
5. Use of cues, shaping and practice to ensure a strong stimulus-response association [simple to complex sequencing of practice, use of prompts]

How Should Instruction Be Structured?

The goal of instruction for the behaviorist is to elicit the desired response from the learner who is presented with a target stimulus. To accomplish this, the learner must know how to execute the proper response, as well as the conditions under which that response should be made. Therefore, instruction is structured around the presentation of the target stimulus and the provision of opportunities for the learner to practice making the proper response. To facilitate the linking of stimulus-response pairs, instruction frequently uses cues (to initially prompt the delivery of the response) and reinforcement (to strengthen correct responding in the presence of the target stimulus).

Behavioral theories imply that the job of the teacher/designer is to (1) determine which cues can elicit the desired responses; (2) arrange practice situations in which prompts are paired with the target stimuli that initially have no eliciting power but which will be expected to elicit the responses in the "natural" (performance) setting; and (3) arrange environmental conditions so that students can make the correct responses in the presence of those target stimuli and receive reinforcement for those responses (Gropper, 1987).

For example, a newly-hired manager of human resources may be expected to organize a meeting agenda according to the company's specific format. The target stimulus (the verbal command "to format a meeting agenda") does not initially elicit the correct response nor does the new manager have the capability to make the correct response. However, with the repeated presentation of cues (e.g., completed templates of past agendas, blank templates arranged in standard format) paired with the verbal command stimulus, the manager begins to make the appropriate responses. Although the initial responses may not be in the final proper form, repeated practice and reinforcement shape the response until it is correctly executed. Finally, learning is demonstrated when, upon the command to format a meeting agenda, the manager reliably organizes the agenda according to company standards and does so without the use of previous examples or models.

Cognitivism

In the late 1950's, learning theory began to make a shift away from the use of behavioral models to an approach that relied on learning theories and models from the cognitive sciences. Psychologists and educators began to de-emphasize a concern with overt, observable behavior and stressed instead more complex cognitive processes such as thinking, problem solving, language, concept formation and information processing (Snelbecker, 1983). Within the past decade, a number of authors in the field of instructional design have openly and consciously rejected many of ID's traditional behavioristic assumptions in favor of a new set of psychological assumptions about learning drawn from the cognitive sciences. Whether viewed as an open revolution or simply a gradual evolutionary process, there seems to be the general acknowledgment that cognitive theory has moved to the forefront of current learning theories (Bednar et al., 1991). This shift from a behavioral orientation (where the emphasis is on promoting a student's overt performance by the manipulation of stimulus material) to a cognitive orientation (where the emphasis is on promoting mental processing) has created a similar shift from procedures for manipulating the materials to be presented by an instructional system to procedures for directing student processing and interaction with the instructional design system (Merrill, Kowalis, & Wilson, 1981).

How Does Learning Occur?

Cognitive theories stress the acquisition of knowledge and internal mental structures and, as such, are closer to the rationalist end of the epistemology continuum (Bower & Hilgard, 1981). Learning is equated with discrete changes between states of knowledge rather than with changes in the probability of response. Cognitive theories focus on the conceptualization of students' learning processes and address the issues of how information is received, organized, stored, and retrieved by the mind. Learning is concerned not so much with what learners do but with what they know and how they come to acquire it (Jonassen, 1991b). Knowledge acquisition is described as a mental activity that entails internal coding and structuring by the learner. The learner is viewed as a very active participant in the learning process.

Which Factors Influence Learning?

Cognitivism, like behaviorism, emphasizes the role that environmental conditions play in facilitating learning. Instructional explanations, demonstrations, illustrative examples and matched non-examples are all considered to be instrumental in guiding student learning. Similarly, emphasis is placed on the role of practice with corrective feedback. Up to this point, little difference can be detected between these two theories. However, the “active” nature of the learner is perceived quite differently. The cognitive approach focuses on the mental activities of the learner that lead up to a response and acknowledges the processes of mental planning, goal-setting, and organizational strategies (Shuell, 1986). Cognitive theories contend that environmental “cues” and instructional components alone cannot account for all the learning that results from an instructional situation. Additional key elements include the way that learners attend to, code, transform, rehearse, store and retrieve information. Learners’ thoughts, beliefs, attitudes, and values are also considered to be influential in the learning process (Winne, 1985). The real focus of the cognitive approach is on changing the learner by encouraging him/her to use appropriate learning strategies.

What is the Role of Memory?

As indicated above, memory is given a prominent role in the learning process. Learning results when information is stored in memory in an organized, meaningful manner. Teachers/designers are responsible for assisting learners in organizing that information in some optimal way. Designers use techniques such as advance organizers, analogies, hierarchical relationships, and matrices to help learners relate new information to prior knowledge. Forgetting is the inability to retrieve information from memory because of interference, memory loss, or missing or inadequate cues needed to access information.

How Does Transfer Occur?

According to cognitive theories, transfer is a function of how information is stored in memory (Schunk, 1991). When a learner understands how to apply knowledge in different contexts, then transfer has occurred. Understanding is seen as being composed of a knowledge base in the form of rules, concepts, and discriminations (Duffy & Jonassen, 1991). Prior knowledge is used to establish boundary constraints for identifying the similarities and differences of novel information. Not only must the knowledge itself be stored in memory but the uses of that knowledge as well. Specific instructional or real-world events will trigger particular responses, but the learner must believe that the knowledge is useful in a given situation before he will activate it.

What Types of Learning Are Best Explained by This Position?

Because of the emphasis on mental structures, cognitive theories are usually considered more appropriate for explaining complex forms of learning (reasoning, problem-solving, information-processing) than are those of a more behavioral perspective (Schunk, 1991). However, it is important to indicate at this point that the actual goal of instruction for both of these viewpoints is often the same: to communicate or transfer knowledge to the students in the most efficient, effective manner possible (Bednar et al., 1991). Two techniques used by both camps in achieving this effectiveness and efficiency of knowledge transfer are simplification and standardization. That is, knowledge can be analyzed, decomposed, and simplified into basic building blocks. Knowledge transfer is expedited if irrelevant information is eliminated. For example, trainees attending a workshop on effective management skills would be presented with information that is “sized” and “chunked” in such a way that they can assimilate and/or accommodate the new information as quickly and as easily as possible. Behaviorists would focus on the design of the environment to optimize that transfer, while cognitivists would stress efficient processing strategies.

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

Many of the instructional strategies advocated and utilized by cognitivists are also emphasized by behaviorists, yet usually for different reasons. An obvious commonality is the use of feedback. A behaviorist uses feedback

(reinforcement) to modify behavior in the desired direction, while cognitivists make use of feedback (knowledge of results) to guide and support accurate mental connections (Thompson, Simonson, & Hargrave, 1992).

Learner and task analyses are also critical to both cognitivists and behaviorists, but once again, for different reasons. Cognitivists look at the learner to determine his/her predisposition to learning (i.e., How does the learner activate, maintain, and direct his/her learning?) (Thompson et al., 1992). Additionally, cognitivists examine the learner to determine how to design instruction so that it can be readily assimilated (i.e., What are the learner's existing mental structures?). In contrast, the behaviorists look at learners to determine where the lesson should begin (i.e., At what level are they currently performing successfully?) and which reinforcers should be most effective (i.e., What consequences are most desired by the learner?).

Specific assumptions or principles that have direct relevance to instructional design include the following (possible current ID applications are listed in italics and brackets following the listed principle):

1. Emphasis on the active involvement of the learner in the learning process [learner control, metacognitive training (e.g., self-planning, monitoring, and revising techniques)]
2. Use of hierarchical analyses to identify and illustrate prerequisite relationships [cognitive task analysis procedures]
3. Emphasis on structuring, organizing, and sequencing information to facilitate optimal processing [use of cognitive strategies such as outlining, summaries, synthesizers, advance organizers, etc.]
4. Creation of learning environments that allow and encourage students to make connections with previously learned material [recall of prerequisite skills; use of relevant examples, analogies]

How Should Instruction Be Structured?

Behavioral theories imply that teachers ought to arrange environmental conditions so that students respond properly to presented stimuli. Cognitive theories emphasize making knowledge meaningful and helping learners organize and relate new information to existing knowledge in memory. Instruction must be based on a student's existing mental structures, or schema, to be effective. It should organize information in such a manner that learners are able to connect new information with existing knowledge in some meaningful way. Analogies and metaphors are examples of this type of cognitive strategy. For example, instructional design textbooks frequently draw an analogy between the familiar architect's profession and the unfamiliar instructional design profession to help the novice learner conceptualize, organize and retain the major duties and functions of an instructional designer (e.g. Reigeluth, 1983, p. 7). Other cognitive strategies may include the use of framing, outlining, mnemonics, concept mapping, advance organizers and so forth (West, Farmer, & Wolff, 1991).

Such cognitive emphases imply that major tasks of the teacher/designer include (1) understanding that individuals bring various learning experiences to the learning situation which can impact learning outcomes; (2) determining the most effective manner in which to organize and structure new information to tap the learners' previously acquired knowledge, abilities, and experiences; and (3) arranging practice with feedback so that the new information is effectively and efficiently assimilated and/or accommodated within the learner's cognitive structure (Stepich & Newby, 1988).

Consider the following example of a learning situation utilizing a cognitive approach: A manager in the training department of a large corporation had been asked to teach a new intern to complete a cost-benefit analysis for an upcoming development project. In this case, it is assumed that the intern has no previous experience with cost-benefit analysis in a business setting. However, by relating this new task to highly similar procedures with which the intern has had more experience, the manager can facilitate a smooth and efficient assimilation of this new procedure into memory. These familiar procedures may include the process by which the individual allocates his monthly paycheck, how (s)he makes a buy/no-buy decision regarding the purchase of a luxury item, or even how one's weekend spending activities might be determined and prioritized. The procedures for such activities may not exactly match those of the cost-benefit analysis, but the similarity between the activities allows for the unfamiliar information to be put within a familiar context. Thus processing requirements are reduced and the potential effectiveness of recall cues is increased.

Constructivism

The philosophical assumptions underlying both the behavioral and cognitive theories are primarily objectivistic; that is: the world is real, external to the learner. The goal of instruction is to map the structure of the world onto the learner (Jonassen, 1991b). A number of contemporary cognitive theorists have begun to question this basic objectivistic assumption and are starting to adopt a more constructivist approach to learning and understanding: knowledge "is a function of how the individual creates meaning from his or her own experiences" (p.10). Constructivism is not a totally new approach to learning. Like most other learning theories, constructivism has multiple roots in the philosophical and psychological viewpoints of this century, specifically in the works of Piaget, Bruner, and Goodman (Perkins, 1991). In recent years, however, constructivism has become a "hot" issue as it has begun to receive increased attention in a number of different disciplines, including instructional design (Bednar et al., 1991).

How Does Learning Occur?

Constructivism is a theory that equates learning with creating meaning from experience (Bednar et al., 1991). Even though constructivism is considered to be a branch of cognitivism (both conceive of learning as a mental activity), it distinguishes itself from traditional cognitive theories in a number of ways. Most cognitive psychologists think of the mind as a reference tool to the real world; constructivists believe that the mind filters input from the world to produce its own unique reality (Jonassen, 1991a). Like with the rationalists of Plato's time, the mind is believed to be the source of all meaning, yet like the empiricists, individual, direct experiences with the environment are considered critical. Constructivism crosses both categories by emphasizing the interaction between these two variables.

Constructivists do not share with cognitivists and behaviorists the belief that knowledge is mind-independent and can be "mapped" onto a learner. Constructivists do not deny the existence of the real world but contend that what we know of the world stems from our own interpretations of our experiences. Humans create meaning as opposed to acquiring it. Since there are many possible meanings to glean from any experience, we cannot achieve a predetermined, "correct" meaning. Learners do not transfer knowledge from the external world into their memories; rather they build personal interpretations of the world based on individual experiences and interactions. Thus, the internal representation of knowledge is constantly open to change; there is not an objective reality that learners strive to know. Knowledge emerges in contexts within which it is relevant. Therefore, in order to understand the learning which has taken place within an individual, the actual experience must be examined (Bednar et al., 1991).

Which Factors Influence Learning?

Both learner and environmental factors are critical to the constructivist, as it is the specific interaction between these two variables that creates knowledge. Constructivists argue that behavior is situationally determined (Jonassen, 1991a). Just as the learning of new vocabulary words is enhanced by exposure and subsequent interaction with those words in context (as opposed to learning their meanings from a dictionary), likewise it is essential that content knowledge be embedded in the situation in which it is used. Brown, Collins, and Duguid (1989) suggest that situations actually co-produce knowledge (along with cognition) through activity. Every action is viewed as "an interpretation of the current situation based on an entire history of previous interactions" (Clancey, 1986). Just as shades of meanings of given words are constantly changing a learner's "current" understanding of a word, so too will concepts continually evolve with each new use. For this reason, it is critical that learning occur in realistic settings and that the selected learning tasks be relevant to the students' lived experience.

What is the Role of Memory?

The goal of instruction is not to ensure that individuals know particular facts but rather that they elaborate on and interpret information. "Understanding is developed through continued, situated use … and does not crystallize into a categorical definition" that can be called up from memory (Brown et al., 1989, p. 33). As mentioned earlier, a concept will continue to evolve with each new use as new situations, negotiations, and activities recast it in a different, more densely textured form. Therefore, "memory" is always under construction as a cumulative history of interactions. Representations of experiences are not formalized or structured into a single piece of declarative knowledge and then

stored in the head. The emphasis is not on retrieving intact knowledge structures, but on providing learners with the means to create novel and situation-specific understandings by "assembling" prior knowledge from diverse sources appropriate to the problem at hand. For example, the knowledge of "design" activities has to be used by a practitioner in too many different ways for them all to be anticipated in advance. Constructivists emphasize the flexible use of pre-existing knowledge rather than the recall of prepackaged schemas (Spiro, Feltovich, Jacobson, & Coulson, 1991). Mental representations developed through task-engagement are likely to increase the efficiency with which subsequent tasks are performed to the extent that parts of the environment remain the same: "Recurring features of the environment may thus afford recurring sequences of actions" (Brown et al., p. 37). Memory is not a context-independent process.

Clearly the focus of constructivism is on creating cognitive tools which reflect the wisdom of the culture in which they are used as well as the insights and experiences of individuals. There is no need for the mere acquisition of fixed, abstract, self-contained concepts or details. To be successful, meaningful, and lasting, learning must include all three of these crucial factors: activity (practice), concept (knowledge), and culture (context) (Brown et al., 1989).

How Does Transfer Occur?

The constructivist position assumes that transfer can be facilitated by involvement in authentic tasks anchored in meaningful contexts. Since understanding is "indexed" by experience (just as word meanings are tied to specific instances of use), the authenticity of the experience becomes critical to the individual's ability to use ideas (Brown et al., 1989). An essential concept in the constructivist view is that learning always takes place in a context and that the context forms an inexorable link with the knowledge embedded in it (Bednar et al., 1991). Therefore, the goal of instruction is to accurately portray tasks, not to define the structure of learning required to achieve a task. If learning is decontextualized, there is little hope for transfer to occur. One does not learn to use a set of tools simply by following a list of rules. Appropriate and effective use comes from engaging the learner in the actual use of the tools in real-world situations. Thus, the ultimate measure of learning is based on how effective the learner's knowledge structure is in facilitating thinking and performing in the system in which those tools are used.

What Types of Learning Are Best Explained by This Position?

The constructivist view does not accept the assumption that types of learning can be identified independent of the content and the context of learning (Bednar et al., 1991). Constructivists believe that it is impossible to isolate units of information or divide up knowledge domains according to a hierarchical analysis of relationships. Although the emphasis on performance and instruction has proven effective in teaching basic skills in relatively structured knowledge domains, much of what needs to be learned involves advanced knowledge in ill-structured domains. Jonassen (1991a) has described three stages of knowledge acquisition (introductory, advanced, and expert) and argues that constructive learning environments are most effective for the stage of advanced knowledge acquisition, where initial misconceptions and biases acquired during the introductory stage can be discovered, negotiated, and if necessary, modified and/or removed. Jonassen agrees that introductory knowledge acquisition is better supported by more objectivistic approaches (behavioral and/or cognitive) but suggests a transition to constructivistic approaches as learners acquire more knowledge which provides them with the conceptual power needed to deal with complex and ill-structured problems.

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

The constructivist designer specifies instructional methods and strategies that will assist learners in actively exploring complex topics/environments and that will move them into thinking in a given content area as an expert user of that domain might think. Knowledge is not abstract but is linked to the context under study and to the experiences that the participants bring to the context. As such, learners are encouraged to construct their own understandings and then to validate, through social negotiation, these new perspectives. Content is not prespecified; information from many sources is essential. For example, a typical constructivist's goal would not be to teach novice ID students straight facts

about instructional design, but to prepare students to use ID facts as an instructional designer might use them. As such, performance objectives are not related so much to the content as they are to the processes of construction.

Some of the specific strategies utilized by constructivists include situating tasks in real-world contexts, use of cognitive apprenticeships (modeling and coaching a student toward expert performance), presentation of multiple perspectives (collaborative learning to develop and share alternative views), social negotiation (debate, discussion, evidencegiving), use of examples as real "slices of life," reflective awareness, and providing considerable guidance on the use of constructive processes.

The following are several specific assumptions or principles from the constructivist position that have direct relevance for the instructional designer (possible ID applications are listed in italics and brackets following the listed principle):

1. An emphasis on the identification of the context in which the skills will be learned and subsequently applied [anchoring learning in meaningful contexts].
2. An emphasis on learner control and the capability of the learner to manipulate information [actively using what is learned].
3. The need for information to be presented in a variety of different ways [revisiting content at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives].
4. Supporting the use of problem-solving skills that allow learners to go "beyond the information given." [developing pattern-recognition skills, presenting alternative ways of representing problems].
5. Assessment focused on transfer of knowledge and skills [presenting new problems and situations that differ from the conditions of the initial instruction].

How Should Instruction Be Structured?

As one moves along the behaviorist-cognitivist-constructivist continuum, the focus of instruction shifts from teaching to learning, from the passive transfer of facts and routines to the active application of ideas to problems. Both cognitivists and constructivists view the learner as being actively involved in the learning process, yet the constructivists look at the learner as more than just an active processor of information; the learner elaborates upon and interprets the given information (Duffy & Jonassen, 1991). Meaning is created by the learner: learning objectives are not pre-specified nor is instruction predesigned. "The role of instruction in the constructivist view is to show students how to construct knowledge, to promote collaboration with others to show the multiple perspectives that can be brought to bear on a particular problem, and to arrive at self-chosen positions to which they can commit themselves, while realizing the basis of other views with which they may disagree" (Cunningham, 1991, p. 14).

Even though the emphasis is on learner construction, the instructional designer/ teacher's role is still critical (Reigeluth, 1989). Here the tasks of the designer are two-fold: (1) to instruct the student on how to construct meaning, as well as how to effectively monitor, evaluate, and update those constructions; and (2) to align and design experiences for the learner so that authentic, relevant contexts can be experienced.

Although constructivist approaches are used quite frequently in the preparation of lawyers, doctors, architects, and businessmen through the use of apprenticeships and on-the-job training, they are typically not applied in the educational arena (Resnick, 1987). If they were, however, a student placed in the hands of a constructivist would likely be immersed in an "apprenticeship" experience. For example, a novice instructional design student who desires to learn about needs assessment would be placed in a situation that requires such an assessment to be completed. Through the modeling and coaching of experts involved in authentic cases, the novice designer would experience the process embedded in the true context of an actual problem situation. Over time, several additional situations would be experienced by the student, all requiring similar needs assessment abilities. Each experience would serve to build on and adapt that which has been previously experienced and constructed. As the student gained more confidence and experience, (s)he would move into a collaborative phase of learning where discussion becomes crucial. By talking with others (peers, advanced students, professors, and designers), students become better able to articulate their own understandings of the needs assessment process. As they uncover their naive theories, they begin to see such activities in a new light, which guides

them towards conceptual reframing (learning). Students gain familiarity with analysis and action in complex situations and consequently begin to expand their horizons: they encounter relevant books, attend conferences and seminars, discuss issues with other students, and use their knowledge to interpret numerous situations around them (not only related to specific design issues). Not only have the learners been involved in different types of learning as they moved from being novices to "budding experts," but the nature of the learning process has changed as well.

General Discussion

It is apparent that students exposed to the three instructional approaches described in the examples above would gain different competencies. This leads instructors/designers to ask two significant questions: Is there a single "best" approach and is one approach more efficient than the others? Given that learning is a complex, drawn-out process that seems to be strongly influenced by one's prior knowledge, perhaps the best answer to these questions is "it depends." Because learning is influenced by many factors from many sources, the learning process itself is constantly changing, both in nature and diversity, as it progresses (Shuell, 1990). What might be most effective for novice learners encountering a complex body of knowledge for the first time, would not be effective, efficient or stimulating for a learner who is more familiar with the content. Typically, one does not teach facts the same way that concepts or problem-solving are taught; likewise, one teaches differently depending on the proficiency level of the learners involved. Both the instructional strategies employed and the content addressed (in both depth and breadth) would vary based on the level of the learners.

So how does a designer facilitate a proper match between learner, content, and strategies? Consider, first of all, how learners' knowledge changes as they become more familiar with a given content. As people acquire more experience with a given content, they progress along a low-to-high knowledge continuum from 1) being able to recognize and apply the standard rules, facts, and operations of a profession (knowing what), to 2) thinking like a professional to extrapolate from these general rules to particular, problematic cases (knowing how), to 3) developing and testing new forms of understanding and actions when familiar categories and ways of thinking fail (reflection-in-action) (Schon, 1987). In a sense, the points along this continuum mirror the points of the learning theory continuum described earlier. Depending on where the learners "sit" on the continuum in terms of the development of their professional knowledge (knowing what vs. knowing how vs. reflection-in-action), the most appropriate instructional approach for advancing the learners' knowledge at that particular level would be the one advocated by the theory that corresponds to that point on the continuum. That is, a behavioral approach can effectively facilitate mastery of the content of a profession (knowing what); cognitive strategies are useful in teaching problem-solving tactics where defined facts and rules are applied in unfamiliar situations (knowing how); and constructivist strategies are especially suited to dealing with ill-defined problems through reflection-in-action.

A second consideration depends upon the requirements of the task to be learned. Based on the level of cognitive processing required, strategies from different theoretical perspectives may be needed. For example, tasks requiring a low degree of processing (e.g., basic paired associations, discriminations, rote memorization) seem to be facilitated by strategies most frequently associated with a behavioral outlook (e.g., stimulus-response, contiguity of feedback/reinforcement). Tasks requiring an increased level of processing (e.g., classifications, rule or procedural executions) are primarily associated with strategies having a stronger cognitive emphasis (e.g., schematic organization, analogical reasoning, algorithmic problem solving). Tasks demanding high levels of processing (e.g., heuristic problem solving, personal selection and monitoring of cognitive strategies) are frequently best learned with strategies advanced by the constructivist perspective (e.g., situated learning, cognitive apprenticeships, social negotiation).

We believe that the critical question instructional designers must ask is not "Which is the best theory?" but "Which theory is the most effective in fostering mastery of specific tasks by specific learners?" Prior to strategy(ies) selection, consideration must be made of both the learners and the task. An attempt is made in Figure 1 to depict these two continua (learners' level of knowledge and cognitive processing demands) and to illustrate the degree to which strategies offered by each of the theoretical perspectives appear applicable. The figure is useful in demonstrating: (a) that the strategies promoted by the different perspectives overlap in certain instances (i.e., one strategy may be relevant

for each of the different perspectives, given the proper amount of prior knowledge and the corresponding amount of cognitive processing), and (b) that strategies are concentrated along different points of the continua due to the unique focus of each of the learning theories. This means that when integrating any strategies into the instructional design process, the nature of the learning task (i.e., the level of cognitive processing required) and the proficiency level of the learners involved must both be considered before selecting one approach over another. Depending on the demands of the task and where the learners are in terms of the content to be delivered/discovered, different strategies based on different theories appear to be necessary. Powerful frameworks for instruction have been developed by designers inspired by each of these perspectives. In fact, successful instructional practices have features that are supported by virtually all three perspectives (e.g., active participation and interaction, practice and feedback).

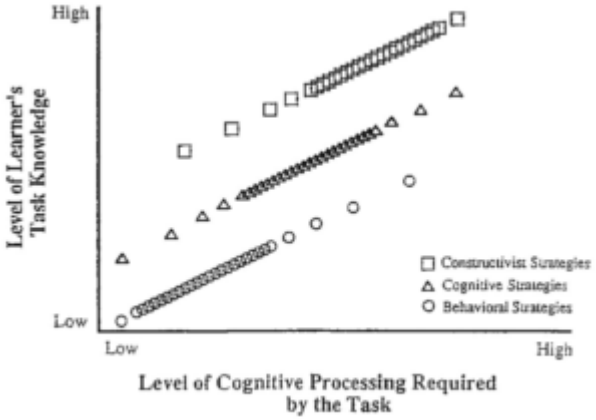

Figure 1. Comparison of the associated instructional strategies of the behavioral, cognitive, and constructivist viewpoints based on the learner's level of task knowledge and the level of cognitive processing required by the task.

For this reason, we have consciously chosen not to advocate one theory over the others, but to stress instead the usefulness of being well versed in each. This is not to suggest that one should work without a theory, but rather that one must be able to intelligently choose, on the basis of information gathered about the learners' present level of competence and the type of learning task, the appropriate methods for achieving optimal instructional outcomes in that situation.

As stated by Smith and Ragan (1993, p. viii): "Reasoned and validated theoretical eclecticism has been a key strength of our field because no single theoretical base provides complete prescriptive principles for the entire design process." Some of the most crucial design tasks involve being able to decide which strategy to use, for what content, for which students, and at what point during the instruction. Knowledge of this sort is an example of conditional knowledge, where "thinking like" a designer becomes a necessary competency. It should be noted however, that to be an eclectic, one must know a lot, not a little, about the theories being combined. A thorough understanding of the learning theories presented above seems to be essential for professional designers who must constantly make decisions for which no design model provides precise rules. Being knowledgeable about each of these theories provides designers with the flexibility needed to be spontaneous and creative when a first attempt doesn't work or when they find themselves limited by time, budget, and/or personnel constraints. The practitioner cannot afford to ignore any theories that might provide practical implications. Given the myriad of potential design situations, the designer's "best" approach may not ever be identical to any previous approach, but will truly "depend upon the context." This type of instructional "cherry-picking" has been termed "systematic eclecticism" and has had a great deal of support in the instructional design literature (Snelbecker, 1989).

In closing, we would like to expand on a quote by P. B. Drucker, (cited in Snelbecker, 1983): "These old controversies have been phonies all along. We need the behaviorist's triad of practice/reinforcement/feedback to enlarge learning and memory. We need purpose, decision, values, understanding–the cognitive categories–lest learning be mere behavioral activities rather than action" (p. 203).

And to this we would add that we also need adaptive learners who are able to function well when optimal conditions do not exist, when situations are unpredictable and task demands change, when the problems are messy and ill-formed and the solutions depend on inventiveness, improvisation, discussion, and social negotiation.

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Additional Reading

An update was published in *Performance Improvement Quarterly* in 2013 by the authors to accompany the 30 year anniversary and republication of the original article. This update adds a strong second part to this article, and you are encouraged to read it here.

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, *26*(2), 43-71.

Application Exercises

- How would the instruction be designed differently by a behaviorist, a cognitivist, and a constructivist? Scenario: A high school social study teacher is planning a class on the Vietnam War.
- Describe an example from your life of when you were taught using each method described in this article: behaviorism, cognitivism, and constructivism.
- Based on your reading, would you consider your current instruction style more behavioralist, cognitivist, or constructivist? Elaborate with your specific mindset and examples.

Please complete this short survey to provide feedback on this chapter: http://bit.ly/3LearningTheories

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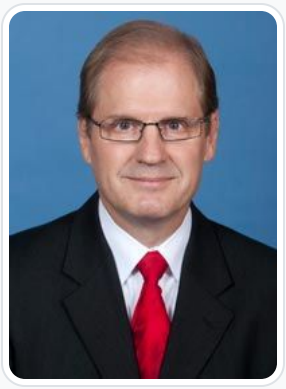

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12

Sociocultural Perspectives of Learning

Drew Polly, Amanda R. Casto, Jessica Norwood, & Bohdana Allman

When considering theories of learning, LIDT professionals should also consider sociocultural perspectives and the role that culture, interaction, and collaboration have on quality learning. Modern social learning theories stem from the work of Russian psychologist Vygotsky, who produced his ideas between 1924 and 1934 as a reaction to existing conflicting approaches in psychology (Kozulin, 1990). Vygotsky's ideas are most recognized for identifying the role social interactions and culture play in the development of higher-order thinking skills, and it is especially valuable for the insights it provides about the "dynamic interdependence of social and individual processes" (John-Steiner & Mahn, 1996, p. 192). Vygotsky's views are often considered primarily as developmental theories, focusing on qualitative changes in behavior over time as attempts to explain unseen processes of development of thought, language, and higher-order thinking skills. Although Vygotsky's intent was mainly to understand higher psychological processes in children, his ideas have many implications and practical applications for learners of all ages.

Interpretations of Vygotsky's and other sociocultural scholars' work have led to diverse perspectives and a variety of new approaches to education. Today, sociocultural theory and related approaches are widely recognized and accepted in psychology and education and are especially valued in the field of applied linguistics because of its underlying notion that language and thought are connected. Sociocultural theory is also becoming increasingly influential in the field of instructional design. In this chapter, we first review some of the fundamental principles of sociocultural theory of learning. We then suggest design implications for learning, teaching, and education in general. Following, we consider how sociocultural theories of learning should influence instructional design.

Fundamental Principles of Sociocultural Perspectives On Learning

Three themes are often identified with Vygotsky's ideas of sociocultural learning: (1) human development and learning originate in social, historical, and cultural interactions, (2) use of psychological tools, particularly language, mediate development of higher mental functions, and (3) learning occurs within the Zone of Proximal Development. While we discuss these ideas separately, they are closely interrelated, non-hierarchical, and connected.

Human development and learning originate in social, historical, and cultural interactions. Vygotsky contended that thinking has social origins, social interactions play a critical role especially in the development of higher order thinking skills, and cognitive development cannot be fully understood without considering the social and historical context within which it is embedded. He explained, "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first between people (interpsychological) and then inside the child (intrapsychological)" (Vygotsky, 1978, p. 57). It is through working with others on a variety of tasks that a learner adopts socially shared experiences and associated effects and acquires useful strategies and knowledge (Scott & Palincsar, 2013).

Rogoff (1990) refers to this process as guided participation, where a learner actively acquires new culturally valuable skills and capabilities through a meaningful, collaborative activity with an assisting, more experienced other. It is critical to notice that these culturally mediated functions are viewed as being embedded in sociocultural activities rather than

being self-contained. Development is a "transformation of participation in a sociocultural activity" not a transmission of discrete cultural knowledge or skills (Matusov, 2015, p. 315). The processes of guided participation reveal the Vygotskian view of cognitive development "as the transformation of socially shared activities into internalized processes," or an act of enculturation, thus rejecting the Cartesian dichotomy between the internal and the external (John-Steiner & Mahn, 1996, p. 192).

This Vygotskian notion of social learning stands in contrast to more popular Piaget's ideas of cognitive development, which assume that development through certain stages is biologically determined, originates in the individual, and precedes cognitive complexity. This difference in assumptions has significant implications to the design and development of learning experiences. If we believe as Piaget did that development precedes learning, then we will make sure that new concepts and problems are not introduced until learners have developed innate capabilities to understand them. On the other hand, if we believe as Vygotsky did that learning drives development and that development occurs as we learn a variety of concepts and principles, recognizing their applicability to new tasks and new situations, then our instructional design will look very different. We will ensure that instructional activities are structured in ways that promote individual student learning and development. We will know that it is the process of learning that enables achievement of higher levels of development, which in turn affects "readiness to learn a new concept" (Miller, 2011, p. 197). In essence:

> *Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and with his peers . . . learning is not development; however, properly organized learning results in mental development and sets in motion a variety of developmental processes that would be impossible apart from learning. Thus learning is a necessary and universal aspect of the process of developing culturally organized, specifically human, psychological functions (Vygotsky, 1978, p. 90).*

Another implication based on Vygotskian views of learning is recognizing that there are individual differences as well as cross-cultural differences in learning and development. As instructional designers, we should be more sensitive to diversity in learners and recognize that a large amount of research has been done on white, middle-class individuals associated with Western tradition, and the resulting understanding of development and learning often incorrectly assumes universality. Recognizing that "ideal thinking and behavior may differ for different cultures" and that "different historical and cultural circumstances may encourage different developmental routes to any given developmental endpoint" may prevent incorrect universalist views of all individuals and allow for environments that value diversity as a resource (Miller, 2011, p. 198).

Use of psychological tools, particularly language, mediate development of higher mental functions. Another important aspect of Vygotsky's views on learning is the significance of language in the learning process. Vygotsky reasoned that social structures determine people's working conditions and interactions with others, which in turn shape their cognition, beliefs, attitudes, and perception of reality and that social and individual work is mediated by tools and signs, or semiotics, such as language, systems of counting, conventional signs, and works of art. He suggested that the use of tools, or semiotic mediation, facilitates co-construction of knowledge and mediates both social and individual functioning. These semiotic means play an important role in development and learning through appropriation, a process of an individual's adopting these socially available psychological tools to assist future independent problem solving (John-Steiner & Mahn, 1996). This means that children and learners do not need to reinvent already existing tools in order to be able to use them. They only need to be introduced to how a particular tool is used, then they can use it across a variety of situations solving new problems (Scott & Palincsar, 2013).

Vygotsky viewed language as the ultimate collection of symbols and tools that emerge within a culture. It is potentially the greatest tool at our disposal, a form of a symbolic mediation that plays two critical roles in development: to communicate with others and to construct meaning.

Learning occurs within the zone of proximal development. Probably the most widely applied sociocultural concept in the design of learning experiences is the concept of the Zone of Proximal Development (ZPD). Vygotsky (1978) defined

ZPD as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). He believed that learning should be matched with an individual’s developmental level and that in order to understand the connection between development and learning, it is necessary to distinguish the actual and the potential levels of development. Learning and development are best understood when the focus is on processes rather than their products. He considered the ZPD to be a better and more dynamic indicator of cognitive development since it reflects what the learner is in the process of learning as compared to merely measuring what the learner can accomplish independently, reflecting what has been already learned (Vygotsky, 1978).

Vygotsky argued that productive interactions align instruction toward the ZPD, and providing instruction and guidance within the ZPD allows a learner to develop skills and strategies they will eventually apply on their own in other situations (1978). This highlights the importance of instructional decisions related to types and quality of interactions in designing effective learning experiences. Whether these interactions occur with a more experienced other or another learner with similar skills, there should always be a degree of common understanding about the task, described as intersubjectivity., The partners should have a sense of shared authority over the process, and they should actively collaborate to co-construct understanding. It is important to notice that ZPD should be viewed broadly as “any situation in which some activity is leading individuals beyond their current level of functioning,” applicable not only to instructional activities but to play, work, and many other activities (Miller, 2011, p. 178).

The notion of instructional *scaffolding* is closely related to the idea of ZPD. Scaffolding is the set of tools or actions that help a learner successfully complete a task within ZPD. Scaffoldings typically include a mutual and dynamic nature of interaction where both the learner and the one providing the scaffold influence each other and adjust their behavior as they collaborate. The types and the extent of supports provided in a learning experience are based on performance, and the scaffold is gradually phased out (Miller, 2011). The expert motivates and guides the learner by providing just enough assistance, modeling, and highlighting critical features of the task as well as continually evaluating and adjusting supports as needed. Additionally, providing opportunities for reflection as part of the learning experience further promotes more complex, meaningful, and lasting learning experiences. In the case of digital learning experiences, scaffolds are not necessarily provided by individuals, but may be embedded into the experience.

Ideas such as ZPD and scaffolding bring to light a fundamentally different view of an instructor who serves more as a facilitator of learning rather than a fount of knowledge. Likewise, the learner takes on more responsibilities such as determining their learning goals, becoming a resource of knowledge for peers, and actively collaborating in the learning process (Grabinger, Aplin, & Ponnappa-Brenner, 2007). This shift in roles promotes individualized, differentiated, and learner-centered types of instruction, and when accompanied with effective pedagogical practices, it has a potential to become a powerful alternative for reforming current educational systems and creating environments where many different individuals develop deep understanding of important subjects (Watson & Reigeluth, 2016).

Summary of Sociocultural Theory

Sociocultural theory has several widely recognized strengths. First, it emphasizes the broader social, cultural, and historical context of any human activity. It does not view individuals as isolated entities; rather, it provides a richer perspective, focusing on the fluid boundary between self and others. It portrays the dynamic of a learner acquiring knowledge and skills from the society and then in turn shaping their environment (Miller, 2011). Second, sociocultural theory is sensitive to individual and cross-cultural diversity. In contrast to many other universalist theories, sociocultural theory acknowledges both differences in individuals within a culture and differences in individuals across cultures. It recognizes that “different historical and cultural circumstances may encourage different developmental routes to any given developmental endpoint” depending on particular social or physical circumstances and tools available (Miller, 2011, p. 198). Finally, sociocultural theory greatly contributes to our theoretical understanding of cognitive development by integrating the notion of learning and development. The idea of learning driving development rather than being determined by a developmental level of the learner fundamentally changes our understanding of the learning process and has significant instructional and educational implications (Miller, 2011).

There are also limitations to the sociocultural perspective. The first limitation is related to Vygotsky's premature death, as many of his theories remained incomplete. Furthermore, his work was largely unknown until fairly recently due to political reasons and issues with translation. The second major limitation is associated with the vagueness of the ZPD. Individuals may have wide or narrow zones, which may be both desirable and undesirable, depending on the circumstances. Knowing only the width of the zone "does not provide an accurate picture of [the learner's]learning, ability, style of learning, and current level of development compared to other children of the same age and degree of motivation" (Miller, 2011, p. 198). Additionally, there is little known about whether a child's zone is comparable across different learning domains, with different individuals, and whether the size of the zone changes over time. here is also not a common metric scale to measure ZPD. Finally, Rogoff (1990) pointed out that Vygotsky's theories may not be as relevant to all cultures as originally thought. She provides an example of scaffolding being heavily dependent on verbal instruction and thus not equally effective in all cultures for all types of learning.

The notion of social origins of learning, the interrelationship of language and thought, and the Zone of Proximal Development are Vygotsky's most important contributions. However, the practical applications of sociocultural theory are also significant that emphasize creating learner-centered instructional environments where learning by discovery, inquiry, active problem solving, and critical thinking are fostered through collaboration with experts and peers in communities of learners and encourage self-directed lifelong learning habits. Presenting authentic and cognitively challenging tasks within a context of collaborative activities, scaffolding learner's efforts by providing a structure and support to accomplish complex tasks, and providing opportunities for authentic and dynamic assessment are all important aspects of this approach. Sociocultural principles can be applied in effective and meaningful ways to design instruction across the curriculum for learners of different ages and variety of skills, and they can be effectively integrated using a wide range of technologies and learning environments. The challenge remains for educators and instructional designers to elevate our practices from efficient, systemic approaches for teaching and instructional design to a focus on individual learners and effective pedagogical practices to develop empowered learners ready to successfully negotiate the rapidly changing era of information. Technology is at our fingertips, and it is up to us to competently implement its unique affordances to promote new ways to educate and support deep, meaningful, and self-directed learning. Grounding our practices in sociocultural theory can significantly aid our efforts.

Design Characteristics Related to Social Perspectives of Learning

In this section major characteristics of sociocultural theory important to instructional design will be discussed. These include the focus on the individual learner and their context for learning and the use of effective pedagogies centered around collaborative practice and communities of learners.

Focus On the Contextualized Learner in Social Learning Activities

Sociocultural theory and related ideas provide a valuable contribution to a focus on the learner within their social, cultural, and historical context and also offer sound pedagogical solutions and strategies that facilitate development of critical thinking and lifelong learning (Grabinger, Aplin, & Ponnappa-Brenner, 2007). The American Psychological Association's *Learner-Centered Principles* (APA Work Group, 1997, p. 6) stated the following about social interactions on individual learners: "In interactive and collaborative instructional contexts, individuals have an opportunity for perspective taking and reflective thinking that may lead to higher levels of cognitive, social, and moral development, as well as self-esteem."

Most instructional design models take into consideration a common or isolated concept of the learner, but recently, a strong call has been issued for a complete shift in our education and instructional design approaches to reflect our society's changing educational needs (Watson & Reigeluth, 2016). More contemporary design approaches, such as Universal Design for Learning, recognize that every learner is unique and influenced by his or her embedded context. These approaches strive to provide challenging and engaging curricula for diverse learners while also designing for the social influences that surround them.

Use of Pedagogies Around Collaborative Practice

Sociocultural theory encourages instructional designers to apply principles of collaborative practice that go beyond social constructivism to create learning communities. The sociocultural perspective views learning taking place through interaction, negotiation, and collaboration in solving authentic problems while emphasizing learning from experience and discourse, which is more than cooperative learning. This is visible, for example, in the ideas of ***situated cognition (situated learning)*** and ***cognitive apprenticeships***.

Brown, Collins, and Duguid (1989), seminal authors on ***situated cognition***, contended that "activity and situations are integral to cognition and learning" (p. 32). By socially interacting with others in real life contexts, learning occurs on deeper levels. They explained that "people who use tools actively rather than just acquire them, by contrast, build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves" (Brown, Collins, & Duguid, 1989, p. 33).

This implicit understanding of the world around them influences how learners understand and respond to instruction. In one study, Carraher, Carraher, and Schliemann (1985) researched Brazilian children solving mathematics problems while selling produce. While selling produce, the context and artifacts positively influenced a child's ability to work through mathematics problems, use appropriate strategies, and find correct solutions. However, these children failed to solve the same problems when they were presented out of context in conventional mathematical form. Lave (1988) studied tailors in Liberia and found that while the tailors were adept at solving mathematics problems embedded in their daily work, they could not apply those same skills to novel contexts. In addition, Brill (2001) synthesized the work of Collins (1988) and identified four benefits of using situated cognition as a theory guiding teaching and instructional design: (1) learners develop the ability to apply knowledge; (2) learners become effective problem solvers after learning in novel and diverse settings; (3) learners are able to see the implications of knowledge; and (4) learners receive support in organizing knowledge in ways to use later.

Cognitive apprenticeships, meanwhile, acknowledge the situated nature of cognition by contextualizing learning (Brown et al., 1989) through apprenticing learners to more experienced experts who model and scaffold implicit and explicit concepts to be learned. Lave and Wenger (1991) wrote about the work of teaching tailors in Liberia and found that new tailors developed the necessary skills by serving as apprenticeships and learning from experienced tailors.

In addition to cognitive apprenticeships, approaches grounded in sociocultural theory pay attention to and model the discourse, norms, and practices associated with a certain ***community of practice*** in order to develop knowledge and skills important to that community (Scott & Palincsar, 2013). Communities of practice involve learners and those teaching or facilitating learning authentic practice within the target context to facilitate easier transfer of learning (Lave & Wenger, 1991). Wenger (1998, pp. 72-73) identified communities of practice as groups of individuals who share three characteristics:

- Mutual Engagement: Firstly, through participation in the community, members establish norms and build collaborative relationships; this is termed mutual engagement.
- Joint Enterprise: Secondly, through their interactions, they create a shared understanding of what binds them together; this is termed the joint enterprise.
- Shared Repertoire: Finally, as part of its practice, the community produces a set of communal resources, which is termed their shared repertoire.

Similarly, Garrison, Anderson, and Archer (2000) described a ***community of inquiry*** as a community of learners who through discourse and reflection construct personal and shared meanings (Garrison, Anderson, & Archer, 2000). Garrison and Akyol (2013) explained that when social presence is established as part of a community of inquiry, "collaboration and critical discourse is enhanced and sustained" (p. 108). Establishment of solid social presence further reflects in positive learning outcomes, increased satisfaction, and improved retention (Garrison & Akyol, 2013). Integrating sociocultural practices into learning design, for example through creation of communities of inquiry, spontaneously integrates a learner's previous knowledge, relationships, and cultural experiences into the learning

process and enculturates the learner into the new community of practice through relevant activities and experiences (Grabinger, Aplin, & Ponnappa-Brenner, 2007). In the context of technology-enhanced environments, the emergence of new synchronous and asynchronous communication technologies and increased attention to computer-supported collaborative learning (CSCL) and virtual communities of practice create new opportunities for applying sociocultural methodologies, as their affordances allow quality collaboration and new ways of interacting in face-to-face, blended, and online environments (Garrison & Akyol, 2013).

Third-space discourse encourages instructors and instructional designers to create learning experiences that provide opportunities to build off of learners' primary discourses (related to informal settings such as home and the community) and students' secondary discourses (related to formal learning settings such as schools) (Soja, 1996). Studies that have examined learning experiences grounded in the construct of third space discourse benefited learners through demonstrated gains in their conceptual understanding and use of academic language (Maniotes, 2005; Scott & Palincsar, 2013). As an example, Mojé et al. (2001) wrote:

> *weaving together of counter scripts [student personal discourses] and official scripts [school science discourses] constructs a Third Space in which alternative and competing discourses and positionings transform conflict and difference into rich zones of collaborative learning … (p. 487)*

In summary, perspectives of social learning recognize that learners develop individually with the support of others in their community, receive support from more knowledgeable others or learning tools within their zone of proximal development, and learn within meaningful situations that are likely to deepen their understanding compared to knowledge void of context.

Examples of Learning Environments Aligned to Social Perspectives

In this section we detail specific examples of learning environments and activities that align to social perspectives of learning. They include collaborative authentic activities, project-based learning, flipped learning environments, and online collaborative spaces.

Collaborative Authentic Activities

Collaborative environments that encourage learners to think critically and apply knowledge and skills is a central component of social learning theories. As educators strive to create cooperative learning experiences for students, authentic activities and anchored instruction promote sociocultural perspectives of learning by encouraging the contextualization of learning in the simulation of practical problems, the development of cultural skills through guided participation in collaborative groups, and the use of language to both communicate and internalize learning. The implementation of collaborative, authentic activities in learning experiences typically involves learners collaborating to solve problems embedded in real-life situations (Reeves et al., 2002), reflecting learning through situated cognition. Teachers, trainers, and facilitators guide and support these collaborative efforts by scaffolding learning with tools and resources, asking questions that support learners' understanding, and helping learners to make sense of the problems.

Authentic activities contextualize learning and allow for a diverse application of skills and knowledge within real-world scenarios. In the literature these authentic activities have sometimes been referred to as anchors or the process of anchored instruction, which focuses learners on developing knowledge and skills through collaborative problem solving experiences (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990). This type of learning allows students to engage in problem solving within learning contexts that provide for connection-building across the curriculum in order to develop meaning (Bransford et al., 1990). Typically presented in a narrative format, anchored learning begins with the "anchor," or story in which the problem is set, and uses multimedia outlets to allow students to explore the problem and develop multiple solutions (Bransford et al., 1990). As students collaborate and engage with the material, the teacher becomes a coach and guides students along the process. Through both authentic activities and anchored instruction,

learning takes place in a social setting, encouraging students to develop, share, and implement creative solutions to complex problems as collaborative teams.

One example of a collaborative, authentic, anchored learning experience is the *Jasper Woodbury* mathematics project developed for middle school mathematics students (Cognition and Technology Group at Vanderbilt, 1997). Learners engaged with pre-designed tasks presented as an adventure on a video-disc, and they had to identify needed information, determine how to examine a task, and apply their solutions to an immediate sub-problem (CTGV, 1997). The teacher's role was to facilitate the experience by asking questions and facilitating discussions of the information in the adventure as well as the mathematics concepts embedded in the situation. Research from the project indicated that learners showed greater understanding of how to solve mathematics problems than their peers who had not participated (Hickey, Moore, & Pellegrino, 2001).

Project-based Learning

Project-based learning engages learners in collaborative situations where they must address a complex problem or real-world challenge. According to Vygotsky's ideas, this collaborative learning style naturally fosters students' development of higher-order thinking skills. Problem-based learning environments have been empirically linked to K-12 students gaining a deeper understanding of content and greater amount of learner engagement compared to more traditional instruction (Condliffe, Visher, Bangser, Drohojowska, & Saco, 2016; Fogelman, McNeill, & Krajcik, 2011).

This instructional method derived from problem-based learning, which was first introduced at McMaster University in Ontario, Canada in 1969 (O'Grady, Yew, Goh, & Schmidt, 2012, p. 21). Although they are alike, problem-based learning and project-based learning traditionally differ in scope and size. Unlike the former, the latter requires students to work together to concurrently master several learning objectives as they apply newly acquired skills and knowledge embedded in several problems to solve (Capraro, Capraro, and Morgan, 2013).

Due to the complexity of these situations, most enactments of project-based learning involve learners working in teams on these tasks (Condliffe et al., 2016). Project-based work that is collaborative, however, teaches students how to prioritize and apportion tasks within the project (Garcia, 2017). It also promotes student-initiated inquiry, scaffolding, and soft skill development in areas such as collaboration and communication.

Project-based learning is a multi-layered process of acquiring new skills and knowledge to successfully provide a solution to a challenge. Throughout the process, students are constantly gaining new information from multiple sources, including their peers, to guide them to their final solution. Based on the interaction between project-based learning and social perspectives, Hutchins' theory of distributed cognition helps to make sense of these ideas with the notion that learning is a cognitive phenomena that occurs when new information is shared, or *distributed*, from multiple individuals, artifacts, and technological devices (Rogers, 1997). Most systems and careers function as a result of distributed cognition: airports, schools, hospitals, and restaurants are all systems that rely on the sharing of information to effectively work. Project-based learning can be viewed in the same manner since students will accomplish more towards the task as more information is shared with them. The more exposed a student is to resources and classmates, the more learning occurs. Students can learn as individuals, but their opportunities for learning are increased when they can engage in a project within a group.

Flipped Learning Environments

One method of maximizing students full engagement in social learning is through a pedagogical model widely known as "the flipped classroom." In a "flipped" classroom, students prepare for an upcoming lesson by watching instructional videos before class. Instead of using class time for lecture and passive, individual acquisition or practice of skills, students participate in active and social learning activities, a key component of Vygotsky's theories of cognitive development. Watching lectures in videos before class is beneficial for two reasons. First, students spend more time communicating and constructing knowledge with hands-on activities during class (Educause, 2012). Secondly, as students are watching the videos and learning new skills and knowledge, they can pause, rewind, and think about their

learning as it is happening, a phenomenon that rarely occurs during a lecture given in class and in real-time (Educause, 2012; Brame, 2013).

In theory, the flipped classroom model is an excellent way to maximize social learning under the facilitation of a teacher. In practice, however, it does have some drawbacks, including the additional amount of time teachers must invest in preparing the video assignments, ensuring all students have access to the videos outside of school, and making sure all students complete their video-lecture assignments prior to class. The research literature indicates that there are evidence-based solutions to several of these drawbacks such as offering student incentives, giving quizzes and student feedback during the videos, and devoting some in-class time to check for student understanding (Educause, 2012; Brame, 2013).

Research evidence has indicated significant student learning gains in the flipped classroom model (Brame, 2013), emphasizing the value of learning in a social context (e.g., discussion, project collaboration, debate, student-led inquiry, etc.). Not only is social learning maximized in a flipped classroom, the levels of learning are reversed in comparison to a traditional classroom; therefore, students are engaged in higher levels of cognitive work (in regards to Bloom's revised taxonomy of learning) amongst their peers as they engage in lower levels of learning on their own outside of class (Brame, 2013).

Online Collaborative Spaces

Online collaborative spaces unite educators' interests in constructivism, classroom technology, and social learning opportunities in an innovative approach to critical thinking and hands-on learning. Also known as ***computer-supported collaborative learning (CSCL)*** (Resta & Laferierre, 2007; Deal, 2009), online collaborative spaces allow students the opportunity to work together in an interactive, flexible online environment. These online spaces promote communication across a variety of modes, including text, speech, and multimedia formats, reflecting Vygotsky's theory of the importance of language use for learning. They may also provide for a greater diversity of participants than might otherwise be possible in a physical classroom, allowing more cross-cultural connections to inspire social learning. Through meaningful learning activities that include goals, student-driven interests and problem-solving skills, opportunities for collaboration and reflection, and adaptations to individual and cultural needs, educators can facilitate authentic experiences and learning communities for their students in these online spaces (Bonk & Cunningham, 1998). With an array of online resources available, there are a variety of avenues through which students can virtually collaborate. Deal (2009) proposed a process through which learning occurs in an online collaborative space: communication, team definition and participants, project management, resource management, co-creation and ideation, consensus building, and presenting and archiving. Initially, students must communicate and organize roles to complete an objective, which can be completed through online resources such as email, instant messaging, virtual conferencing (such as Skype or Google Hangouts), or discussion boards (Deal, 2009). In an online collaborative environment, students must also find ways to share and establish ideas through project management, resource management, and co-creation programs, such as Google Drive, Google Docs, wikis, and virtual whiteboards (Deal, 2009). Finally, once the project has been organized and at its final stage, students can use online resources to create a final product, such as a webinar, video, or slideshow. Throughout all components of the online collaboration process, teachers have opportunities for assessment, including evaluating the process, final product, or specific outcomes. Ultimately, as students make use of the variety of online resources to navigate a meaningful learning activity as prescribed by an instructor, social learning provides for the refinement of both content knowledge and critical thinking skills (Stahl, Koschmann, & Suthers, 2006; Scardamalia & Bereiter, 1994).

Applying Social Learning Theories: Suggestions for K-12 Teachers and Instructional Designers

When applying social perspectives of learning for K-12 learners and adults, it is important to establish learning teams with specific roles, identify authentic contexts, and scaffold learners.

Engaging All Learners in Social Learning Groups

For learners of all ages, establishing roles provides support to students to facilitate the completion of learning activities (Antil, Jenkins, Watkins, 1998). Kagan (1999) developed the acronym PIES to represent elements of collaborative learning: positive interdependence, individual accountability, equal participation, and simultaneous interaction. Positive interdependence refers to the idea that the potential work that can be done by the group is greater than if each individual in the group worked alone. Individual accountability means that learners are each responsible for some aspects of the work. Equal participation refers to relatively fair shares of the work required. Simultaneous interaction refers to the idea that learners are working together at the same time on the project instead of a jigsaw approach where learners work on their own on separate pieces that are compiled at the end of the work.

For instructional designers who are creating social learning experiences for adults, the tasks must be complex enough to foster positive interdependence and hold individuals accountable. This may include grouping individuals from different backgrounds. If employees of a bank were participating in training on new financial guidelines, an instructional designer may design learning activities in which teams encompassed a mortgage consultant, a retirement consultant, a manager, and a teller. The scenarios included in the training would vary as to require the expertise and background of each to be used in discussing and solving the problem.

K-12 teachers should intentionally establish collaborative learning experiences for students that involve projects, authentic tasks, and other activities embedded in contexts. In order to facilitate collaboration, creating learning teams or groups in which students have specific roles is suggested. For example, in an elementary school classroom, a teacher may put learners in groups and assign the following roles:

- Leader/facilitator: Individual in charge of organizing the group and keeping the group on task.
- Recorder: Individual who records and organizes notes, information, and data.
- Timekeeper: Individual who keeps time and makes sure things are completed in a timely manner.
- Spokesperson: Individual in charge of finalizing the project and leading the presentation

The intentional establishment of learning teams is fundamental for both K-12 teachers and instructional designers in facilitating social learning experiences.

Identifying Authentic Contexts

As stated previously, social perspectives of learning embrace the idea of situated cognition that learning is embedded within specific contexts. For K-12 teachers, the challenge is identifying authentic contexts for learners. Culture, geography, and students' backgrounds clearly must be taken into consideration when identifying contexts for social learning experiences. Students on the coast of Florida have authentic contexts that are different from those in a rural town in the midwestern United States. As a result, the development of curriculum, instructional materials, and resources for these types of experiences cannot be a one-size-fits-all approach, and should provide opportunities for teachers to modify the activities to ensure that they are authentic to their students.

Further, it is critical to make sure that learning experiences provide opportunities for learners to work within an authentic context but also provide generalizations or opportunities to apply their knowledge and skills in other settings. For example, after high school students study economic concepts of supply and demand in the context of researching the prices of brands of clothes popular in that area, students should have opportunities to apply those concepts in a new context.

For an instructional designer, an authentic setting is a realistic scenario the learners may experience. Instructional designers typically design training for individuals that is directly related to their work. For instance, creating training for lifeguards about CPR and first aid certification could include cases and scenarios that require multiple individuals to participate and collaboratively problem solve. This could include scenarios that require an individual to role play someone who is choking and groups of people to identify how to remove the object causing the individual to choke. During the learning segment individuals take turns role playing and collaborating to identify and solve various problems.

Scaffolding Learners

In social learning experiences both K-12 teachers and instructional designers must create learning activities that include scaffolds and supports for learners. Social learning experiences are guided by teachers or learning facilitators without significant direct teaching and presentation. This does not mean that the teacher is absent or off in the corner; rather, they should leverage strategies such as posing questions, providing examples, or supporting students' collaboration to support these learning experiences.

Scaffolding can occur in a few ways. First, teachers can serve as a scaffold by providing initial guidance or questions to help students launch into the activity. As the activity continues, teachers can decrease or remove the amount of support that they provide or limit their support to specific instances, such as when learners are stuck and unable to continue with the task. An instructional designer may design training for salesmen in which learners collaborate to learn about new strategies and receive ongoing feedback from the facilitator and other employees. However, after time, the amount of feedback and support decreases. Similar types of support can occur in K-12 classrooms when teachers provide feedback and guidance early on and then withdraw the scaffolds over time. For example, in an elementary school mathematics classroom a teacher may provide a conversion table between units of measurement for a group project at first, and then after students have had time to work with the measurement units take the conversion table away.

Second, teachers and facilitators can provide external scaffolds or learning tools. An instructional designer who is training salesmen about new procedures may provide a document and visual to help learners become familiar with the new procedures at the beginning of their learning experience, but after collaborative activities and feedback, the supporting documents may be removed, requiring learners to rely on each other or their memory. Likewise for K-12 teachers in a middle school science classroom, students studying landforms may be given access to an anchor chart or visual of different types of landforms initially to help them identify and classify landforms that they are learning about. After time, however, the teacher may remove the scaffold so that learners must rely on knowledge and each other as they lean on skills they have developed together. The amount of scaffolding that teachers should provide is a fine balance between teachers over-guiding on the one hand and on the other letting learners falter in a way that is not productive (CTGV, 1997).

Considering the Role of Technology

There are a variety of ways in which technology can support the use of social learning theories in the classroom. Through current and emerging online collaborative spaces, such as Google, Skype, wikis, and more, as well as hands-on collaborative technology in the classroom, such as SMART Tables and iPads, students have robust opportunities to experience meaningful collaborative learning in both physical and virtual settings that embody the tenets of sociocultural learning. Different technological and online tools can assist with greater communication strategies, more realistic simulations of real-world problem scenarios, and even greater flexibility when seeking to scaffold instruction within students' ZPD. Embracing the use of technology within collaborative learning can also foster a more equal distribution of voices as compared to in-person groupings (Deal, 2009), potentially providing greater opportunity to ensure active participation among all students.Through using technology to support the implementation of social learning theories in the classroom, students experience collaboration while refining 21st century skills.

While the array of technology available to support social learning is beneficial, the volume of resources available for online and in-person technology-based collaboration may be overwhelming to some groups of students. Considering the amount of scaffolding needed based on individual class needs may be appropriate to ensure technology is being used most productively. By providing students with useful resources in an online environment or being explicit about technology use within a physical classroom, students may be able to better focus on the actual problem-solving task rather than filtering through different platforms.

Additionally, keeping in mind the purpose of sociocultural learning within technological contexts is important to the task of promoting online collaborative learning. For example, after differentiating instruction to meet individual students' ZPD and organizing scaffolded activities, providing an authentic task in which students use technology to facilitate

communication and the exchange of ideas (rather than simply as a tool to produce) would be integral to a social learning environment. Through use of online environments and organized activities, students could also have greater access to problem-based learning that reflects situated cognition, opportunities for cognitive apprenticeships, participation in flipped classrooms, and a range of experiences that promote the robust and diverse communication critical to Vygotskian theory. Careful consideration of appropriate guidance within the use of technology-based collaborative learning can enable the thoughtful design of learning that maximizes benefits promised by sociocultural learning theories.

Application Exercises

- Vygotsky was instrumental in pioneering Activity Theory, a learning theory closely tied to the principles discussed in this chapter. Research Activity Theory and discuss how sociocultural learning relates to the main points of the theory.
- Name at least 3 ways in which language is important to learning according to the sociocultural theory of learning.

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13

Learning Communities

How Do You Define a Community?

Gregory S. Williams & Richard E. West

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A strong learning community "sets the ambience for life-giving and uplifting experiences necessary to advance an individual and a whole society" (Lenning and Ebbers 1999); thus the learning community has been called "a key feature of 21st century schools" (Watkins 2005) and a "powerful educational practice" (Zhao and Kuh 2004). Lichtenstein (2005) documented positive outcomes of student participation in learning communities such as higher retention rates, higher grade point averages, lower risk of academic withdrawal, increased cognitive skills and abilities, and improved ability to adjust to college. Watkins (2005) pointed to a variety of positive outcomes from emphasizing the development of community in schools and classes, including higher student engagement, greater respect for diversity of all students, higher intrinsic motivation, and increased learning in the areas that are most important. In addition, Zhao and Kuh (2004) found learning communities associated with enhanced academic performance; integration of academic and social experiences; gains in multiple areas of skill, competence, and knowledge; and overall satisfaction with the college experience.

Because of the substantial learning advantages that research has found for strong learning communities, teachers, administrators, researchers, and instructional designers must understand how to create learning communities that provide these benefits. Researchers and practitioners have overloaded the literature with accounts, studies, models, and theories about how to effectively design learning communities. However, synthesizing and interpreting this scholarship can be difficult because researchers and practitioners use different terminology and frameworks for conceptualizing the nature of learning communities. Consequently, many become confused about what a learning community is or how to measure it.

In this chapter we address ways learning communities can be operationalized more clearly so research is more effective, based on a thorough review of the literature described in our other article (West & Williams, 2017).

Defining Learning Communities

Knowing what we mean when we use the word community is important for building understanding about best practices. Shen et al. (2008) concluded, "[H]ow a community of learners forms and how social interaction may foster a sense of community in distance learning is important for building theory about the social nature of online learning" (p. 18). However, there is very little agreement among educational researchers about what the specific definition of a learning community should be. This dilemma is, of course, not unique to the field of education, as rural sociologists have also debated for decades the exact meaning of community as it relates to their work (Clark 1973; Day and Murdoch 1993; Hillery 1955).

In the literature, learning communities can mean a variety of things, which are certainly not limited to face-to-face settings. Some researchers use this term to describe something very narrow and specific, while others use it for broader groups of people interacting in diverse ways, even though they might be dispersed through time and space. Learning communities can be as large as a whole school, or as small as a classroom (Busher 2005) or even a subgroup of learners from a larger cohort who work together with a common goal to provide support and collaboration (Davies et al. 2005). The concept of community emerges as an ambiguous term in many social science fields.

Perhaps the most frustrating aspect of researching learning communities is the overwhelming acceptance of a term that is so unclearly defined. Strike (2004) articulated this dilemma through an analogy: "The idea of community may be like democracy: everyone approves of it, but not everyone means the same thing by it. Beneath the superficial agreement is a vast substratum of disagreement and confusion" (p. 217). When a concept or image is particularly fuzzy, some find it helpful to focus on the edges (boundaries) to identify where "it" begins and where "it" ends, and then work inward to describe the thing more explicitly. We will apply this strategy to learning communities and seek to define a community by its boundaries.

However, researchers have different ideas about what those boundaries are (Glynn 1981; Lenning and Ebbers 1999; McMillan and Chavis 1986; Royal and Rossi 1996) and which boundaries are most critical for defining a learning community. In our review of the literature, we found learning community boundaries often defined in terms of participants' sense that they share access, relationships, vision, or function (see Fig. 1). Each of these boundaries contributes in various ways to different theoretical understandings of a learning community.

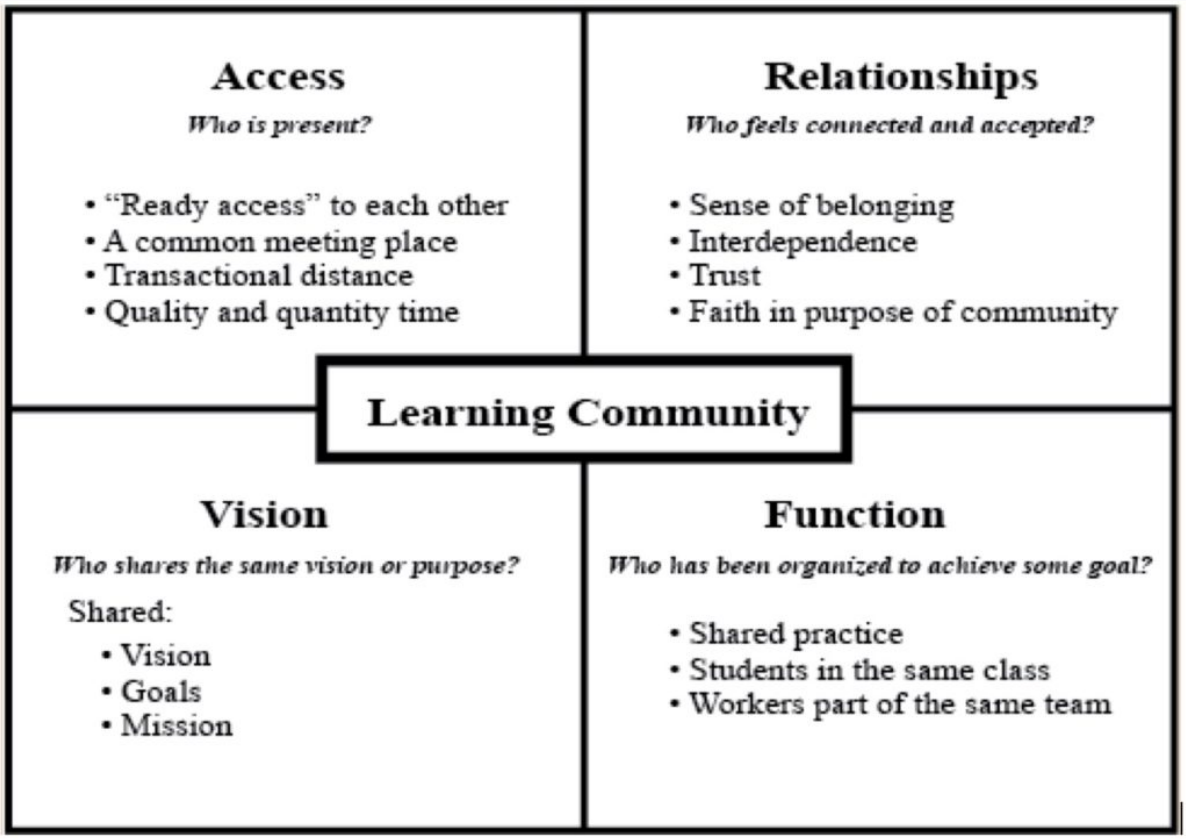

Figure 1. The defining characteristics of learning communities, representing different ways of defining the boundaries of a community

Community Defined by Access

Access might have been at one point the easiest way to define a community. If people lived close together, they were a community. If the children attended the same school or classroom, then they were a school or class community. Some researchers and teachers continue to believe that defining a community is that simple (For example, Kay et al., 2011).

This perception about spatial/geographic communities is common in community psychology research, but also emerges in education when scholars refer to the "classroom community" as simply a synonym for the group of students sitting together. Often this concept is paired with the idea of a cohort, or students entering programs of professional or educational organizations who form a community because they share the same starting time and the same location as their peers.

However, because of modern educational technologies, the meaning of being "present" or having access to one another in a community is blurred, and other researchers are expanding the concept of what it means to be "present" in a community to include virtual rather than physical opportunities for access to other community members.

Rovai et al. (2004) summarized general descriptions of what it means to be a community from many different sources (Glynn 1981; McMillan 1996; Royal and Rossi 1996; Sarason 1974) and concluded that members of a learning community need to have "ready access" to each other (Rovai et al. 2004). He argued that access can be attained without physical presence in the same geographic space. Rovai (2002) previously wrote that learning communities need a common meeting place, but indicated that this could be a common virtual meeting place. At this common place, members of the community can hold both social and intellectual interactions, both of which are important for fostering community development. One reason why many virtual educational environments do not become full learning

communities is that although the intellectual activity occurs in the learning management system, the social interactions may occur in different spaces and environments, such as Twitter and Facebook—thus outside of the potential community.

The negotiation among researchers about what it means to be accessible in a learning community, including whether these boundaries of access are virtual or physical, is still ongoing. Many researchers are adjusting traditional concepts of community boundaries as being physical in order to accommodate modern virtual communities. However, many scholars and practitioners still continue to discuss communities as being bounded by geographic locations and spaces, such as community college math classrooms (Weissman et al. 2011), preservice teachers' professional experiences (Cavanagh and Garvey 2012), and music educator PhD cohorts (Shin 2013). More important is the question of how significant physical or virtual access truly is. Researchers agree that community members should have access to each other, but the amount of access and the nature of presence needed to qualify as a community are still undefined.

Community Defined by Relationships

Being engaged in a learning community often requires more than being present either physically or virtually. Often researchers define learning communities by their relational or emotional boundaries: the emotional ties that bind and unify members of the community (Blanchard et al. 2011). Frequently a learning community is identified by how close or connected the members feel to each other emotionally and whether they feel they can trust, depend on, share knowledge with, rely on, have fun with, and enjoy high quality relationships with each other (Kensler et al. 2009). In this way, affect is an important aspect of determining a learning community. Often administrators or policymakers attempt to force the formation of a community by having the members associate with each other, but the sense of community is not discernible if the members do not build the necessary relational ties. In virtual communities, students may feel present and feel that others are likewise discernibly involved in the community, but still perceive a lack of emotional trust or connection.

In our review of the literature, we found what seem to be common relational characteristics of learning communities: (1) sense of belonging, (2) interdependence or reliance among the members, (3) trust among members, and (4) faith or trust in the shared purpose of the community.

Belonging

Members of a community need to feel that they belong in the community, which includes feeling like one is similar enough or somehow shares a connection to the others. Sarason (1974) gave an early argument for the psychological needs of a community, which he defined in part as the absence of a feeling of loneliness. Other researchers have agreed that an essential characteristic of learning communities is that students feel "connected" to each other (Baker and Pomerantz 2000) and that a characteristic of ineffective learning communities is that this sense of community is not present (Lichtenstein 2005).

Interdependence

Sarason (1974) believed that belonging to a community could best be described as being part of a "mutually supportive network of relationships upon which one could depend" (p. 1). In other words, the members of the community need each other and feel needed by others within the community; they feel that they belong to a group larger than the individual self. Rovai (2002) added that members often feel that they have duties and obligations towards other members of the community and that they "matter" or are important to each other.

Trust

Some researchers have listed trust as a major characteristic of learning communities (Chen et al. 2007; Mayer et al. 1995; Rovai et al. 2004). Booth's (2012) focus on online learning communities is one example of how trust is instrumental to the emotional strength of the learning group. "Research has established that trust is among the key enablers for knowledge sharing in online communities" (Booth 2012, p. 5). Related to trust is the feeling of being respected and valued within a community, which is often described as essential to a successful learning community

(Lichtenstein 2005). Other authors describe this feeling of trust or respect as feeling “safe” within the community (Baker and Pomerantz 2000). For example, negative or ineffective learning communities have been characterized by conflicts or instructors who were “detached or critical of students and unable or unwilling to help them” (Lichtenstein 2005, p. 348).

Shared Faith

Part of belonging to a community is believing in the community as a whole—that the community should exist and will be sufficient to meet the members’ individual needs. McMillan and Chavis (1986) felt that it was important that there be “a shared faith that members’ needs will be met through their commitment to be together” (p. 9). Rovai et al. (2004) agreed by saying that members “possess a shared faith that their educational needs will be met through their commitment to the shared goals and values of other students at the school” (p. 267).

These emotional boundaries not only define face-to-face learning communities, but they define virtual communities as well—perhaps more so. Because virtual communities do not have face-to-face interaction, the emotional bond that members feel with the persons beyond the computer screen may be even more important, and the emergence of video technologies is one method for increasing these bonds (Borup et al. 2014).

Community Defined by Vision

Communities defined by shared vision or sense of purpose are not as frequently discussed as boundaries based on relationships, but ways members of a community think about their group are important. Rather than feeling like a member of a community—with a sense of belonging, shared faith, trust, and interdependence—people can define community by thinking they are a community. They conceptualize the same vision for what the community is about, share the same mission statements and goals, and believe they are progressing as a community towards the same end. In short, in terms many researchers use, they have a shared purpose based on concepts that define the boundaries of the community. Sharing a purpose is slightly different from the affective concept of sharing faith in the existence of the community and its ability to meet members’ needs. Community members may conceptualize a vision for their community and yet not have any faith that the community is useful (e.g., a member of a math community who hates math). Members may also disagree on whether the community is capable of reaching the goal even though they may agree on what the goal is (“my well intentioned study group is dysfunctional”). Thus conceptual boundaries of a community of learners are distinct from relational ties; they simply define ways members perceive the community’s vision. Occasionally the shared conception is the most salient or distinguishing characteristic of a particular learning community.

Schrum et al. (2005) summarized this characteristic of learning communities by saying that a community is “individuals who share common purposes related to education” (p. 282). Royal and Rossi (1996) also described effective learning communities as rich environments for teamwork among those with a common vision for the future of their school and a common sense of purpose.

Community Defined by Function

Perhaps the most basic way to define the boundaries of a learning community is by what the members do. For example, a community of practice in a business would include business participants engaged in that work. This type of definition is often used in education which considers students members of communities simply because they are doing the same assignments: Participants’ associations are merely functional, and like work of research teams organized to achieve a particular goal, they hold together as long as the work is held in common. When the project is completed, these communities often disappear unless ties related to relationships, conceptions, or physical or virtual presence [access] continue to bind the members together.

The difference between functional boundaries and conceptual boundaries [boundaries of function and boundaries of vision or purpose] may be difficult to discern. These boundaries are often present simultaneously, but a functional community can exist in which the members work on similar projects but do not share the same vision or mental focus

about the community's purpose. Conversely, a group of people can have a shared vision and goals but be unable to actually work together towards this end (for example, if they are assigned to different work teams). Members of a functional community may work together without the emotional connections of a relational community, and members who are present in a community may occupy the same physical or virtual spaces but without working together on the same projects. For example, in co-working spaces, such as Open Gov Hub in Washington D.C., different companies share an open working space, creating in a physical sense a very real community, but members of these separate companies would not be considered a community according to functional boundaries. Thus all the proposed community boundaries sometimes overlap but often represent distinctive features.

The importance of functional cohesion in a learning community is one reason why freshman learning communities at universities usually place cohorts of students in the same classes so they are working on the same projects. Considering work settings, Hakkarainen et al. (2004) argued that the new information age in our society requires workers to be capable of quickly forming collaborative teams (or networked communities of expertise) to achieve a particular functional purpose and then be able to disband when the project is over and form new teams. They argued that these networked communities are increasingly necessary to accomplish work in the 21st Century.

Relying on functional boundaries to define a learning community is particularly useful with online communities. A distributed and asynchronously meeting group can still work on the same project and perhaps feel a shared purpose along with a shared functional assignment, sometimes despite not sharing much online social presence or interpersonal attachment.

Conclusion

Many scholars and practitioners agree that learning communities "set the ambience for life-giving and uplifting experiences necessary to advance an individual and a whole society" (Lenning and Ebbers 1999). Because learning communities are so important to student learning and satisfaction, clear definitions that enable sharing of best practices are essential. By clarifying our understanding and expectations about what we hope students will be able to do, learn, and become in a learning community, we can more precisely identify what our ideal learning community would be like and distinguish this ideal from the less effective/efficient communities existing in everyday life and learning.

In this chapter we have discussed definitions for four potential boundaries of a learning community. Two of these can be observed externally: access (Who is present physically or virtually?) and function (Who has been organized specifically to achieve some goal?). Two of these potential boundaries are internal to the individuals involved and can only be researched by helping participants describe their feelings and thoughts about the community: relationships (Who feels connected and accepted?) and vision (who shares the same mission or purpose?).

Researchers have discussed learning communities according to each of these four boundaries, and often a particular learning community can be defined by more than one. By understanding more precisely what we mean when we describe a group of people as a learning community—whether we mean that they share the same goals, are assigned to work/learn together, or simply happen to be in the same class—we can better orient our research on the outcomes of learning communities by accounting for how we erected boundaries and defined the subjects. We can also develop better guidelines for cultivating learning communities by communicating more effectively what kinds of learning communities we are trying to develop.

Application Exercises

- Evaluate your current learning community. How can you strengthen your personal learning community? Make one commitment to accomplish this goal.
- Analyze an online group (Facebook users, Twitter users, NPR readers, Pinners on Pinterest, etc.) that you are part of to determine if it would fit within the four proposed boundaries of a community. Do you feel like an active member of this community? Why or why not?

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Please complete this short survey to provide feedback on this chapter: http://bit.ly/CommunityBoundaries

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14

Communities of Innovation

Individual, Group, and Organizational Characteristics Leading to Greater Potential for Innovation

Richard E. West

Editor's Note

The following was published in *TechTrends* as the 2013 Invited Paper/Presentation to the Research & Theory Division of AECT, available on Springer here.

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Video Abstract

Watch on YouTube

In this video abstract (available at http://bit.ly/COIAbstract), Dr. West discusses the Communities of Innovation framework. Additionally, in this presentation (available at http://bit.ly/CIDIPTSeminar), Dr. West and his collaborators share their efforts to implement ideas from this article in an interdisciplinary innovation studio at Brigham Young University as part of the CID effort.

Introduction

In 1950, in a memorable presidential address to the American Psychological Association, Guilford chided his colleagues for the period's lack of research on creativity, noting that only 0.2% of published articles in *Psychology Abstracts* had discussed creativity. He then made a prescient prediction about the future, with the development of computers, which he called "thinking machines":

> *[It will] be necessary to develop an economic order in which sufficient employment and wage earning would still be available . . . eventually about the only economic value of brains left would be in the creative thinking of which they are capable. (p. 36)*

The time that Guilford envisioned is quickly becoming the present, when the combination of powerful computers and the ability to network these computers through the Internet has created a different kind of employment marketplace, one where employees are being expected to produce innovations, where knowledge is not managed but created (Howkins, 2002; Sawyer, 2006a; Tepper, 2010). As a sign of the times, patents granted in the United States have risen from about 49,000 in 1963 to over 276,000 in 2012 (U.S. Patent and Trademark Office, 2012). Patent filings are, of course, not a perfect measure of innovation for many reasons, but they reflect the current stress for innovation in business and industry.

Creativity in Education

Responding to this market need, educational organizations find it increasingly critical to develop creativity in their students. For example, the Partnership for 21st Century Skills has designated innovation as one of the skills students need (see https://edtechbooks.org/-nt). Livingston (2010) argued, "Higher education needs to use its natural resources in ways that develop content knowledge and skills in a culture infused at new levels by investigation, cooperation, connection, integration, and synthesis. Creativity is necessary to accomplish this goal" (p. 59).

How are we doing at teaching this critical capability? Not as well as we perhaps should be. Berland (2012) surveyed 1,000 adult working college graduates in the United States and found that 78% felt creativity to be important to their current career, and 82% wished they had been more exposed to creative thinking in school. In addition, 88% felt creativity should be integrated into university curricula, with 71% thinking it should be a class in itself. Particularly interesting is the work done by Kyung Hee Kim, who in 2011 published an influential article on the "Creativity Crisis" in the prestigious *Creativity Research Journal*. Kim reported that results from the Torrance Test of Creative Thinking (TTCT), widely used to measure creative and gifted abilities in children, had dropped significantly since 1990 on nearly all of its subscales, which represent the qualities of creative thinking defined by Torrance in his extensive work on the topic.

Collaborative Creativity and Communities of Innovation

There is a critical need to teach and foster basic creative thinking among today's students, but of particular importance is the need to develop their abilities to engage in collaborative creativity. Many of the current problems and challenges graduates will face in society and industry are too large to be faced alone. However, insufficient research is going into understanding, defining, and teaching collaborative creativity skills in educational contexts.

In seeking to understand what collaborative creativity would look like in education, I reviewed the literature on organizational and social creativity, along with social learning theory, to develop a framework of characteristics common to most environments that foster collaborative creativity in students (West, 2009). I see this framework, *Communities of Innovation*, as an evolution of popular conceptions about social activity within communities of practice (Lave & Wenger, 1991; Wenger, 1998). Since publishing my 2009 paper, I have been seeking to research and develop this framework. I am still in this process, but the purpose of this paper is to update the framework with currently expanded knowledge and experience.

A Community of Innovation (COI) is a group of people focused on producing innovative outputs in a collaborative environment. Different COIs may have varying attributes or qualities that make them successful, but in general COIs have similar characteristics at the individual, group, and organizational levels (see Figure 1).

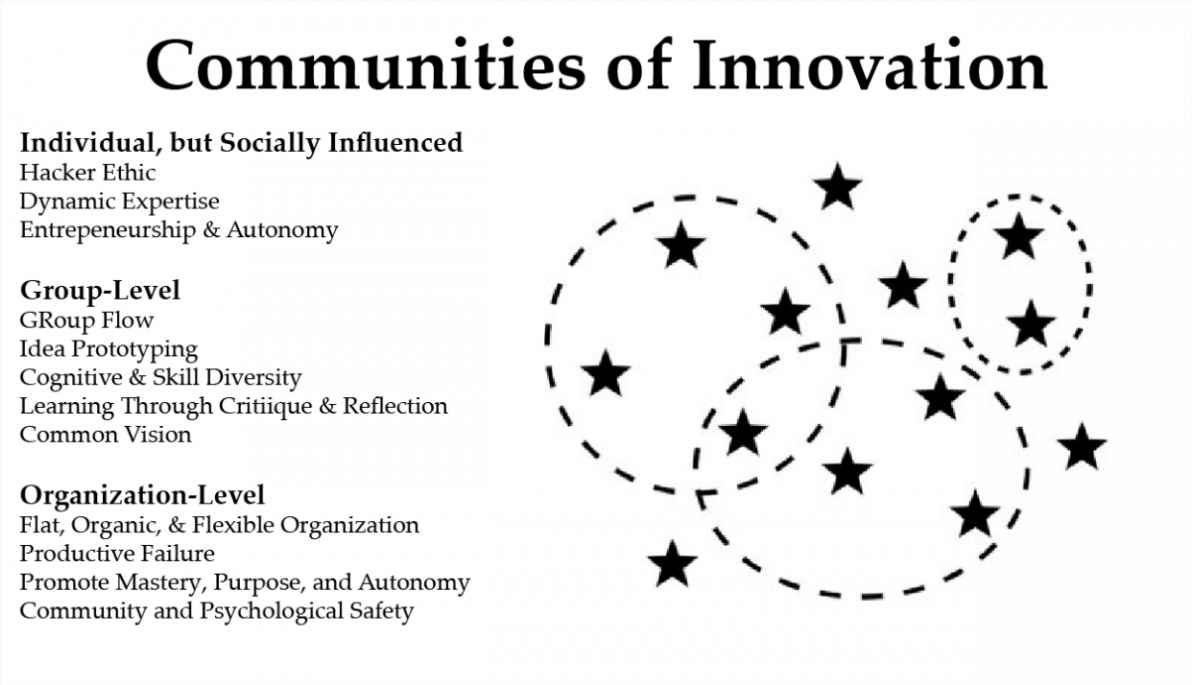

Figure 1. Communities of Innovation

In this paper I will explain what I see as some of the core attributes of COIs at each level, including what we know from research about each attribute. The following section will consider characteristics of Communities of Innovation in the categories of general characteristics influenced by social creativity and learning, characteristics significant on the level of individual groups, and characteristics necessary on the organizational level.

Individual but Socially Influenced Characteristics

Hacker Motivation

Hacker has typically been used to describe "illicit computer intruders" (Jordan & Taylor, 1998, p. 757), but more recently the word has been expanded beyond computer programming or networking buffs to any potential expert or enthusiast (Chance, 2005). Identifying hackers now is less about the domain of their expertise than about their motivation in using it. The term *hacker ethic* was popularized by Himanen (2001), who used it to designate a work ethic emphasizing (a) the importance of a particular kind of work that is motivating to the hacker beyond financial gain because it is valuable to others, (b) a playful and passionate approach to working, and (c) equal access to information and tools through open sharing. Thus hackers, according to Himanen, are motivated by the complexity of real-world problems, deep concern and care for their work, and dedication to quality.

Computer programmers have responded to this type of deep, intrinsic motivation when they have developed open source tools like Linux, Apache, and Wikipedia and given them away without charge, being motivated not by money but by the challenge and the opportunity to produce something that improves their lives and society. Even though the motivation is not financial, people exhibiting the hacker ethic can produce amazingly creative products. As Raymond (2003) said:

> *To do the Unix philosophy right, you have to be loyal to excellence. You have to believe that software design is a craft worth all the intelligence and passion you can muster. . . . You need to care. You need to play. You need to be willing to explore. (p. 27)*

One application of hacker motivation to creativity has been involving users to produce innovative consumer products. Jeppesen and Frederiksen (2006) reported that in various industries producing everything from electronics to computers to chemical processes/equipment, 11-76% of the innovation in the field came from actual users, not professionals, and that often products developed by collaborating lead users have been many times better than products generated in house (Lilien, Morrison, Searls, Sonnack, & von Hippel, 2003). Many companies have realized the power of hacker motivation and have tried to foster it with their employees by granting autonomy, resources, and access to collaborators for employees working on intrinsically motivating projects. Often these projects become some of the most creative products in the company. For example, Google has allowed its employees to work one day each week on their own intrinsically motivating projects, and from this hacker time have come AdSense, Gmail, Google Talk, Google News, and Google Reader.

Dynamic Expertise

Dynamic expertise, a term coined by Hakkarainen, Palonen, Paavola, & Lehtinen (2004), contrasts with traditional views of expertise as an accumulation of skills and knowledge in a particular domain. Dynamic expertise designates the ability to continually learn and surpass earlier achievements by "living on the edge" (Marianno & West, 2013) of one's competence, pushing for new expertise in ever-evolving new ways and domains. Thus expertise is a dynamic, progressive ability to gain new skills and knowledge. In developing and validating a survey to measure dynamic expertise in creative groups, Marianno and West (2013) found three main relevant factors: awareness and understanding of the problems facing the group, motivation to pursue these challenging problems, and ability to gain new competencies in the process. In this study, groups in which the individual members exhibited more dynamic expertise were significantly more innovative than their peers.

Entrepreneurship and Autonomy

Developing and using dynamic expertise requires that members of a community have a certain amount of entrepreneurship and autonomy. Gagne and Deci (2005) explained *autonomy* as acting with choice and purpose and engaging in an activity because one finds it enjoyable. McLean (2005) explained that freedom and autonomy within an organization will likely promote intrinsic motivation and, consequently, innovation (see also Oldham & Cummings, 1996). Similarly, scholars have found that promoting autonomy and self-directed activity can substantially improve student morale, motivation, learning, and performance (Gagne & Deci, 2005; Gelderen, 2010; Ryan & Deci, 2000). On the other hand, Amabile (1996) found that perception of organizational control over its members impedes creativity. This relationship is especially important when critiquing or evaluating the work within a COI, as evaluation is critical to improving the product (West, Williams, & Williams, 2013), but feedback must be given without the perception of limiting autonomy (Egan, 2005).

While members of a COI need to feel autonomy over how they accomplish their work, this does not mean constraints should not be given or particular tasks assigned. In fact, constraints are widely recognized for improving creativity to a degree (Dyer, Gregersen, & Christensen, 2009; Moreau & Dahl, 2005). However, creativity flourishes when COI members feel they have high autonomy and ownership over the everyday work, ideas, and manner of discovering how to accomplish their tasks (Amabile, 1998; Amabile, Conti, Coon, Lazenby, & Herron, 1996; Egan, 2005; Kurtzberg & Amabile, 2001). Supporting autonomy can lead to the likelihood of group members internalizing and adopting the values and goals of the group (Gagne & Deci, 2005).

Group Level Characteristics

Group Flow

Keith Sawyer, whose graduate adviser was Mihalyi Csikszentmihalyi, adapted his mentor's conception of flow (Csikszentmihalyi, 1990) to group collaboration. Sawyer (2008) explained that group flow was more likely to occur based on 10 important elements of effective group collaboration: a shared goal, close listening, complete concentration, the ability to be in control (related to what I call autonomy), blended egos, equal participation, familiarity,

communication, effort to move ideas forward (often through improvisation, building on previous ideas), and risk that comes from the potential for failure. Sawyer (2006b) argued that when groups achieve flow, innovation is at its peak: “Performers are in interactional synchrony,” and “each of the group members can even feel as if they are able to anticipate what their fellow performers will do before they do it” (p. 158).

Research into group flow is still in the early stages, and few use the term besides Sawyer, but evidence has shown that Sawyer’s theory is solid. For example, Byrne, MacDonald, & Carlton (2003; see also MacDonald, Byrne, & Carlton, 2006) studied how group flow impacted creative output in musical compositions of 45 university students who were rated for their creativity. The authors found a significant correlation between the levels of flow the student groups experienced and the creativity of their group compositions.

The biggest challenge with group flow is how “fragile” (Armstrong, 2008) it is and how difficult to foster. It is also “hard to predict in advance” (Sawyer, 2006b, p. 158), which makes it difficult to research. Of particular interest to me is what happens when group collaboration moves online. Sawyer (2013) has argued that the Internet cannot support group flow at all, but more research is needed, including studies into whether group flow might emerge online but require circumstances entirely different than those Sawyer articulated for group flow in face-to-face settings.

Idea Prototyping

Design industries have long acknowledged the value of rapidly prototyping group ideas so that collaboration can continue by improvising (Tripp & Bichelmeyer, 1990) on the design. This significant application of the design thinking approach to group creativity is growing in popularity in both industry and education because of its perceived ability to “change how people learn and solve problems” (Razzouk & Shute, 2012, p. 331). Sutton and Kelley (1997) noted that IDEO prototypes not only their products, but also their spaces, organizational structures, and size—making prototyping a core feature of their successful approach to innovation.

Idea prototyping

Brown (2008) explained, "[T]he goal of prototyping isn't to finish. It is to learn about the strengths and weaknesses of the idea and to identify new directions that further prototypes might take" (p. 87). Thus group members are able to learn through the process of creation, which has been shown to be a powerful way to promote constructivist learning (Kafai & Resnick, 1996).

Second, prototyping can facilitate group reflection by putting a concept into tangible form for discussion. We have seen this in research into collaborative innovation at Brigham Young University's Center for Animation, as much of the innovation in this highly successful studio emerges from group criticisms of designed prototypes in biweekly student-run meetings (see West, Williams & Williams, 2013). Third, Sawyer (2003b) has argued that improvisation is key to collaborative innovation, and prototyping can facilitate improvisation by providing an initial concept to begin experimentation.

Cognitive and Skill Diversity

Diversity is so critical to collaborative innovation that Justesen (2004) termed it "innoversity" (p. 79). Bielaczyc and Collins (2006) explained, "[M]ultiple perspectives . . . raise questions about what is the best approach. They provide different possible solutions. . . . They offer ingredients for new syntheses. . . . [and are] critical to the invention process" (p. 42). For innovation, the most important kind of diversity involves thinking abilities and design skills, so that a greater variety of ideas can be forged together for the most creative outcomes. Particularly valuable are individuals who have connections not only within a group, but outside of it and can thus contribute outside perspectives. This is widely referred to as the "strength of weak ties," since strength often comes from weaker but still important ties to others outside of the collaborating team, which can bring new perspectives into the collaborating group (e.g., Baer, 2010; Granovetter, 1973)

Individuals with diverse perspectives in a group must freely share these diverse viewpoints and ideas. Diversity can be inhibited by social constraints like hierarchies of power or even personal constraints like shyness; efforts must be made to bring out the diversity of the group. For example, research has found that traditional brainstorming does not produce better creativity (Pauhus et al., 1993; Taylor, Berry, & Block, 1958) because groupthink can emerge if a few individuals share opinions and the rest of the group is hesitant to challenge or offer their own. More effective are methods, such as the nominal group technique (Mullin et al., 1991; Putman & Paulus, 2009), which ask individuals to first do the hard work of developing their ideas and positions individually or in smaller teams before sharing them in an open, but critical and evaluative, collaboration where the ideas can be merged and improvised upon.

Critique and Reflection

An important quality of innovative communities is the ability of members to give and receive criticism in productive ways. This capacity is due in large measure to organizational-level efforts to support exploration and allow for failure with recoverability, as long as quality reflection enables learning from the failure, thus making it actually "productive" (Kapur & Rummel, 2012). As an organization creates a culture where failure is no longer devastating to the team, then at the group level teams have a greater opportunity to develop skills in critique, reflection, evaluation, and team learning.

One example of the role of critical evaluation and reflection in collaborative innovation was the Center for Animation that we studied (West, Williams & Williams, 2013). In that setting, evaluation was a top priority, and the design community met twice a week over a year and a half to showcase and critique weekly progress on their animated short. We found that the qualities that made evaluation successful in this community were the culture of high expectations, collaboration, and evaluation; the ability of the instructors to unite the students, teachers, and leaders as shared stakeholders in the success of the project; the important criteria for evaluating progress; and the frequent opportunities to question and discuss this progress.

In an earlier study (West & Hannafin, 2011), I learned that often the act of critiquing another's work not only helps the person receiving the evaluation, but also the one giving it. One student in that study explained how she and her peers learned through the process of critique, quoting Nelson & Stolterman (2003): "[I]t is also possible to develop design skills by critiquing existing designs" (p. 217)

Common Vision

Essential to the ability of a group to collaborate and critique their progress effectively is that they have a common vision of what they are trying to do. This does not mean they know exactly what the design will look like, but only what they hope the design will accomplish. Anderson and West (1998) explained that a group's shared vision is more effective when it is clear and understandable, is important to and widely shared by all members of the group, and is attainable so it is not demotivating. The importance of a common vision to a productive team climate has been shown in both business (Anderson & West, 1998) and education (West, Williams, & Williams, 2013). Wang & Rafiq (2009) explained the tension in organizational learning between paradigms of exploration and exploitation, and argued that organizational diversity and shared vision are vital to balancing these competing views of group productivity.

Organizational Level Characteristics

Flexible and Organic Organization

Many scholars in organizational studies argue that a flexible organizational structure can promote innovation in a community. For example, Volberda (1996) argued, "Bureaucratic vertical forms severely hamper the ability to respond to accelerating competition. Flexible forms, in contrast, can respond to a wide variety of changes in the competitive environment in an appropriate and timely way" (p. 359). A classic example is the organizational structure of IDEO. In a 2001 interview with *Businessweek*, Beth Strong, IDEO's Director of Recruiting, explained that IDEO's organizational structure is "very flat" where "hot teams" can form on their own and work as a studio for a period of time to complete a project that the team members are all excited about. There is no expectation of an entire career within one studio, and

movement between studios is encouraged, with leadership within the studios often being organic—emerging from within the group.

This type of organizational structure is radically different from that of many communities of practice. Some research has argued that the type of organizational structure is less important than expected, and that flat organizations can struggle with inefficiency due to interpersonal conflicts and inadequate effort coordination (Carzo & Yanouzas, 1969). Possibly what matters more than tall vs. flat organizational structure are characteristics of that organization, such as how quickly innovative ideas can be approved for prototyping, how much autonomy individuals and groups have for innovating, and how flexible the organization is in reorganizing teams according to emergent needs and situations.

Mastery, Purpose, and Autonomy

Pink (2011) popularized the idea that higher-order thinking tasks, such as creativity, are best motivated by organizations that promote mastery, purpose, and autonomy in employees. His ideas are based in large part on the work of Teresa Amabile of Harvard, who has found in her research that "when it comes to granting freedom, the key to creativity is giving people autonomy concerning the means . . . but not necessarily the ends" of a task (1998, p. 81) or, in other words, "choice in how to go about accomplishing the tasks that they are given" (Amabile, Conti, Coon, Lazenby, & Herron, 1996; see also Kurtzberg & Amabile, 2001). This finding holds true not only in business settings but in education (Gelderen, 2010) and research, where Parker & Hackett (2012) explained that research groups benefit from providing younger investigators autonomy, allowing them to be a group that is "getting-big-while-remaining-small" (p. 38): in other words, maintaining their entrepreneurial creativity.

An organization's focus on individuals and groups working towards mastery and purpose in their work can also increase motivation, often more effectively than extrinsic rewards, which have been shown in many research studies to diminish creativity (Hennessey, 1989) and damage intrinsic motivation (Deci, Koestner, & Ryan, 1999). For this reason many innovative design companies encourage lifelong learning for their employees, even in areas not directly related to their work (consider, for example, Pixar University), and to work on projects that give them a sense of purpose, so they feel they are accomplishing a greater good (see previous discussion on the importance of fostering a hacker ethic).

Sense of Community and Psychological Safety

The glue that unifies any community, particularly one with the differences in characteristics and structures of a community of innovation, is a strong sense of community and psychological safety among the members. Rogers (1954), well known for articulating the importance of psychological safety for creativity, explained that psychological safety depends on three separate processes: (1) accepting the individual as of unconditional worth, (2) providing a climate in which external evaluation is absent*and (3) empathically understanding the individual (referred to by Sawyer [2008] as *close listening*). Since Rogers' work, many scholars have found evidence for the importance of a strong sense of community in education units (Rovai, 2002; West & Hannafin, 2011), work teams (Barczak, Lassk, & Mulki, 2010), and whole organizations (Baer & Frese, 2003).

Discussion and Implications

Implications for Teaching

Teaching in a way that builds communities of innovation is not easy, but it is increasingly important. Like many higher order skills, collaborative innovation skills are best taught through modeling, nurturing, and supporting students' growth in ways specific to every context and group of individuals. Still the community of innovation characteristics outlined in this paper seem to lead to some suggested strategies.

First, our research in online learning needs to transition from a predominant focus on delivering content and testing information recall (I'm looking at *you*, MOOCs) and more on how to recapture the powerful improvisational and impromptu conversations and interactions that lead to group innovation. Tools like Mural.ly (https://mural.ly/), Mendley

(http://mendeley.com; see Zaugg, West, Tateishi, & Randall, 2011), and Chatter (https://edtechbooks.org/-Dr) are examples of the kinds of collaboration tools we need that foster people and ideas "bumping into each other" in unforeseen ways to foster innovation.

Second, we need to foster idea generation in effective ways by encouraging individual work and contribution first and then group evaluation and improvisation/prototyping afterward. We will have more group genius (Sawyer, 2008) instead of groupthink when we use strategies that utilize the diversity within a group and encourage open and critical dialogue in an atmosphere of psychological safety.

Third, one of our primary goals in education should be to encourage group flow, which is where the magic of collaborative innovation happens. This means focusing less on seat time and more on project goals. Studio-based approaches to teaching (Chen & You, 2010; Clinton & Rieber, 2010; Docherty, Sutton, Brereton, & Kaplan, 2001) work well because they tend to de-emphasize time on task in favor of work completed and creativity developed. Nothing disrupts a group's flow worse than having the bell ring for the end of class. Instead, we should encourage students to work together in ways and on projects that are most likely to lead to flow, and when they are doing so effectively, we need to give them the space and time to keep it going!

Fourth, acknowledging the literature on autonomy and self-determination theory, we need to promote entrepreneurial attitudes among individuals and groups by allowing and rewarding choices within appropriate boundaries. Fifth, as instructors we need to be more flexible in allowing for self-organizing projects and teams and to create more opportunities for student communication. Sixth, reflection, critique, and learning from failure should be built into every assignment so that failure is productive, not destructive. Although there are many other strategies to explore, and much more to understand about effectively implementing the above strategies in ways that will work in our educational systems, I believe this is a fertile ground for additional research and theory development.

Implications for Research

To date, the research on teaching group- or community-based innovation strategies is nascent. Researching group innovation is challenging, particularly isolating variables and observing outcomes with no assurance of when or how the innovation will actually emerge. However, just because the research is difficult does not mean it should be avoided. Several areas of prospective research could be fruitful.

First, we need more concrete definitions and methods for measuring/observing the COI principles outlined in this paper, as well as any others that may also be important to collaborative innovation, using as many different research methods as possible. Although traditional creativity scholars have largely rejected qualitative methods, too much is still unknown about how to foster collaborative innovation for us to not use every potentially useful research method, including quantitative, qualitative, conversation analysis, and social network analysis.

Second, education is rapidly changing and transitioning towards online and blended environments. While this transition is clearly important and can provide many benefits, we need to be careful that we do not focus on what is easier to teach online (information) instead of what is more difficult but also important (collaboration, creativity, and critical thinking). Instructional designers and researchers need to lead out on setting the agenda for online education in ways that theory suggests will lead to better learning.

Third, we need to explore how to teach collaborative innovation skills on various educational levels. Most of the current research focuses on higher education, for example, and tight national standards for grade-school education often make it harder to justify spending time on skills such as creativity that do not readily show up on standardized tests. Still there is room in national standards for creativity, particularly in the upsurge of interest in teaching engineering practices to children. More research is needed on how to infuse group creativity into this type of curriculum effectively.

Unfortunately, education administrators' and leaders' talk about teaching creativity is often little more than "rhetorical flourishes in policy documents and/or relegated to the borderlands of the visual and performing arts" (McWilliam & Dawson, 2008, p. 634), perhaps because this capability is among the most "elusive" (p. 633) of skills. However, the

scholar considered by many to be the father of creativity, E. Paul Torrance, encouraged creative persons to seek great teachers and mentors in their quest to develop their creativity (Torrance, 2002). As educators and instructional designers we are responsible to be those teachers and mentors as we design the kinds of learning environments that best foster creativity and innovation, especially in collaborative communities.

Application Exercises

- 71% of students surveyed by Berland (2012) felt that universities should offer a class on creativity. Using some of the guidelines and information from this chapter, create an outline of what you think a class on creativity would look like.
- Consider an organization that you are a part of. What are the ways in which you could integrate principles of communities of innovation?
- What is one thing you would do to create group flow in an online learning environment?

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* I have previously argued for the importance of critique, but this critique must not reflect on the individual itself, but rather on the project.

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15

Motivation Theories and Instructional Design

Seung Won Park

Introduction

Motivation has been defined as *a desire or disposition* to engage and persist in a task (Schunk, Pintrich, & Meece, 2014). When a student wants to read a history book on the Civil War, we can say that he or she is motivated to learn about American history. The student may learn, however, of a TV program about his favorite singer and decide not to *engage in* reading the history book on this particular day. Motivation thus refers to a state of being *moved* to do something, a movement that drives a person's behavior. Students without motivation feel no impetus or inspiration to learn a new behavior and will not engage in any learning activities.

Educational researchers have long recognized the role of motivation in learning and have studied motivation from various perspectives. Their efforts have produced a rich foundation of motivation theories. Early motivation theories reflected the traditional behaviorism approach, an approach that considered the basis of motivation to be rewards and punishments. Other theories looked at drives and needs. Over the last 30 years, however, researchers have studied motivation primarily from a social cognitive approach. This approach focuses on individuals' beliefs and contextual factors that influence motivation. This chapter provides a brief overview of the major social-cognitive theories of motivation and discusses how the theories have informed the field of instructional design technology. The chapter concludes by introducing several technology examples designed to enhance student motivation.

Theories of Motivation

Expectancy-value Theory

Expectancy-value theory suggests that the two most immediate predictors of achievement behaviors are expectancies for success and task value beliefs (Wigfield & Eccles, 2000). Expectancies for success refer to students' beliefs of whether they will do well on an upcoming task (Wigfield, 1992). The more students expect to succeed at a task, the more motivated they are to engage with it. Such beliefs are closely related to but conceptually distinguished from ability beliefs. Ability beliefs are defined as students' evaluations of their *current* competence at a given task. Ability beliefs are concerned with present ability whereas expectancies for success are concerned with future potential.

Task value answers the question, "Why should I do this task?" There are four possible answers to the question: intrinsic value, attainment value, utility value, and cost (Wigfield & Eccles, 1992). *Intrinsic value* is pure enjoyment a student feels from performing a task. When they are intrinsically interested in it, students are willing to become involved in a given task. *Attainment value* refers to the importance of doing well on a task. Tasks are perceived important when they reflect the important aspects of one's self. *Utility value* is the perception that a task will be useful for meeting future goals, for instance, taking a Chinese class to get a job in China. The last component of task value, *cost*, refers to what an

individual has to give up to engage in a task or the effort needed to accomplish the task. If the cost is too high, students will be less likely to engage in a given task. For instance, students may not decide to take an extra course when they need to reduce the hours of their part-time job.

Numerous studies have shown that students' expectancies for success and subjective task values positively influenced achievement behaviors and outcomes (Dennissen, Zarret, & Eccles, 2007; Durik, Shechter, Noh, Rozek, & Harackiewicz, 2015; Wigfield & Eccles, 2000). For example, Bong (2001) reported that college students' perceived competence was a significant predictor of their performance. Also, students' perceived utility predicted future enrollment intentions. These relations have been also found in online learning environments. Joo, Lim, and Kim (2013) reported that perceived competence and task value of students enrolled in an online university significantly predicted learner satisfaction, persistence, and achievement.

Self-efficacy Theory

Self-efficacy is defined as people's beliefs in their ability to perform a course of action required to achieve a specific task (Bandura, 1977). Self-efficacy is one of the strongest factors that drive one's motivation. When students believe that they are competent to successfully accomplish a task, they are more motivated to engage in and complete the task. Numerous studies have shown that, compared to low-efficacy learners, high-efficacy students choose to engage in more challenging tasks, work harder, persist longer in the face of difficulties, and perform better (Bandura, 1997; Park & Huynh, 2015; Pintrich & De Groot, 1990).

The concept of self-efficacy is similar to expectancies for success in expectancy-value theory. Both refer to the individuals' judgments of their competence to accomplish an upcoming task. One difference is that self-efficacy conceptually represents a task-specific view of perceived competence, whereas expectancies for success tend to be domain specific (Wigfield & Eccles, 2000). For example, self-efficacy would not merely be a self-judgment of being good at mathematics but rather feeling competent at correctly subtracting fractions. Despite such conceptual differences, self-efficacy and expectancies for success are often used interchangeably. Bandura (1997) also noted that self-efficacy is different from self-confidence. Self-confidence is a belief about a person's general capability that is not related to a specific subject. In spite of demonstrations of high self-confidence, a person can fail to accomplish a specific task.

According to Bandura (1977), self-efficacy can be gauged through four sources—past performance, modeling, verbal persuasion, and psychological states. The strongest factor influencing self-efficacy is past experience with similar tasks. Successful performance on similar tasks enhances self-efficacy while failure experience lowers it. Self-efficacy can also be increased when one observes similar peers accomplishing similar tasks. Such experiences develop expectations that one can do the same thing as another person can. Although limited in its effectiveness, self-efficacy can be enhanced when a trustworthy person, such as a teacher, persuades or encourages students to try a challenging task. Finally, emotional states, such as anxiety, and bodily symptoms, such as sweating, can influence self-efficacy by signaling that students are not capable of accomplishing the task. These four sources of self-efficacy information do not directly influence individuals' beliefs of competence. Individuals make their own interpretations of the events, and these interpretations form the basis for self-efficacy beliefs.

Goals and Goal Orientations

Goal setting is a key motivational process (Locke & Latham, 1984). Goals are the outcome that a person is trying to accomplish. People engage in activities that are believed to lead to goal attainment. As learners pursue multiple goals such as academic goals and social goals, goal choice and the level at which learners commit to attaining the goals influence their motivation to learn (Locke & Latham, 2006; Wentzel, 2000).

Besides goal content (i.e., what a person wants to achieve), the reason that a person tries to achieve a certain goal also has a significant influence on learning and performance. Goal orientations refer to the reasons or purposes for engaging in learning activities and explain individuals' different ways of approaching and responding to achievement situations (Ames & Archer, 1988; Meece, Anderman, & Anderman, 2006). The two most basic goal orientations are mastery and performance goals (Ames & Archer, 1988). Different researchers refer to these goals with the following

terms: learning and performance goals (Elliot & Dweck, 1988), task-involved and ego-involved goals (Nicholls, 1984), and task-focused and ability-focused goals (Maehr & Midgley, 1991). A mastery goal orientation is defined as a focus on mastering new skills, trying to gain increased understanding, and improving competence (Ames & Archer, 1988). Students adopting mastery goals define success in terms of improvement and learning. In contrast, a performance goal orientation focuses on doing better than others and demonstrating competence, for example, by striving to best others, using social comparative standards to make judgments about their abilities while seeking favorable judgment from others (Dweck & Leggett, 1988).

In addition to the basic distinction between mastery and performance goals, performance goal orientations have been further differentiated into performance-approach and performance-avoidance goals (Elliot & Church, 1997; Elliot & Harackiewicz, 1996). Performance-approach goals represent individuals motivated to outperform others and demonstrate their superiority, whereas a performance-avoidance goal orientation refers to those who are motivated to avoid negative judgments and appearing inferior to others. Incorporating the same approach and avoidance distinction, some researchers have further distinguished mastery-approach and mastery-avoidance goals (Elliot & McGregor, 2001). Mastery-approach goals are related to attempts to improve knowledge, skills, and learning. In contrast, mastery-avoidance goals represent a focus on avoiding misunderstanding or the failure to master a task. For instance, athletes who are concerned about falling short of their past performances reflect a mastery-avoidance goal. Despite the confirmatory factor analyses of the 22 goal framework (Elliot & McGregor, 2001; see Table 1), the mastery-avoidance construct remains controversial and is in fact the least accepted construct in the field.

Table 1. The 22 model of goal orientations

	Mastery Goal	**Performance Goal**
Approach Focus	Focus on mastery of learning	Focus on outperforming others
	Learn from errors	Errors indicative of failure
	Judge performance based on standards of self-improvement and progress	Judge performance based on normative standards of being the best performer
Avoidance Focus	Focus on avoiding not mastering task	Focus on avoiding failure
	Errors indicative of failure	Errors indicative of failure
	Judge performance based on standards of not being wrong	Judge performance based on normative standards of not being the worst performer

Studies typically report that mastery-approach goals are associated with positive achievement outcomes such as high levels of effort, interest in the task, and use of deep learning strategies (e.g., Greene, Miller, Crowson, Duke, & Akey, 2004; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Wolters, 2004). On the other hand, research on performance-avoidance goals has consistently reported that these goals induced detrimental effects, such as poor persistence, high anxiety, use of superficial strategies, and low achievement (Linnenbrink, 2005; Urdan, 2004; Wolters, 2003, 2004). With regard to performance-approach goals, the data have yielded a mix of outcomes. Some studies have reported modest positive relations between performance-approach goals and achievement (Linnenbrink-Garcia, Tyson, & Patall, 2008). Others have found maladaptive outcomes such as poor strategy use and test anxiety (Keys, Conley, Duncan, & Domina, 2012; Elliot & McGregor, 2001; Middleton & Midgley, 1997). Taken together, these findings suggest that students who adopt performance-approach goals demonstrate high levels of achievement but experience negative emotionality such as test anxiety. Mastery-avoidance goals are the least studied goal orientation thus far. However, some studies have

found mastery-avoidance to be a positive predictor of anxiety and a negative predictor of performance (Howell & Watson, 2007; Hulleman, Schrager, Bodmann, & Harackiewicz, 2010).

Attribution Theory

Attribution theory considers the source of people's motivation to be their perception of why they succeeded or failed. The theory assumes that people try to understand causal determinants of their own success and failures (Weiner, 1986). For example, people may attribute their success (or failure) to ability, effort, luck, task difficulty, mood, fatigue, and so on. These perceived causes of outcomes are called attributions (Weiner, 1986). Attributions may or may not be actual causes, and regardless of actual causes of the event, the perceived causes are what drive individuals' motivation and behaviors.

According to Weiner (2010), attributed causes for success and failure can be classified along three dimensions: locus, stability, and controllability. The *locus* dimension concerns the location of the cause, or whether a cause is within or outside the individual. Effort is internal to the learner, for example, whereas luck is external. The *stability*dimension refers to whether or not the cause is constant. Effort and luck are unstable because they can vary across situations, whereas ability is regarded as relatively stable. Lastly, the *controllability* dimension concerns how much control an individual has over a cause. Learners can control effort but not luck or task difficulty.

The conceptual classification of causes for success and failure based on the three dimensions is central to the attribution theory of motivation because each dimension is related to a set of motivational, affective, and behavioral consequences. Locus of causality, for example, influences learners' self-esteem and esteem-related emotions (Weiner, 1986). When a successful outcome is attributed to internal causes (e.g., ability, effort) and not external causes (e.g., luck), the students are more likely to take pride in the success and their self-esteem tends to be heightened. On the other hand, failure attributed to internal causes usually results in feelings of shame or guilt and a lowering of self-esteem.

The stability dimension influences individuals' expectancy for future success (Weiner, 1986). If success is attributed to a stable cause, one will expect to have the same outcome in the future. Failure attributed to a stable cause (e.g., low ability) will lower one's expectancy for future success unless he or she believes the ability can and will increase. Attribution for failure to an unstable cause (e.g., "I did not try hard enough") allows students to expect the outcome could change—as long as they put forth enough effort, they could succeed next time.

The controllability dimension is also related to self-directed emotions (Weiner, 1986). When failure is attributed to a controllable cause (e.g., effort), one is likely to experience guilt and the desire to alter the situation. One will experience a feeling of shame or humiliation when failure is attributed to causes that are internal and uncontrollable (e.g., low ability). When attribution for failure is made to the causes that are external and uncontrollable, one is likely to feel helpless and depressed because he or she believes that nothing can change the situation. Thus, failure attribution to uncontrollable causes tends to decrease motivation and engagement.

Self-determination Theory

Self-determination theory focuses on different orientations of motivation that influence the quality of engagement (Deci & Ryan, 1985). According to the theory, motivation can differ not only in strength but also in orientation. The orientations of motivation refer to the different reasons that give rise to an inclination for an individual to do something. Students can be motivated to learn a new skill because they gain their parents' approval or because learning the skills is necessary for their dream job. Based on the orientations of motivation, the theory categorizes motivation into several types.

The two basic types of motivation are *intrinsic motivation* and *extrinsic motivation* (Ryan & Deci, 2000). Intrinsic motivation refers to a disposition to engage in a task for one's inner pleasure. An example of intrinsic motivation is a student reading a history textbook for fun. It is human nature for people to engage in activities that they are intrinsically interested in. Intrinsic motivation often leads to high levels of engagement and performance (Deci & Ryan, 2000).

According to the theory, intrinsic motivation emerges spontaneously from satisfying the basic psychological needs of autonomy, competence, and relatedness (Deci & Ryan, 1985). *Autonomy* is the psychological need to experience one's behaviors as volitional and is self-endorsed. It is closely related to a feeling of freedom to determine one's own behaviors. For example, choice over one's actions can satisfy the need for autonomy; a feeling of autonomy can be undermined, however, by external rewards and threats (Deci & Ryan, 2000). *Competence* is the psychological need to feel efficacious in one's pursuits of goals. A feeling of competence is facilitated by optimal challenges and positive feedback (Ryan & Deci, 2000). *Relatedness* refers to the inherent desire to experience a feeling of being connected to others. The need for relatedness is satisfied by feeling respected and cared for.

Although it is clear that intrinsic motivation promotes learning, most learning activities are not intrinsically interesting to students. Students are often motivated to engage in an activity because it is instrumental to some outcomes separated from the activity itself, which indicates extrinsic motivation. An example of extrinsic motivation is a student who reads a history book for the exam in order to get good grades. In general, it is understood that because an action enacted by extrinsic motivation is controlled by an external factor, it leads to less productive learning behaviors and low-quality engagement compared to learning behaviors that ensue from intrinsic behaviors. However, self-determination theory asserts that extrinsic motivation is a differentiated construct. Extrinsic motivation can represent *inner* sources of an action and result in high-quality learning behaviors. The theory proposes four types of extrinsic motivation—external, introjected, identified, and integrated. These differ according to the degree to which the motivation is self-determined or autonomous (Ryan & Deci, 2000). The more autonomous a motivation is, the higher quality of engagement students demonstrate.

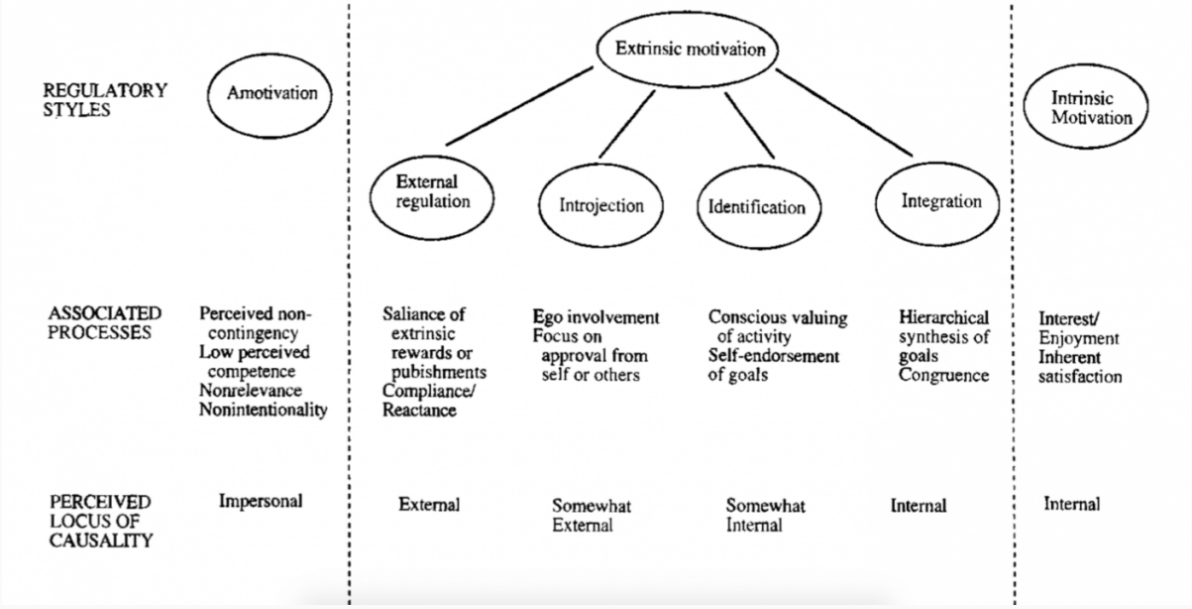

Figure 1. Illustrates the types of motivation in a continuum with regard to the degree of autonomy.

External motivation, located at the far left of the extrinsic motivation continuum in Figure 1, is characterized by behaviors enacted to achieve a reward or avoid a punishment. An example of external motivation is a student who skims a history book before an exam only to get good grades. *Introjected motivation* refers to behaviors performed to maintain a feeling of self-worth or to avoid a feeling of guilt. This type of motivation is still less autonomous because the behaviors are associated with an external locus of causality (e.g., pressure and obligation). On the other hand, *identified motivation* represents an autonomous type of extrinsic motivation. This type of motivation is signified when an individual perceives the value of an activity and considers it to be personally relevant. Finally, the most autonomous, self-determined form of extrinsic motivation is *integrated motivation*, which occurs when the identified value of an

activity is fully integrated with a part of the self. Integrated regulation is similar to intrinsic motivation in terms of its degree of self-determination, though the two motivational constructs conceptually differ in their source of motivation. Integrated regulation is based on the internalized importance of the activity, whereas intrinsic motivation is based on inherent interest in the activity.

Self-determination theory is unique in that it differentiates the construct of extrinsic motivation. The theory explains how to motivate students to carry out learning tasks that are not inherently interesting. The theory specifies three psychological needs—autonomy, competence, and relatedness—as the basis for sustaining intrinsic motivation and more self-determined extrinsic motivation. To the extent that students internalize and integrate external regulations and values, they experience greater autonomy and demonstrate high-quality engagement in learning activities.

Individual and Situational Interest

The most well-known antecedent of motivation is probably interest. We often see students saying that they do not learn because classes are boring and they are not interested in the topic. While we generally refer to "feeling of enjoyment" as interest in everyday language, researchers have differentiated interest into two types—individual (personal) and situational. *Individual interest* is a relatively enduring and internally driven disposition of the person that involves enjoyment and willingness to reengage with a certain object over time (Hidi & Renninger, 2006; Krapp, 2005; Schiefele, 1991). Schiefele (2001) conceptualized individual interest as including both positive feelings (e.g., enjoyment) and the value-related belief that the object is personally important. *Situational interest*, on the other hand, refers to a temporary psychological state aroused by contextual features in the learning situation (Hidi & Renninger, 2006; Schiefele, 2009). When a student is lured by a catchy title to a news article, his or her interest is triggered by the environmental stimuli. Individual interest can also be supported by a particular situation, but it continues to be present without the situational cues.

Hidi and Renninger (2006) proposed a four-phase model of interest development describing how interest develops from transient situational interest into stable individual interest. In the first phase, situational interest is sparked by environmental features such as novel, incongruous, or surprising information, which is called *triggered situational interest*. Triggered situational interest provokes attention and arousal only in the short term. The second phase is referred to as *maintained situational interest*, which involves focused attention and persistence over a longer period of time. Situational interest is sustained when a person finds the meaningfulness of tasks or personal connections to the tasks. Only maintained situational interest can develop into long-term individual interest. The third phase of interest development is called e*merging individual interest,* marking a transition to individual interest. This phase is characterized by an individual's tendency to reengage with tasks and to generate his or her own curiosity questions without much external support as well as the individual's (?) positive feelings. The last phase is referred to as *well-developed individual interest*, a person's deep-seated interest that involves a tendency to engage, with positive feelings, with a topic over an extended period of time. Although the four-phase model of interest development has been generally accepted, the model is underspecified and has received limited empirical support. For example, the model does not provide a psychological mechanism explaining how the transition to the next phase occurs. More research is needed to achieve a better understanding of interest development.

Much research on interest has focused on examining the relationship between interest and text-based learning. Studies that have investigated the effects of situational interest have reported a moderate correlation between text learning and text-based features that facilitate situational interest; such a relation is independent of other text-based factors such as text length, nature of text, readability, and so on (Schiefele, 1996). Research on the effects of individual interest yielded results similar to those found with situational interest. Schiefele (1996) reported in his meta-analysis an average correlation of .27 between individual interest (i.e., topic interest) and text-based learning. The effects of individual interest on text learning were not influenced by other factors (e.g., text length, reading ability) but were less prominent than the effects of prior knowledge on learning (Schiefele, 2009).

Design for Motivation

These various motivation theories show that motivation is complex and multidimensional. Also, motivational states can be influenced by various factors in an environment. This means that students' lack of motivation can be caused by various sources. As such, in order to design an intervention to promote student motivation, it is indispensable to identify the sources of low motivation in a given situation. Designing strategies to influence people's motivation is a problem-solving process. Like the traditional instructional design process, motivational design includes a systematic process of identifying goals (or motivational problems), developing strategies for goal attainment (of addressing motivational problems), and evaluating the outcome of the strategies. Within the instructional design and technology community, the most well-known motivational design model is John M. Keller's (1987) ARCS model.

Keller's Arcs Model

The shared attributes of the different motivational concepts constitute the acronym ARCS, *attention*, *relevance*, *confidence*, and *satisfaction*, representing Keller's four categories of learner motivation (Keller, 2010). The ARCS model describes strategies for stimulating and sustaining motivation in each of the four categories as well as a systematic process of motivational design.

The first category, *attention*, is related to stimulating and maintaining learners' interests. Learner's attention is required before any learning can take place. This attention should also be sustained in order to keep learners focused and engaged. Keller (2010) describes three categories of attention-getting strategies: perceptual arousal, inquiry arousal, and variability. *Perceptual arousal* refers to capturing interest by arousing learners' senses and emotions. This construct is conceptually similar to triggered situational interest in Hidi and Renninger's (2006) development of interest. Likewise, perceptual arousal is usually transitory. One of the most common ways to provoke perceptual arousal is making an unexpected change in the environment. Example tactics include a change in light, a sudden pause, and presenting a video after text-based information in an online learning environment. *Inquiry arousal*, similar to the construct of maintained situational interest, refers to a cognitive level of curiosity. Students are cognitively attracted to learning materials, for instance, when they contain paradoxical facts. *Variability* concerns variation in instructional methods. No matter how effective motivational tactics are, they lose their potency when used unvaryingly.

The second category, *relevance*, refers to making the learning experience personally relevant or meaningful. According to the goal theory, students engage in learning activities that help to attain their goals (Locke & Latham, 1984). Also, as described in expectancy-value theory and self-determination theory, the perceived value of task is a critical antecedent of motivation (Deci & Ryan, 2000; Wigfield & Eccles, 1992). One way to establish the perceived relevance of the learning materials is to use authentic or real-world examples and assignments. Simply relating the instruction to what is familiar to learners (e.g., prior knowledge) can also help learners to perceive its relevance.

The *confidence* category is pertinent to self-efficacy and expectancies for success of the expectancy-value theory. According to self-determination theory, the feeling of competence is one of the basic human needs (Ryan & Deci, 2000). If the learners' need for competence is not satisfied during learning, they would develop low expectancies for success and demonstrate low self-efficacy, which results in poor motivation to learn (Bandura, 1997; Wigfield & Eccles, 2000). Strategies to enhance self-efficacy, such as experience of success, can be applied in order to build confidence in instruction. Another way to enhance confidence is to foster learners' belief that they have control over their performance. Autonomy support such as providing choices and making internal, controllable attributions are a few examples.

The last category, *satisfaction*, concerns learner's continued motivation to learn. If they experience satisfying outcomes, students are likely to develop a persistent desire to learn (Skinner, 1963). Satisfying or positive consequences of instruction can result from both extrinsic and intrinsic matters (Ryan & Deci, 2000). High grades, certificates, and other tangible rewards are the most common extrinsic outcomes. However, these extrinsic rewards may not always result in feelings of satisfaction. For example, a student is not pleased at the high score that he or she received on a final exam because the test was extremely easy and most students did well. If the extrinsic rewards fail to fulfill learners' inner

needs, students won't be satisfied. Such intrinsic consequences that lead to satisfaction include a feeling of mastery and the pleasure of accomplishing a challenging task.

Besides identifying the four major categories of motivational design, the ARCS model describes 10 steps for a systematic process of motivational design (Keller, 2010). The first four steps are the analysis process. This includes acquisition of course and audience information and analysis of audience motivation and existing materials. The main goal of these steps is to identify motivational problems. The next four steps (Step 5 through Step 8) correspond to the design phase in the traditional instructional design process. The first task in the design phase is to determine the motivational behaviors of learners that you wish to observe based on the motivational problems identified in the previous steps. Then, you select or design motivational tactics that help to achieve the objectives and can be feasibly incorporated into instruction. One important task is to integrate these tactics into instructional materials. Designers are to determine where and how to insert the motivational tactics in the instruction. In this process, they may need to modify the design of instruction. Steps 9 and 10 are the development and evaluation phases. After identifying the motivational tactics to use, designers will develop the actual motivational materials. Lastly, they will evaluate the effectiveness of the embedded motivational tactics, for instance, by collecting learner's reactions to the learning materials. Table 2 summarizes the steps of motivational design.

Table 2. Systematic process of motivational design (adapted from Keller, 2010)

	Motivational Design Steps
Analyze	1. Acquisition of course information
	2. Acquisition of audience information
	3. Analysis of audience motivation
	4. Analysis of motivational tactics in existing materials
Design	5. Description of motivational goals and assessment methods
	6. Identification of potential tactics
	7. Design of tactics
	8. Integration of motivational tactics with instructional plans
Develop	9. Development of materials
Evaluate	10. Evaluation of student reactions

Technology Examples for Promoting Motivation

There are various technologies that have been developed to enhance learners' motivation. Educational games are one of them. Games contain many attributes that promote motivation and thus people tend to be intrinsically motivated to play games (Prensky, 2001; Tüzün, Yilmaz-Soylu, Karakus, & Înal, & Kizlkaya, 2009). As such, games have long been adopted within an educational context and been found to have a positive impact on learning. Not every game, though, is motivating; games should be designed carefully by applying motivational strategies grounded in theories of motivation (Butler, 2017; Dickey, 2007; Kirriemuir, 2002; Prensky, 2001). Here, I provide a few recent technologies that have been developed specifically to influence learner motivation.

Van der Meij, van der Meij, and Harmsen (2015) developed a motivational animated pedagogical agent (MAPA) to promote students' perceived task relevance and self-efficacy in an inquiry learning environment. In the study, students used SimQuest to learn kinematics in a physics class and MAPA was presented in SimQuest with a face and an upper

body visible. Acting as a fellow student, MAPA delivered motivational audible messages to students. The motivational messages were designed based on strategies for enhancing relevance and confidence described in the ARCS model. The study reported a significant increase in students' self-efficacy after using MAPA (van der Meji et al. 2015).

Kim and Bennekin (2013, 2016) developed a Virtual Change Agent (VCA) that provided support for community college students' motivation and persistence in online mathematics courses. The VCA was an animated, human-like, three-dimensional character that delivered messages containing strategies based on theories of motivation, volition, and emotional regulation. For example, the VCA told students a story of applying mathematics for comparing cell phone plans in order to arouse students' interest and curiosity. After using the VCA, students showed a significant increase in their self-efficacy and perceived value of learning mathematics (Kim & Bennekin, 2013).

Another similar technology called Virtual Tutee System (VTS) was designed to facilitate college students' reading motivation and engagement (Park & Kim, 2012). In the VTS, students become a tutor of a virtual tutee (a human-like virtual character) and teach the tutee about the content they have learned from readings. Capitalizing on the motivational aspects of learning-by-teaching effects, the VTS-embedded strategies support the needs for autonomy, competence, and relevance described in self-determination theory. The VTS was used in a few studies and found to promote students' reading engagement and their deep learning (Park & Kim, 2015, 2016).

Summary

Motivation is a so-called prerequisite to learning. As such, it has long been of interest among many educational researchers. This chapter introduced social cognitive theories of motivation. These theories, which continue to expand, have contributed significantly to the understanding of learner motivation. The theories of motivation have also yielded important implications for the instructional design process. In particular, Keller's ARCS model specifies how we take learner motivation into account when designing instruction. Expanding upon Keller's work, researchers have devised many technologies that aim to boost learner motivation. This chapter has presented an introduction to a few of those technologies.

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16

Motivation Theories on Learning

Kelvin Seifert & Rosemary Sutton

Editor's Note

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Not so long ago, a teacher named Barbara Fuller taught general science to elementary years students, and one of her units was about insects and spiders. As part of the unit, she had students search for insects and spiders around their own homes or apartments. They brought the creatures to school (safely in jars), answered a number of questions about them in their journals, and eventually gave brief oral reports about their findings to the class. The assignment seemed straightforward, but Barbara found that students responded to it in very different ways. Looking back, here is how Barbara described their responses:

> *I remember Jose couldn't wait to get started, and couldn't bear to end the assignment either! Every day he brought more bugs or spiders—eventually 25 different kinds. Every day he drew pictures of them in his journal and wrote copious notes about them. At the end he gave the best oral presentation I've ever seen from a third-grader; he called it "They Have Us Outnumbered!" I wish I had filmed it, he was so poised and so enthusiastic.*
>
> *Then there was Lindsey—the one who . . . always wanted to be the best in everything, regardless of whether it interested her. She started off the work rather slowly—just brought in a few bugs and only one spider. But she kept an eye on what everyone else was bringing, and how much. When she saw how much Jose was doing, though, she picked up her pace, like she was trying to match his level. Except that instead of bringing a diversity of creatures as Jose was doing, she just brought more and more of the same ones—almost twenty dead house flies, as I recall! Her presentation was OK—I really could not give her a bad mark for it—but it wasn't as creative or insightful as Jose's. I think she was more concerned about her mark than about the material.*
>
> *And there was Tobias—discouraging old Tobias. He did the work, but just barely. I noticed him looking a lot at other students' insect collections and at their journal entries. He wasn't cheating, I believe, just figuring out what the basic level of work was for the assignment—what he needed to do simply to avoid failing it. He brought in fewer bugs than most others, though still a number that was acceptable. He also wrote*

shorter answers in his journal and gave one of the shortest oral reports. It was all acceptable, but not much more than that.

And Zoey: she was quite a case! I never knew whether to laugh or cry about her. She didn't exactly resist doing the assignment, but she certainly liked to chat with other students. So she was easily distracted, and that cut down on getting her work done, especially about her journal entries. What really saved her—what kept her work at a reasonably high level of quality—were the two girls she ended up chatting with. The other two were already pretty motivated to do a lot with the assignment—create fine-looking bug collections, write good journal entries, and make interesting oral presentations. So when Zoey attempted chitchat with them, the conversations often ended up focusing on the assignment anyway! She had them to thank for keeping her mind on the work. I don't know what Zoey would have done without them.

As Barbara Fuller's recollections suggest, students assign various meanings and attitudes to academic activities—personal meanings and attitudes that arouse and direct their energies in different ways. We call these and their associated energizing and directing effects by the term *motivation* or sometimes *motivation to learn*. As you will see, differences in motivation are an important source of diversity in classrooms, comparable in importance to differences in prior knowledge, ability, or developmental readiness. When it comes to school learning, furthermore, students' motivations take on special importance because students' mere presence in class is (of course) no guarantee that students really want to learn. It is only a sign that students live in a society requiring young people to attend school. Since modern education is compulsory, teachers cannot take students' motivation for granted, and they have a responsibility to insure students' motivation to learn. Somehow or other, teachers must persuade students to want to do what students have to do anyway. This task—understanding and therefore influencing students' motivations to learn—is the focus of this chapter. Fortunately, as you will see, there are ways of accomplishing this task that respect students' choices, desires, and attitudes.

Like motivation itself, theories of it are full of diversity. For convenience in navigating through the diversity, we have organized the chapter around six major theories or perspectives about motives and their sources. We call the topics (1) motives as behavior change, (2) motives as goals, (3) motives as interests, (4) motives as attributions about success, (5) motives as beliefs about self-efficacy, and (6) motives as self-determination. We end with a perspective called *expectancy-value theory,* which integrates ideas from some of the other six theories and partly as a result implies some additional suggestions for influencing students' motivations to learn in positive ways.

Motives as Behavior

Sometimes it is useful to think of motivation not as something "inside" a student driving the student's behavior, but as *equivalent* to the student's outward behaviors. This is the perspective of behaviorism. In its most thorough-going form, behaviorism focuses almost completely on what can be directly seen or heard about a person's behavior and has relatively few comments about what may lie behind (or "underneath" or "inside") the behavior. When it comes to motivation, this perspective means minimizing or even ignoring the distinction between the inner drive or energy of students and the outward behaviors that express the drive or energy. The two are considered the same or nearly so.

Sometimes the circumstances of teaching limit teachers' opportunities to distinguish between inner motivation and outward behavior. Certainly teachers see plenty of student behaviors—signs of motivation of some sort. But the multiple demands of teaching can limit the time available to determine what the behaviors mean. If a student asks a lot of questions during discussions, for example, is he or she curious about the material itself or just wanting to look intelligent in front of classmates and the teacher? In a class with many students and a busy agenda, there may not be a lot of time for a teacher to decide between these possibilities. In other cases, the problem may not be limited time as much as communication difficulties with a student. Consider a student who is still learning English or who belongs to a cultural community that uses patterns of conversation that are unfamiliar to the teacher or who has a disability that limits the student's general language skill. In these cases, discerning the student's inner motivations may take more time and effort. It is important to invest the extra time and effort for such students, but while a teacher is doing so, it is

also important for her to guide and influence the students' behavior in constructive directions. That is where behaviorist approaches to motivation can help.

Operant Conditioning as a Way of Motivating

The most common version of the behavioral perspective on motivation is the theory of *operant conditioning*associated with B. F. Skinner (1938, 1957). To understand this model in terms of motivation, think of the *likelihood* of response as the motivation and the *reinforcement* as the motivator. Imagine, for example, that a student learns by operant conditioning to answer questions during class discussions: each time the student answers a question (the operant), the teacher praises (reinforces) this behavior. In addition to thinking of this situation as behavioral *learning,* however, you can also think of it in terms of *motivation:* the likelihood of the student answering questions (the motivation) is increasing because of the teacher's praise (the motivator).

Many concepts from operant conditioning, in fact, can be understood in motivational terms. Another one, for example, is the concept of *extinction,* the tendency for learned behaviors to become less likely when reinforcement no longer occurs—a sort of "unlearning" or at least a decrease in performance of previously learned behaviors. The decrease in performance frequency can be thought of as a loss of motivation, and removal of the reinforcement can be thought of as removal of the motivator. Table 1 summarizes this way of reframing operant conditioning in terms of motivation.

Table 1. Operant Conditioning as Learning and as Motivation

Concept	Definition phrased in terms of learning	Definition phrased in terms of motivation	Classroom Example
Operant	Behavior that becomes more likely because of reinforcement	Behavior that suggests an increase in motivation	Student listens to teacher's comments during lecture or discussion
Reinforcement	Stimulus that increases likelihood of a behavior	Stimulus that motivates	Teacher praises student for listening
Positive reinforcement	Stimulus that *increases*likelihood of a behavior by being *introduced* or *added* to a situation	Stimulus that motivates by its *presence;* an "incentive"	Teacher makes encouraging remarks about student's homework
Negative reinforcement	Stimulus that *increases* the likelihood of a behavior by being *removed* or taken away from a situation	Stimulus that motivates by its *absence* or *avoidance*	Teacher stops nagging student about late homework
Punishment	Stimulus that *decreases* the likelihood of a behavior by being *introduced* or *added* to a situation	Stimulus that *decreases*motivation by its *presence*	Teacher deducts points for late homework
Extinction	Removal of reinforcement for a behavior	Removal of motivating stimulus that leads to decrease in motivation	Teacher stops commenting altogether about student's homework
Shaping successive approximations	Reinforcements for behaviors that gradually resemble	Stimuli that gradually shift motivation toward a final goal motivation	Teacher praises student for returning homework a bit closer to the deadline;

Concept	Definition phrased in terms of learning	Definition phrased in terms of motivation	Classroom Example
	(approximate) a final goal behavior		gradually she praises for actually being on time
Continuous reinforcement	Reinforcement that occurs *each* time that an operant behavior occurs	Motivator that occurs *each* time a behavioral sign of motivation occurs	Teacher praises highly active student for *every* time he works for five minutes without interruption
Intermittent reinforcement	Reinforcement that *sometimes* occurs following an operant behavior, but not on every occasion	Motivator that occurs *sometimes* when a behavioral sign of motivation occurs, but not on every occasion	Teacher praises highly active student *sometimes* when he works without interruption, but not every time

Cautions about Behavioral Perspectives On Motivation

As we mentioned, behaviorist perspectives about motivation do reflect a classroom reality: that teachers sometimes lack time and therefore must focus simply on students' appropriate outward behavior. But there are nonetheless cautions about adopting this view. An obvious one is the ambiguity of students' specific behaviors; what looks like a sign of one motive to the teacher may in fact be a sign of some other motive to the student (DeGrandpre, 2000). If a student looks at the teacher intently while she is speaking, does it mean the student is motivated to learn or only that the student is daydreaming? If a student invariably looks away while the teacher is speaking, does it mean that the student is disrespectful of the teacher or that the student comes from a family or cultural group where *avoiding* eye contact actually shows more respect for a speaker than direct eye contact?

Another concern about behaviorist perspectives, including operant conditioning, is that it leads teachers to ignore students' choices and preferences and to "play God" by making choices on their behalf (Kohn, 1996). According to this criticism, the distinction between "inner" motives and expressions of motives in outward behavior does not disappear just because a teacher (or a psychological theory) chooses to treat a motive and the behavioral expression of a motive as equivalent. Students usually *do* know what they want or desire, and their wants or desires may not always correspond to what a teacher chooses to reinforce or ignore. Approaches that are exclusively behavioral, it is argued, are not sensitive enough to students' *intrinsic,* self-sustaining motivations. As it happens, help with being selective and thoughtful can be found in the other, more cognitively oriented theories of motivation. These use the goals, interests, and beliefs of students as ways of explaining differences in students' motives and in how the motives affect engagement with school. We turn to these cognitively oriented theories next, beginning with those focused on students' goals.

Motives as Goals

One way motives vary is by the kind of goals that students set for themselves and by how the goals support students' academic achievement. As you might suspect, some goals encourage academic achievement more than others, but even motives that do not concern academics explicitly tend to affect learning indirectly.

Goals That Contribute to Achievement

What kinds of achievement goals do students hold? Imagine three individuals, Maria, Sara, and Lindsay, who are taking algebra together. Maria's main concern is to learn the material as well as possible because she finds it interesting and because she believes it will be useful to her in later courses, perhaps at university. Hers is a mastery goal, because she wants primarily to learn or master the material. Sara, however, is concerned less about algebra than about getting top

marks on the exams and in the course. Hers is a performance goal, because she is focused primarily on looking successful; learning algebra is merely a vehicle for performing well in the eyes of peers and teachers. Lindsay, for her part, is primarily concerned about avoiding a poor or failing mark. Hers is a performance-avoidance goal or failure-avoidance goal, because she is not really as concerned about learning algebra, as Maria is, or about competitive success, as Sara is; she is simply intending to avoid failure.

As you might imagine, mastery, performance, and performance-avoidance goals often are not experienced in pure form, but in combinations. If you play the clarinet in the school band, you might want to improve your technique simply because you enjoy playing as well as possible—essentially a mastery orientation. But you might also want to look talented in the eyes of classmates—a performance orientation. Another part of what you may wish, at least privately, is to avoid looking like a complete failure at playing the clarinet. One of these motives may predominate over the others, but they all may be present.

Mastery goals tend to be associated with enjoyment of learning the material at hand and in this sense represent an outcome that teachers often seek for students. By definition, therefore, they are a form of *intrinsic motivation.* As such, mastery goals have been found to be better than performance goals at sustaining students' interest in a subject. In one review of research about learning goals, for example, students with primarily mastery orientations toward a course they were taking not only tended to express greater interest in the course, but also continued to express interest well beyond the official end of the course and to enroll in further courses in the same subject (Harackiewicz et al., 2002; Wolters, 2004).

Performance goals, on the other hand, imply *extrinsic motivation* and tend to show the mixed effects of this orientation. A positive effect is that students with a performance orientation do tend to get higher grades than those who express primarily a mastery orientation. The advantage in grades occurs both in the short term (with individual assignments) and in the long term (with overall grade point average when graduating). But there is evidence that performance-oriented students do not actually learn material as deeply or permanently as students who are more mastery oriented (Midgley, Kaplan, & Middleton, 2001). A possible reason is that measures of performance—such as test scores—often reward relatively shallow memorization of information and therefore guide performance-oriented students away from processing the information thoughtfully or deeply. Another possible reason is that a performance orientation, by focusing on gaining recognition as the best among peers, encourages competition among peers. Giving and receiving help from classmates is thus not in the self-interest of a performance-oriented student, and the resulting isolation limits the student's learning.

Goals That Affect Achievement Indirectly

Failure-avoidant Goals

Failure-avoidant goals by nature undermine academic achievement. Often they are a negative byproduct of the competitiveness of performance goals (Urdan, 2004). If a teacher (and sometimes also fellow students) put too much emphasis on being the best in the class and if interest in learning the material therefore suffers, then some students may decide that success is beyond their reach or may not be desirable in any case. The alternative—simply avoiding failure—may seem wiser as well as more feasible. Once a student adopts this attitude, he or she may underachieve more or less deliberately, doing only the minimum work necessary to avoid looking foolish or to avoid serious conflict with the teacher. Avoiding failure in this way is an example of self-handicapping—deliberate actions and choices that reduce chances of success. Students may self-handicap in a number of ways; in addition to not working hard, they may procrastinate about completing assignments, for example, or set goals that are unrealistically high.

Social Goals

Most students need and value relationships, both with classmates and with teachers, and often (though not always) they get a good deal of positive support from the relationships. But the effects of social relationships are complex and at times can work both for and against academic achievement. If a relationship with the teacher is important and reasonably positive, then the student is likely to try pleasing the teacher by working hard on assignments (Dowson &

McInerney, 2003). Note, though, that this effect is closer to performance than mastery; the student is primarily concerned about looking good to someone else. If, on the other hand, a student is especially concerned about relationships with peers, the effects on achievement depend on the student's motives for the relationship as well as on peers' attitudes. The abilities and achievement motivation of peers themselves can also make a difference, but once again the effects vary depending on the context. Low achievement and motivation by peers affect an individual's academic motivation more in elementary school than in high school, more in learning mathematics than learning to read, and more if there is a wide range of abilities in a classroom than if there is a more narrow range (Burke & Sass, 2006).

In spite of these complexities, social relationships are valued so highly by most students that teachers should generally facilitate them, though also keep an eye on their nature and their consequent effects on achievement. Many assignments can be accomplished productively in groups, for example, as long as the groups are formed thoughtfully. But the majority of students' social contacts are likely always to come from students' own initiatives with each other in simply taking time to talk and interact. The teacher's job is to encourage these informal contacts, especially when they happen at times that support rather than interfere with learning.

Encouraging Mastery Goals

Even though a degree of performance orientation may be inevitable in school because of the mere presence of classmates, it does not have to take over students' academic motivation completely. Teachers can encourage mastery goals in various ways and should in fact do so, because a mastery orientation leads to more sustained, thoughtful learning, at least in classrooms, where classmates may sometimes debate and disagree with each other (Darnon, Butera, & Harackiewicz, 2006).

How can teachers do so? One way is to allow students to choose specific tasks or assignments for themselves, where possible, because their choices are more likely than usual to reflect prior personal interests, and hence be motivated more intrinsically than usual. The limitation of this strategy, of course, is that students may not see some of the connections between their prior interests and the curriculum topics at hand. In that case it also helps for the teacher to look for and point out the relevance of current topics or skills to students' personal interests and goals. Suppose, for example, that a student enjoys the latest styles of music. This interest may actually have connections with a wide range of school curriculum, such as:

- biology (because of the physiology of the ear and of hearing)
- physics or general science (because of the nature of musical acoustics)
- history (because of changes in musical styles over time)
- English (because of relationships of musical lyrics and themes with literary themes)
- foreign languages (because of comparisons of music and songs among cultures)

Still another way to encourage mastery orientation is to focus on students' individual effort and improvement as much as possible, rather than on comparing students' successes to each other. You can encourage this orientation by giving students detailed feedback about how they can improve performance, by arranging for students to collaborate on specific tasks and projects rather than to compete about them, and in general by showing your own enthusiasm for the subject at hand.

Reflection

Much of education focuses on comparisons in grades, test scores, publications, and awards. How can you develop more of an orientation yourself for your own growth and learning, rather than comparative norms?

Motives as Interests

In addition to holding different kinds of goals—with consequent differences in academic motivation—students show obvious differences in levels of interest in the topics and tasks of the classroom. Suppose that two high school classmates, Frank and Jason, both are taking chemistry, specifically learning how to balance chemical equations. Frank finds the material boring and has to force himself to study it; as a result he spends only the time needed to learn the basic material and to complete the assignments at a basic level. Jason, on the other hand, enjoys the challenges of balancing chemical equations. He thinks of the task as an intriguing puzzle; he not only solves each of them, but also compares the problems to each other as he goes through them.

Frank's learning is based on effort compared to Jason's, whose learning is based more fully on interest. As the example implies, when students learn from interest, they tend to devote more attention to the topic than if they learn from effort (Hidi & Renninger, 2006). The finding is not surprising since interest is another aspect of intrinsic motivation—energy or drive that comes from within. A distinction between effort and interest is often artificial, however, because the two motives often get blended or combined in students' personal experiences. Most of us can remember times when we worked at a skill that we enjoyed and found interesting, but that also required effort to learn. The challenge for teachers is therefore to draw on and encourage students' interest as much as possible and thus keep the required effort within reasonable bounds—neither too hard nor too easy.

Situational Interest Versus Personal Interest

Students' interests vary in how deeply or permanently they are located within students. Situational interests are ones that are triggered temporarily by features of the immediate situation. Unusual sights, sounds, or words can stimulate situational interest. A teacher might show an interesting image on the overhead projector or play a brief bit of music or make a surprising comment in passing. At a more abstract level, unusual or surprising topics of discussion can also arouse interest when they are first introduced. Personal interests are relatively permanent preferences of the student and are usually expressed in a variety of situations. In the classroom, a student may (or may not) have a personal interest in particular topics, activities, or subject matter. Outside class, though, he or she usually has additional personal interests in particular non-academic activities (e.g. sports, music) or even in particular people (a celebrity, a friend who lives nearby). The non-academic personal interests may sometimes conflict with academic interest; it may be more interesting to go to the shopping mall with a friend than to study even your most favorite subject.

Motives Related to Attributions

Attributions are perceptions about the causes of success and failure. Suppose that you get a low mark on a test and are wondering what caused the low mark. You can construct various explanations for—make various attributions about—this failure. Maybe you did not study very hard; maybe the test itself was difficult; maybe you were unlucky; maybe you just are not smart enough. Each explanation attributes the failure to a different factor. The explanations that you settle upon may reflect the truth accurately—or then again, they may not. What is important about attributions is that they reflect personal beliefs about the sources or causes of success and failure. As such, they tend to affect motivation in various ways, depending on the nature of the attribution (Weiner, 2005).

Locus, Stability, and Controllability

Attributions vary in three underlying ways: locus, stability, and controllability. **Locus** of an attribution is the location (figuratively speaking) of the source of success or failure. If you attribute a top mark on a test to your ability, then the locus is internal; if you attribute the mark to the test's having easy questions, then the locus is external. The **stability** of an attribution is its relative permanence. If you attribute the mark to your ability, then the source of success is relatively stable—by definition, ability is a relatively lasting quality. If you attribute a top mark to the effort you put in to studying, then the source of success is unstable—effort can vary and has to be renewed on each occasion or else it disappears. The **controllability** of an attribution is the extent to which the individual can influence it. If you attribute a top mark to

your effort at studying, then the source of success is relatively controllable—you can influence effort simply by deciding how much to study. But if you attribute the mark to simple luck, then the source of the success is uncontrollable—there is nothing that can influence random chance.

As you might suspect, the way that these attributions combine affects students' academic motivations in major ways. It usually helps both motivation and achievement if a student attributes academic successes and failures to factors that are internal and controllable, such as effort or a choice to use particular learning strategies (Dweck, 2000). Attributing successes to factors that are internal but stable or controllable (like ability), on the other hand, is both a blessing and a curse: sometimes it can create optimism about prospects for future success ("I always do well"), but it can also lead to indifference about correcting mistakes (Dweck, 2006), or even create pessimism if a student happens not to perform at the accustomed level ("Maybe I'm not as smart as I thought"). Worst of all for academic motivation are attributions, whether stable or not, related to external factors. Believing that performance depends simply on luck ("The teacher was in a bad mood when marking") or on excessive difficulty of material removes incentive for a student to invest in learning. All in all, then, it seems important for teachers to encourage internal, stable attributions about success.

Teachers can influence students' attributions in various ways. It's useful to frame the teachers' own explanations of success and failure around internal, controllable factors. Instead of telling a student: "Good work! You're smart!", try saying: "Good work! Your effort really made a difference, didn't it?" If a student fails, instead of saying,"Too bad! This material is just too hard for you," try saying, "Let's find a strategy for practicing this more, and then you can try again." In both cases the first option emphasizes uncontrollable factors (effort, difficulty level), and the second option emphasizes internal, controllable factors (effort, use of specific strategies).

Such attributions will only be convincing, however, if teachers provide appropriate conditions for students to learn—conditions in which students' efforts really do pay off. There are three conditions that have to be in place in particular. First, academic tasks and materials actually have to be at about the right level of difficulty. If you give problems in advanced calculus to a first-grade student, the student will not only fail them but also be justified in attributing the failure to an external factor, task difficulty. If assignments are assessed in ways that produce highly variable, unreliable marks, then students will rightly attribute their performance to an external, unstable source: luck. Both circumstances will interfere with motivation.

Second, teachers also need to be ready to give help to individuals who need it—even if they believe that an assignment is easy enough or clear enough that students should not need individual help. Third, teachers need to remember that ability—usually considered a relatively stable factor—often actually changes incrementally over the long term. Effort and its results appear relatively immediately; a student expends effort this week, this day, or even at this very moment, and the effort (if not the results) are visible right away. But ability may take longer to show itself.

Motivation as Self-efficacy

In addition to being influenced by their goals, interests, and attributions, students' motives are affected by specific beliefs about the student's personal capacities. In self-efficacy theory the beliefs become a primary, explicit explanation for motivation (Bandura, 1977, 1986, 1997). Self-efficacy is the belief that you are capable of carrying out a specific task or of reaching a specific goal. Note that the belief and the action or goal are specific. Self-efficacy is a belief that you can write an acceptable term paper, for example, or repair an automobile, or make friends with the new student in class. These are relatively specific beliefs and tasks. Self-efficacy is not about whether you believe that you are intelligent in general, whether you always like working with mechanical things, or think that you are generally a likeable person. These more general judgments are better regarded as various mixtures of self-concepts (beliefs about general personal identity) or of self-esteem (evaluations of identity). They are important in their own right, and sometimes influence motivation, but only indirectly (Bong & Skaalvik, 2004). Self-efficacy beliefs, furthermore, are not the same as "true" or documented skill or ability. They are self-constructed, meaning that they are personally developed perceptions. As with confidence, it is possible to have either too much or too little self-efficacy. The optimum level seems to be either at or

slightly above true capacity (Bandura, 1997). As we indicate below, large discrepancies between self-efficacy and ability can create motivational problems for the individual.

Effects of Self-efficacy On Students' Behavior

Self-efficacy may sound like a uniformly desirable quality, but research as well as teachers' experience suggests that its effects are a bit more complicated than they first appear. Self-efficacy has three main effects, each of which has both a "dark" or undesirable side and a positive or desirable side. The first effect is that self-efficacy makes students more willing to choose tasks where they already feel confident of succeeding. Since self-efficacy is self-constructed, furthermore, it is also possible for students to miscalculate or misperceive their true skill, and the misperceptions themselves can have complex effects on students' motivations. A second effect of high self-efficacy is to increase a persistence at relevant tasks. If you believe that you can solve crossword puzzles, but encounter one that takes longer than usual, then you are more likely to work longer at the puzzle until you (hopefully) really do solve it. This is probably a desirable behavior in many situations, unless the persistence happens to interfere with other, more important tasks (what if you should be doing homework instead of working on crossword puzzles?).

Third, high self-efficacy for a task not only increases a person's persistence at the task, but also improves their ability to cope with stressful conditions and to recover their motivation following outright failures. Suppose that you have two assignments—an essay and a science lab report—due on the same day, and this circumstance promises to make your life hectic as you approach the deadline. You will cope better with the stress of multiple assignments if you already believe yourself capable of doing both of the tasks, than if you believe yourself capable of doing just one of them or (especially) of doing neither. The bad news, at least from a teacher's point of view, is that the same resilience can sometimes also serve non-academic and non-school purposes. How so? Suppose, instead of two school assignments due on the same day, a student has only one school assignment due, but also holds a part-time evening job as a server in a local restaurant. Suppose, further, that the student has high self-efficacy for both of these tasks; he believes, in other words, that he is capable of completing the assignment as well as continuing to work at the job.

Learned Helplessness and Self-efficacy

If a person's sense of self-efficacy is very low, he or she can develop learned helplessness, a perception of complete lack of control in mastering a task. The attitude is similar to depression, a pervasive feeling of apathy and a belief that effort makes no difference and does not lead to success. Learned helplessness was originally studied from the behaviorist perspective of classical and operant conditioning by the psychologist Martin Seligman (1995). The studies used a somewhat "gloomy" experimental procedure in which an animal, such as a rat or a dog, was repeatedly shocked in a cage in a way that prevented the animal from escaping the shocks. In a later phase of the procedure, conditions were changed so that the animal could avoid the shocks by merely moving from one side of the cage to the other. Yet frequently they did not bother to do so! Seligman called this behavior learned helplessness. In people, learned helplessness leads to characteristic ways of dealing with problems. They tend to attribute the source of a problem to themselves, to generalize the problem to many aspects of life, and to see the problem as lasting or permanent. More optimistic individuals, in contrast, are more likely to attribute a problem to outside sources, to see it as specific to a particular situation or activity, and to see it as temporary or time-limited.

Sources of Self-efficacy Beliefs

Psychologists who study self-efficacy have identified four major sources of self-efficacy beliefs (Pajares & Schunk, 2001, 2002). In order of importance they are (1) prior experiences of mastering tasks, (2) watching others' mastering tasks, (3) messages or "persuasion" from others, and (4) emotions related to stress and discomfort. Fortunately the first three can be influenced by teachers directly, and even the fourth can sometimes be influenced indirectly by appropriate interpretive comments from the teacher or others.

A Caution: Motivation as Content Versus Motivation as Process

A caution about self-efficacy theory is its heavy emphasis on just the process of motivation, at the expense of the content of motivation. The basic self-efficacy model has much to say about how beliefs affect behavior, but relatively little to say about which beliefs and tasks are especially satisfying or lead to the greatest well-being in students. The answer to this question is important to know, since teachers might then select tasks as much as possible that are intrinsically satisfying, and not merely achievable.

Motivation as Self-determination

Common sense suggests that human motivations originate from some sort of inner "need". We all think of ourselves as having various "needs", a need for food, for example, or a need for companionship—that influences our choices and activities. This same idea also forms part of some theoretical accounts of motivation, though the theories differ in the needs that they emphasize or recognize.

According to Maslow and his hierarchy of needs, individuals must satisfy physical survival needs before they seek to satisfy needs of belonging, they satisfy belonging needs before esteem needs, and so on. In theory, too, people have both deficit needs and growth needs, and the deficit needs must be satisfied before growth needs can influence behavior (Maslow, 1970). In Maslow's theory, as in others that use the concept, a need is a relatively lasting condition or feeling that requires relief or satisfaction and that tends to influence action over the long term. Some needs may decrease when satisfied (like hunger), but others may not (like curiosity). Either way, needs differ from the selfefficacy beliefs discussed earlier, which are relatively specific and cognitive, and affect particular tasks and behaviors fairly directly.

A recent theory of motivation based on the idea of needs is self-determination theory, proposed by the psychologists Edward Deci and Richard Ryan (2000), among others. The theory proposes that understanding motivation requires taking into account three basic human needs:

- autonomy—the need to feel free of external constraints on behavior
- competence—the need to feel capable or skilled
- relatedness—the need to feel connected or involved with others

Note that these needs are all psychological, not physical; hunger and sex, for example, are not on the list. They are also about personal growth or development, not about deficits that a person tries to reduce or eliminate. Unlike food (in behaviorism) or safety (in Maslow's hierarchy), you can never get enough of autonomy, competence, or relatedness. You (and your students) will seek to enhance these continually throughout life

The key idea of self-determination theory is that when persons (such as you or one of your students) feel that these basic needs are reasonably well met, they tend to perceive their actions and choices to be intrinsically motivated or "self-determined". In that case they can turn their attention to a variety of activities that they find attractive or important, but that do not relate directly to their basic needs. Among your students, for example, some individuals might read books that you have suggested, and others might listen attentively when you explain key concepts from the unit that you happen to be teaching. If one or more basic needs are not met well, however, people will tend to feel coerced by outside pressures or external incentives. They may become preoccupied, in fact, with satisfying whatever need has not been met and thus exclude or avoid activities that might otherwise be interesting, educational, or important. If the persons are students, their learning will suffer.

Self-determination and Intrinsic Motivation

In proposing the importance of needs, then, self-determination theory is asserting the importance of intrinsic motivation. The self-determination version of intrinsic motivation emphasizes a person's perception of freedom, rather than the presence or absence of "real" constraints on action. Self-determination means a person feels free, even if the

person is also operating within certain external constraints. In principle, a student can experience self-determination even if the student must, for example, live within externally imposed rules of appropriate classroom behavior. To achieve a feeling of self-determination, however, the student's basic needs must be met—needs for autonomy, competence, and relatedness. In motivating students, then, the bottom line is that teachers have an interest in helping students to meet their basic needs, and in not letting school rules or the teachers' own leadership styles interfere with or block satisfaction of students' basic needs.

Using Self-determination Theory in the Classroom

What are some teaching strategies for supporting students' needs? Educational researchers have studied this question from a variety of directions, and their resulting recommendations converge and overlap in a number of ways. For convenience, the recommendations can be grouped according to the basic need that they address, beginning with the need for autonomy. A major part of supporting autonomy is to give students choices wherever possible (Ryan & Lynch, 2003). The choices that encourage the greatest feelings of self-control, obviously, are ones that are about relatively major issues or that have relatively significant consequences for students, such as whom to choose as partners for a major group project. But choices also encourage some feeling of self-control even when they are about relatively minor issues, such as how to organize your desk or what kind of folder to use for storing your papers at school. It is important, furthermore, to offer choices to all students, including students needing explicit directions in order to work successfully; avoid reserving choices for only the best students or giving up offering choices altogether to students who fall behind or who need extra help. All students will feel more self-determined and therefore more motivated if they have choices of some sort. Teachers can also support students' autonomy more directly by minimizing external rewards (like grades) and comparisons among students' performance, and by orienting and responding themselves to students' expressed goals and interests.

A second strategy for using self-determination theory is to support students' needs for competence. The most obvious way to make students feel competent is by selecting activities which are challenging but nonetheless achievable with reasonable effort and assistance (Elliott, McGregor, & Thrash, 2004). There are some strategies that are generally effective even if you are not yet in a position to know the students well. One is to emphasize activities that require active response from students. Sometimes this simply means selecting projects, experiments, discussions and the like that require students to do more than simply listen. Other times it means expecting active responses in all interactions with students. Another generally effective way to support competence is to respond and give feedback as immediately as possible.

A third strategy for using self-determination theory is to support students' relational needs. The main way of support students' need to relate to others is to arrange activities in which students work together in ways that are mutually supportive, that recognize students' diversity, and minimize competition among individuals. You can, for example, deliberately arrange projects that require a variety of talents; some educators call such activities "rich group work" (Cohen, 1994; Cohen, Brody, & Sapon-Shevin, 2004). As a teacher, you can encourage the development of your own relationships with class members. Your goal, as teacher, is to demonstrate caring and interest in your students not just as students, but as people.

Keeping Self-determination in Perspective

In certain ways self-determination theory provides a sensible way to think about students' intrinsic motivation and therefore to think about how to get them to manage their own learning. A particular strength of the theory is that it recognizes degrees of self-determination and bases many ideas on this reality. Although these are positive features for understanding and influencing students' classroom motivation, some educators and psychologists nonetheless have lingering questions about the limitations of self-determination theory. One is whether merely providing choices actually improves students' learning, or simply improves their satisfaction with learning. Another question is whether it is possible to overdo attention to students' needs—and again there is evidence for both favoring and contradicting this possibility. Too many choices can actually make anyone (not just a student) frustrated and dissatisfied with a choice the person actually does make (Schwartz, 2004).

Target: A Model for Integrating Ideas about Motivation

A model of motivation that integrates many ideas about motivation, including those in this chapter, has been developed by Carole Ames (1990, 1992). The acronym or abbreviated name for the program is TARGET, which stands for six elements of effective motivation:

- Task
- Authority
- Recognition
- Grouping
- Evaluating
- Time

Each of the elements contributes to students' motivation either directly or indirectly.

Task

As explained earlier, students experience tasks in terms of their value, their expectation of success, and their authenticity. The value of a task is assessed by its importance, interest to the student, usefulness or utility, and the cost in terms of effort and time to achieve it. Expectation of success is assessed by a student's perception of the difficulty of a task. Generally a middling level of difficulty is optimal for students; too easy, and the task seems trivial (not valuable or meaningful), and too hard, and the task seems unlikely to succeed and in this sense useless. Authenticity refers to how much a task relates to real-life experiences of students; the more it does so, the more it can build on students' interests and goals, and the more meaningful and motivating it becomes.

Authority

Motivation is enhanced if students feel a degree of autonomy or responsibility for a learning task. Autonomy strengthens self-efficacy and self-determination—two valued and motivating attitudes described earlier in this chapter. Where possible, teachers can enhance autonomy by offering students' choices about assignments and by encouraging them to take initiative about their own learning.

Recognition

Teachers can support students' motivation by recognizing their achievements appropriately. Much depends, however, on how this is done; as discussed earlier, praise sometimes undermines performance. It is not especially effective if praise is very general and lacking in detailed reasons for the praise; or if praise is for qualities which a student cannot influence (like intelligence instead of effort); or if praise is offered so widely that it loses meaning or even becomes a signal that performance has been substandard. Many of these paradoxical effects are described by self-determination and self-efficacy theory (and were explained earlier in this chapter).

Grouping

Motivation is affected by how students are grouped together for their work—a topic discussed in more detail in Chapter 8 ("Instructional Strategies"). There are many ways to group students, but they tend to fall into three types: cooperative, competitive, and individualistic (Johnson & Johnson, 1999). In cooperative learning, a set of students work together to achieve a common goal (for example, producing a group presentation for the class); often they receive a final grade, or part of a final grade, in common. In competitive learning, students work individually, and their grades reflect comparisons among the students (for example, their performances are ranked relative to each other, or they are "graded on a curve"). In individualistic learning, students work by themselves, but their grades are unrelated to the performance of classmates. Research that compares these three forms of grouping tends to favor cooperative learning groups, which apparently supports students' need for belonging—an idea important in self-determination theory discussed earlier in this chapter.

Evaluation

Grouping structures obviously affect how students' efforts are evaluated. A focus on comparing students, as happens with competitive structures, can distract students from thinking about the material to be learned, and to focus instead on how they appear to external authorities; the question shifts from "What am I learning?" to "What will the teacher think about my performance?" A focus on cooperative learning, on the other hand, can have doubleedged effects: students are encouraged to help their group mates, but may also be tempted to rely excessively on others' efforts or alternatively to ignore each other's contributions and overspecialize their own contributions. Some compromise between cooperative and individualistic structures seems to create optimal motivation for learning (Slavin, 1995).

Time

As every teacher knows, students vary in the amount of time needed to learn almost any material or task. Accommodating the differences can be challenging, but also important for maximizing students' motivation. School days are often filled with interruptions and fixed intervals of time devoted to non-academic activities—facts that make it difficult to be flexible about granting individuals different amounts of time to complete academic tasks. Nonetheless a degree of flexibility is usually possible: larger blocks of time can sometimes be created for important activities (for example, writing an essay), and sometimes enrichment activities can be arranged for some students while others receive extra attention from the teacher on core or basic tasks.

Chapter Summary

Motivation—the energy or drive that gives behavior direction and focus—can be understood in a variety of ways, each of which has implications for teaching. One perspective on motivation comes from behaviorism, and equates underlying drives or motives with their outward, visible expression in behavior. Most others, however, come from cognitive theories of learning and development. Motives are affected by the kind of goals set by students—whether they are oriented to mastery, performance, failure-avoidance, or social contact. They are also affected by students' interests, both personal and situational. And they are affected by students' attributions about the causes of success and failure—whether they perceive the causes are due to ability, effort, task difficulty, or luck.

A major current perspective about motivation is based on self-efficacy theory, which focuses on a person's belief that he or she is capable of carrying out or mastering a task. High self-efficacy affects students' choice of tasks, their persistence at tasks, and their resilience in the face of failure. It helps to prevent learned helplessness, a perception of complete lack of control over mastery or success. Teachers can encourage high self-efficacy beliefs by providing students with experiences of mastery and opportunities to see others' experiences of mastery, by offering well-timed messages persuading them of their capacity for success, and by interpreting students' emotional reactions to success, failure and stress.

An extension of self-efficacy theory is self-determination theory, which is based on the idea that everyone has basic needs for autonomy, competence, and relatedness to others. According to the theory, students will be motivated more intrinsically if these three needs are met as much as possible. A variety of strategies can assist teachers in doing so. One program for doing so is called TARGET; it draws on ideas from several theories of motivation to make practical recommendations about motivating students.

Key Terms

Albert Bandura

Attributions of success or failure

Autonomy, need for

Behaviorist perspective on motivation

Competence, need for

Failure-avoidant goals

Intrinsic motivation

Jigsaw classroom

Learned helplessness

Mastery goals

Motivation Need for relatedness

Performance goals

Personal interests

Self-determination theory

Self-efficacy

Situational interests

TARGET

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Further Resources

This page lists several materials and links related to motivating students in classroom situations.

Please complete this short survey to provide feedback on this chapter: http://bit.ly/MotivationTheories

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17

Informal Learning

Tim Boileau

In today's digitally connected world we are constantly acquiring new personal knowledge and skills, discovering new methods of work and ways to earn a living, solving problems, and changing the way we create, access and share information, through informal learning. The topic of informal learning can be discussed in many different contexts and from a variety of theoretical perspectives. For the purposes of this chapter, informal learning is examined through the lens of lifelong learning and performance, primarily as it relates to adult learners. Jay Cross (2007) may be credited for popularizing the term "informal learning", although he claimed to have first heard it from Peter Henschel sometime during the mid-1990s, who at the time was director of the Institute for Research on Learning (IRL), when he said:

> *People are learning all the time, in varied settings and often most effectively in the context of work itself. 'Training'—formal learning of all kinds—channels some important learning but doesn't carry the heaviest load. The workhorse of the knowledge economy has been, and continues to be, informal learning. (Cross, 2007, p. xiii)*

Indeed, the concept of informal learning has been around for many years preceding the peak of the industrial revolution during the 19th century in the form of guild support for traditional apprenticeships, and is ubiquitous in the knowledge-based economy of the 21st century in the form of cognitive apprenticeship (Collins & Kapur, 2014).

From a performance perspective, informal learning occurs through self-initiated activity undertaken by people in a work setting, resulting in the creation of new skills and knowledge, in the completion of a job or task (Boileau, 2011). In other words, informal learning is situated in meaningful experiences that are built on top of prior experiences and pre-existing knowledge constructs, thereby facilitating the development of new tacit and explicit knowledge. This is different from formal learning where the emphasis is on transfer of explicit knowledge from instructor to learner, typically associated with a separation of time and space between the formal learning event and application of the knowledge or skill. In this scenario, additional performance support is often needed in order to close the gap between existing knowledge and skills, and expected performance. According to Boileau (2011, p. 13), "Humans learn when they perceive a need to know, and evidence of learning is in their ability to do something they could not do before."

In this chapter, I explore the nuances of informal learning to better understand its unique role in lifelong learning and performance. The remainder of this chapter is organized in the following sections:

- Definition of Informal vs. Formal Learning
- Informal Learning Trends and Issues
- Informal Learning and Culture

Definition of Informal vs. Formal Learning

A review of the literature on the definition of informal vs. formal learning shows that much ambiguity exists, leading to contradiction and disagreement among scholars (Czerkawski, 2016). As I will argue in this section, informal and formal learning can be shown to coexist at opposite ends of a continuum, with most learning occurring somewhere in between as opposed to an absolute definition for informal learning. Let us begin with the definition of learning provided by Driscoll (2005, p. 9) "as a persisting change in human performance or performance potential," adding that the change "must come about as a result of the learner's experience and interaction with the world." Note that the first part of this definition emphasizes outcomes of the learning experience in terms of purposeful and intentional change occurring within the learner as a consequence of the learning experience provided via the learning setting. The second part recognizes that learning is inherently social and that authentic learning is achieved only through interaction with the world. This premise is reflected in the "Seven Principles of Learning" provided by Peter Henschel of the Institute for Research on Learning, at TechLearn 1999 (Henschel, 2001):

- Learning is fundamentally social.
- Knowledge is integrated in the life of communities.
- Learning is an act of participation.
- Knowing depends on engagement in practice.
- Engagement is inseparable from empowerment.
- Failure to Learn is often the result of exclusion from participation.
- We are all lifelong learners.

Learning may also be described using different classifications linked to the setting or circumstances in which the learning is most likely to occur, such as formal, non-formal, and informal learning. Taking a brief look at this typology, formal learning implies learning settings provided by educational institutions where the primary mission is the construction of new knowledge. Non-formal learning settings may be found in organizations and businesses within the community where the primary mission is not necessarily educational. However, formal learning activities are present such as in the delivery of specialized training that is linked to achieving the goals of the organization (Coombs, Prosser, & Ahmed, 1973). Informal learning, on the other hand, refers to embedded learning activities that are linked to performance, in the setting of one's everyday life. Within each category, there are identifiable subcategories representing different learning taxonomies. Merriam and Bierema (2014) identified four sub-types of learning specific to informal learning, which can be summarized as:

- Self-directed learning – learner-initiated and -guided learning activity including goal setting, resource identification, strategy selection, and evaluation of outcomes.
- Incidental learning – an accidental by-product of another learning activity that occurs outside of the learner's direct stream of consciousness as an unplanned or unintended consequence of doing something else.
- Tacit learning – the most subtle form of informal learning, which occurs at the subconscious level based on intuition, personal experience, or emotion that is unique to the individual learner.
- Integrative learning – integration of non-conscious tacit knowledge with conscious learning activities providing creative insight through non-linear implicit processing.

In the training industry, informal learning is often discussed in the context of the "70:20:10 Rule" (please see Association for Talent Development (ATD) at www.td.org and do a search on 70:20:10). Generally speaking, this suggests that: 70% of learning occurs through informal or on-the-job learning; 20% through mentoring and other specialized developmental relationships; and the remaining 10% through formal learning including course work and associated reading.

There are two important takeaways from the assertion of the so-called 70:20:10 Rule, as it relates to workplace learning. First, there is a growing body of research providing insight into just how widespread and embedded informal learning is in the lives of adult learners, with estimates of as high as 70-90% of all learning over the course of a lifetime, occurring via informal learning activity (Merriam & Bierema, 2014). Specific to learning about science, Falk and Dierking

(2010) placed the estimate even higher, with as much as 95% of all science learning occurring outside of school, given the richness, availability, and increased access to "free-choice" (i.e., informal) digital learning resources. Based on this premise, Falk and Dierking (2010) contended that a policy of increased investment in informal learning resources would provide a cost-effective way to increase public understanding of science. The second takeaway is the recognition that formal and informal learning occurs along a continuum—comprised of both formal and informal learning activities, depending on the type of learning and level of mastery required, as well as the characteristics and prior experience of the learner—as opposed to dichotomous categories of formal vs. informal learning (Sawchuk, 2008).

In the following illustration, Cross (2007) presented what he referred to as the spending/outcome paradox of learning. The suggested paradox is that while formal learning represents 80% of an organization's training budget, it provides a mere 20% return on learning in terms of performance outcomes. Conversely, informal learning on average represents 20% of training resources, yet delivers 80% of the learning occurring within the organization, measured in terms of performance or potential performance. The spending/outcome paradox remains a global challenge as noted by De Grip (2015), "Policies tend to emphasize education and formal training, and most firms do not have strategies to optimize the gains from informal learning at work." (p. 1).

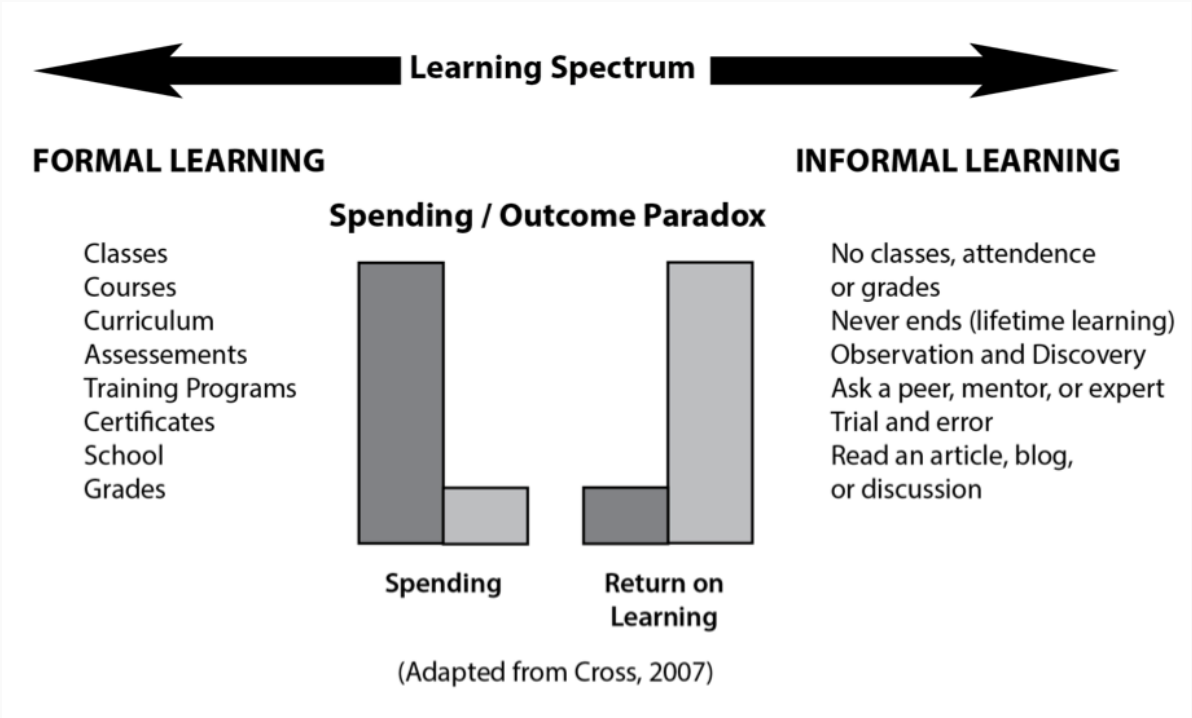

Figure 1. Learning spectrum

This leads us to a definition of *informal learning* as "the unofficial, unscheduled, impromptu way people learn to do their jobs . . . Informal learning is like riding a bike; the rider [learner] chooses the destination, the speed, and the route." (Cross, 2007, p. 236). In other words, learners decide what they need to learn and then establish their own learning objectives and agenda. In addition, learners determine when they should learn, and select the format and modality that best meets their needs. Perhaps most importantly, the learner is responsible for organizing and managing his or her own learning-related activities. To fully engage learners and to ensure that a transfer of knowledge occurs, informal learning should be authentic and ideally occur in the workplace or other performance setting, be situated in a meaningful context that builds on prior knowledge, and employ strategies and activities to promote transfer of knowledge (Boileau, 2011). In informal learning, learners are "pulled" into the learning experience based on a problem,

or identified knowledge and skills gap, which is determined by the learner who then engages in learning activities intended to close the knowledge gap or otherwise mitigate the performance challenge or problem.

In contrast, in *formal learning*, learning objectives and curricula are determined by someone else. Formal learning or "book learning" is what most people in western culture think of when they envision learning in terms of schools, classrooms, and instructors who decide what, when, and how learning is to take place. "Formal learning is like riding a bus: the driver [instructor] decides where the bus is going; the passengers [learners] are along for the ride" (Cross, 2007, p. 236). In formal learning, learning is "pushed" to the learners according to a set of needs or predetermined curricula that are established by someone other than the learner.

In this section, I have discussed informal and formal learning as co-existing in a spectrum or continuum of learning activities linked to experience and performance context over the course of a lifetime, as opposed to dichotomous branches of learning that are fixed in time and space. This is an important precept to keep in mind because increasingly, blended learning experiences may include elements or activities associated with formal learning settings such as lectures or media-based presentations, along with informal learning activities such as discussions with peers, Web-based searches for examples, and practice experimenting with new techniques and tools (Lohman, 2006).

Informal Learning Trends and Issues

This section examines some of the trends and issues associated with informal learning from an individual and organizational perspective. In previous generations, learning was (and still is) often viewed as separate from performance, and linked to identifiable stages of human social-cultural development. In terms of formal learning, this includes primary and secondary education (K-12) to prepare an individual for participation in society, whereas post-secondary education has historically provided additional preparation for a career with increased earnings potential. Informal learning, as discussed in the preceding sections, addresses learning in terms of a series of non-linear episodic events, experiences, and activities occurring in the real world over the course of a lifetime, having financial and social consequences for individuals and organizations.

Science learning. There is increased recognition of the need to support lifelong science learning in order to meet the growing demand for science and engineering jobs in a modern global economy. It can be argued that science literacy, acquired through informal learning, is essential to economic growth (as discussed in the next topic), and to promoting the shared cultural values of a democratic society. According to Falk et al. (2007), "the majority of the public constructs much of its understanding of science over the course of their lives, gathering information from many places and contexts, and for a diversity of reasons." (p. 455). Evidence of this trend can be seen in new standards for compulsory testing and curriculum changes, placing greater emphasis on STEM (science, technology, engineering, and mathematics) subjects in publicly funded K-12 education. Yet, the average adult spends a small fraction of their life (1-3 percent) in formal education related to science learning (Falk, Storksdieck, & Dierking, 2007). Indeed, the research literature suggests that most science learning, as with other domains of learning, occurs informally and is driven by self-identified needs and interests of learners. This suggests that informal learning activities within the workplace, personal investigation using internet-based tools and resources, and active leisure pursuits such as visits to museums, zoos and aquariums, and national parks account for the majority of science learning in America (Falk & Dierking, 2010).

Other forms of informal science learning include hobbies such as model rockets and drones, organic and sustainable farming, beekeeping, mineralogy, and amateur astronomy. Life events may also trigger a personal need for informal science learning via the web such as when individuals are diagnosed with an illness like cancer or heart disease, or in the wake of environmental disasters such as oil spills, the discovery of radon gas in rock, or tracking the path of a hurricane. The Internet now represents the major source of science information for adults and children, with the tipping point occurring in 2006, when the Internet surpassed broadcast media as a source for public science information, according to the Pew Internet and American Life Project (Falk & Dierking, 2010). In a similar fashion, more people now turn to the Internet for medical diagnostic information using services like WebMD.com, before scheduling an appointment with their physician.

Return on learning within organizations. The implications of informal learning for organizations are significant in terms of expectations for individual and organizational performance. Specifically, *return on learning* (i.e., return on spending for learning) has increasingly become linked to an organization's bottom-line. It is no longer enough to simply have well-trained employees with advanced degrees and certifications gained through formal education and training, unless employees are also able to demonstrate advanced skills leading to valued on-the-job performance outcomes. The result is a shift in many organizations from training to talent management, taking advantage of eLearning innovations, including online and just-in-time learning technologies, to support personalized and sustainable professional development. This trend is supported by a growing body of evidence from the Organisation for Economic Co-operation and Development (OECD.org), suggesting that informal learning in the workplace is a principal driver of human capital development for employees of all age groups, with the greatest impact shown in the performance of younger workers as advanced learning and skills are attained through work experience (De Grip, 2015).

Microtraining. As previously suggested, organizations have continued to over-invest in and, in some instances, overestimate the value of formal training programs relative to the spending/outcome paradox and return on learning, while potentially missing out on opportunities to fully leverage informal learning processes (Cross, 2007). *Microtraining* provides a possible mechanism to help address this perceived imbalance, by focusing attention along the entire learning spectrum, as opposed to a strict separation of learning activities between formal and informal learning domains. Microtraining is an instructional technology intervention that integrates formal with informal learning activities, using short learning segments designed for rapid development and dissemination of knowledge that can be completed in 15-minute time blocks, in close proximity to the work setting (De Vries & Brall, 2008). According to De Vries and Brall (2008), microtraining learning segments are used to provide a structure combining semi-formal learning activities with informal and ad hoc learning processes. This structure begins with activation of prior knowledge, followed by demonstration/practice, feedback session, and transfer strategy. In addition, all microtraining segments should promote critical thinking and reflection on work, to facilitate deeper learning.

The microtraining approach is generally well suited for performance remediation, knowledge refreshing, and development of mastery in topics already familiar to learners. Conversely, microtraining may be less ideally suited for novice learners unless it is combined with other strategies for scaffolding learning in order to build prerequisite knowledge and skills. The primary benefit of microtraining is in its ability to provide just-in-time, non-formal training within the work setting, causing minimal disruption to the daily work schedule as employees considered vital to the enterprise are not required to travel to another location in order for learning to occur (De Vries & Brall, 2008).

Microtraining draws from the theoretical foundations of constructivism and connectivism, recognizing the social aspects of informal learning, and the role of learning communities within communities of practice, for facilitation of lifelong learning. Learners play a central role in contributing to the collective knowledge of the community while building their personal sense of identity, at the same time providing a positive incentive for sustained participation in the learning community (Lave & Wenger, 1991). Organizations committed to microtraining understandably play an instrumental role in enabling communities of practice. In this capacity, the organization commits the resources to support development of microtraining learning units. Implementation of microtraining via learning communities also requires different roles for learners and trainers than those traditionally held within the organization. Specifically, learners assume primary responsibility for personal and team learning processes; whereas the trainer's role shifts from presenter to learning coach/facilitator in support of informal learning activities.

Microlearning. A closely related trend is *microlearning*, which is an emergent informal learning strategy intended to quickly close gaps in knowledge and skills, in the context of completing a task. Microlearning is most often mediated by Web 2.0 technology on mobile devices, involving short bursts of inter-connected and loosely coupled learning activities, having a narrow topical focus (Buchem & Hamelmann, 2010). In other words, microlearning tends to build depth, as opposed to breadth of knowledge, particularly when the learning event is situated in the performance of a skill needed to complete a task.

Microlearning is dependent upon access to microcontent, referring to small, user-created, granular pieces of content or learning objects in varied media format ranging from a YouTube video to a Wikipedia entry, intended to convey a single

concept or idea. Learners engage in microlearning activities to find immediate answers to questions that arise in completing a task such as “how does this work?”, or “what does this mean?”, or “who said that?”. A common theme is that the microlearning event triggered by the informal learning inquiry draws context from the learning setting and performance task at hand, where immediacy in the application of learning is the primary objective. This type of episodic informal learning event stands in contrast to learning simply for learning’s sake, as it relates to knowledge retention and recollection. There are additional affordances that may be associated with microlearning, which include:

- Diversity of sources – Sources for microlearning activities include a range of options and services in diverse media formats including blogs, wikis, Kahn Academy video courses and lessons, YouTube tutorials, infographics, TEDTalks, and an increasing number of Open Educational Resources (OER).
- Learning types – Microlearning may be applied to a wide range of learning types, goals, preferences, and theoretical frameworks (e.g., cognitivist, constructivist, connectivist), producing mashups of informal and formal learning activities.
- Cost – Production costs of learning objects used in microlearning tend to be lower than traditional course development costs given the brevity and narrow topical focus of learning episodes. As the range of topics and number of Open Educational Resources continues to rise, content costs should be expected to continue to decline.
- Access – Increased Web 2.0 and mobile access for content production and consumption has made microlearning ubiquitous for learners in many parts of the world, via learner-defined Personal Learning Environments (PLE) where all you need is a smartphone to participate.
- Connected learning – Microlearning facilitated by social media technologies (e.g., Facebook, Twitter, LinkedIn) provides new ways for collaborative and cooperative learning to occur via Personal Learning Networks (PLN) and within Communities of Practice (CoP).

Performance support tools. Another informal learning trend is Performance Support Tools (PST). Rossett and Schafer (2007) defined performance support as “A helper in life and work, performance support is a repository for information, processes, and perspectives that inform and guide planning and action.” (p. 2). Performance support tools are in many ways analogous to the concepts and affordances discussed with microlearning. Indeed, many of the tools and activities used to support learning and performance discussed in the preceding paragraphs have existed since the early days of personal computing and the Internet, in the form of Electronic Performance Support Systems (EPSS). Gery (1991) first coined the term EPSS as the intentional and purposeful integration of technology, information and cognitive tools to provide on-demand access to expert advice, guidance, assistance, and training to facilitate high performance levels on the job, while requiring minimal support from others.

Performance Support Tools serve as job-aids to help facilitate completion of a task or achievement of a goal, while at the same time have a mediating effect on informal learning activities that support desired performance outcomes (Boileau, 2011). This results in the formation of reproducible patterns for learning and performance, comprised of linked actions and operations that are aligned with performance outcomes, adding to the learner’s personal knowledge and skills repertoire. Over time, these regular and recurring patterns in learning and performance activity systems can evolve into practices shared by other members of the community of practice (Greeno & Engeström, 2014). These practices are shaped by and, in turn, shape the way PSTs are used to support learning and to affect the transfer of knowledge and skills to on-the-job performance. Information and communications technology (e.g., social media) has been shown to have a mediating effect on practice, using digital representation of signs and symbols for linguistic communication, along with knowledge objects that are produced and exist within the community (Boileau, 2011).

As previously stated, Rossett and Schafer (2007) viewed this effect on practice in terms of support for performance, specifically by building a repository of externally curated information, processes, resources and perspectives that inform and guide performance planning and execution, using performance support tools. This approach is less concerned with new knowledge acquisition and more so in direct application and transfer of knowledge, mediated by PSTs.

Rossett and Schafer (2007) further categorized PSTs as sidekicks and planners. A *sidekick* functions as a job aid in the context of specific types of activity performed in realtime, concurrent with the task at hand. An example of a sidekick is

a GPS navigation system (e.g., Google® maps application on a mobile device) providing turn-by-turn navigational instructions in the situated context of operating a vehicle.

A *planner*, on the other hand, is typically used in advance of the activity to access prior, externally created, knowledge shared by the community of practice, for use in a specific learning and performance context. An example of this would be accessing Google® Maps via the Web to determine (i.e., plan) the most efficient route of travel between two pre-determined points, in advance of starting the trip.

A distinction can be made between performance support tools and other types of tools such as a file cabinet or office chair, used to support informal learning and performance. The difference with non-PST tools is that there is no innate support for the informal learning or performance activity; there is only potential support for manipulating the environment to make it more conducive to achieving the goal for the activity. In a similar manner, "Instruction is not performance support. It is planned experience that enables an individual to acquire skills and knowledge to advance the capability to perform." (Rossett & Schafer, 2007, p. 5). In other words, there is a separation between the learning event and the performance context. Performance support for informal learning may be further characterized by looking at four factors: convergence, simplicity, relevance to performance, and personalization (Rossett & Schafer, 2007).

- Convergence is rooted in proximity, meaning that the information and guidance to support learning is situated where the learner/performer and task or challenge exists.
- Simplicity means having a focus on the content in the here and now, to accomplish a task or to quickly close a gap in skills and knowledge.
- Relevance increases support for the performer, ensuring the right tools for the job to accomplish his or her goals in a specific context, resulting in increased learner motivation.
- Personalization allows the learner to dynamically adjust the level of information and support needed, according to the needs of the situation and the prior experience of the learner. Personalization also facilitates user-generated content adding new insight and lessons learned, thus increasing the utility of the tool and contributing new artifacts to the collective body of knowledge available to the community of practice, via a more integrative user experience.

Digital open badging. As opportunities for informal learning continue to increase for personal and professional development across different industries and disciplines, a question on the minds of many learners is how informal learning achievements may be recognized (Law, 2015). *Digital open badges* provide validated recognition of participation and achievement from informal learning activities, and evidence of learning milestones such as completion of a microtraining learning segment. The use of digital badges can also be seen with formal learning in educational institutions, as a motivational tool and in the form of micro-credentials to demonstrate incremental achievement in a variety of education settings.

The amount of OER content available to support informal learning has increased exponentially in recent years in support of microlearning. Concurrent with the increase in OER is the emergence of different business models to support the issuance of digital open badges. For example, learners can access OER content for free, through a variety of MOOC (Massive Open Online Course) service providers such as EdX and Coursera. These services provide access to hundreds of courses for free. If you would like to receive a micro-credential (i.e., certificate) as evidence of successful completion, however, you are required to pay a nominal fee. This changes our definition of informal learning provided by Cross (2007) when learners begin to pay-for certification by MOOC providers, because informal learning is no longer anonymous when attendance is tracked and grades are issued (Law, 2015). This trend is expected to continue according to Law (2015) as "learners in an informal environment are willing to pay for certification and recognition of unsupported informal learning." (p. 232).

Summary. In this section, we have examined some of the trends, issues, and tools used to facilitate informal learning, noting the emergence of four themes. First is that informal learning is situated in performance, knowledge development, or in completion of a task, and is driven by intrinsic as well as extrinsic motivation. Second, as organizations refocus their attention from training to talent management, they look to innovative methods and learner-centered processes to enable communities of practice. Third is that technology and more specifically, performance

support tools are at the forefront of informal learning, serving as job-aids intended to mediate informal learning activities that support job performance. Finally, the use of digital open badges is expected to increase, to eventually provide validated evidence of informal learning outcomes.

Informal Learning and Culture

I conclude this chapter by considering the role of culture in learning. The paradigm used to understand informal learning is influenced by a set of assumptions around learning that are firmly rooted in culture. For example, the concept of informal learning in the West is inevitably linked to Western philosophies such as liberalism, progressivism, humanism, behaviorism, and radicalism (Merriam & Bierema, 2014). This provides a unique cultural lens through which learning events and activities are perceived that is further shaped by personal experience and access to information surrounding global events, which may vastly differ from the view of education and learning held by people living in different cultural settings from our own. Ironically, while informal or experiential learning is clearly evident in all cultures, "it is less valued in the West where formal book knowledge predominates." (Merriam & Bierema, 2014, p. 243). It is also interesting to note that this is consistent with the "spending/outcome paradox" noted by Cross (2007) that was discussed earlier in this chapter.

Merriam and Bierema (2014) identified three themes in knowing and learning that are more prevalent among **non**-Western cultures, characterized as communal, lifelong and informal, and holistic. To say that learning is *communal*implies that it is situated within the community as a means for collaborative knowledge development that benefits from, and exists within, the entire community through strong interdependency and relationships among the members. This stands in contrast with Western culture in which the learner is more typically viewed from an individualistic and independent perspective. The second theme is that informal learning is a *lifelong* pursuit that is also situated within the communal ethic (Merriam & Kim, 2011). The concept of informal lifelong learning is evident in the Buddhist principles of mindfulness; can be seen in the African cultural expectation that members of the community share their knowledge with each other for the benefit of the community at large; and may be found in the words of the Prophet Muhammad: to "Seek knowledge from the cradle to the grave." Finally, the culturally-based theme of informal learning as *holistic* represents a clear shift from a Western emphasis on cognitive knowing, to alternative types of learning that include: somatic, spiritual, emotional, moral, experiential and social learning (Merriam & Kim, 2011).

Approaching informal learning from a more culturally holistic perspective creates new opportunities to increase cultural sensitivity among increasingly diverse learner and worker populations, by recognizing that learning is embedded in performance activities and in the experiences of everyday life.

Application Exercises

- Take five minutes and think about your own experiences with informal learning. How has technology influenced your informal learning? Give your best assumption of how much informal learning occurs outside of a technological medium vs. how much informal learning occurs through a technological medium.
- Think of a work or school situation where learning was formal. Knowing that there is a better chance of meeting learning outcomes with informal learning, what adjustments would you make to create a more informal learning experience?

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18

Overview of Problem-Based Learning

Definitions and Distinctions

John R. Savery

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Introduction

When asked to provide an overview of problem-based learning for the introductory issue of this journal, I readily agreed, thinking it was a wonderful opportunity to write about a subject I care about deeply. As I began to jot down ideas about "What is PBL?" it became clear that I had a problem. Some of what I knew about PBL was learned through teaching and practicing PBL, but so much more had been acquired by reading the many papers authored by experts with decades of experience conducting research and practicing problem-based learning. These authors had frequently begun their papers with a context-setting discussion of "What is PBL?" What more was there to say?

Origins of PBL

In discussing the origins of PBL, Boud and Feletti (1997) stated:

> *PBL as it is generally known today evolved from innovative health sciences curricula introduced in North America over 30 years ago. Medical education, with its intensive pattern of basic science lectures followed by an equally exhaustive clinical teaching programme, was rapidly becoming an ineffective and inhumane way to prepare students, given the explosion in medical information and new technology and the rapidly changing demands of future practice. Medical faculty at McMaster University in Canada introduced the tutorial process, not only as a specific instructional method (Barrows & Tamblyn, 1980) but also as central to their philosophy for structuring an entire curriculum promoting student-centered, multidisciplinary education, and lifelong learning in professional practice. (p. 2)*

Barrows (1994; 1996) recognized that the process of patient diagnosis (doctors' work) relied on a combination of a hypothetical-deductive reasoning process and expert knowledge in multiple domains. Teaching discipline specific content (anatomy, neurology, pharmacology, psychology, etc.) separately, using a "traditional" lecture approach, did little to provide learners with a context for the content or for its clinical application. Further confounding this traditional approach was the rapidly changing knowledge base in science and medicine, which was driving changes in both theory and practice.

During the 1980s and 1990s the PBL approach was adopted in other medical schools and became an accepted instructional approach across North America and in Europe. There were some who questioned whether or not a physician trained using PBL was as well prepared for professional practice as a physician trained using traditional approaches. This was a fair question, and extensive research was conducted to answer it. A meta-analysis of 20 years of PBL evaluation studies was conducted by Albanese and Mitchell (1993), and also by Vernon and Blake (1993), and concluded that a problem-based approach to instruction was equal to traditional approaches in terms of conventional tests of knowledge (i.e., scores on medical board examinations), and that students who studied using PBL exhibited better clinical problem-solving skills. A smaller study of graduates of a physical therapy program that utilized PBL (Denton, Adams, Blatt, & Lorish, 2000) showed that graduates of the program performed equally well with PBL or traditional approaches but students reported a preference for the problem-centered approach. Anecdotal reports from PBL practitioners suggest that students are more engaged in learning the expected content (Torp & Sage, 2002).

However, a recent report on a systematic review and meta-analysis on the effectiveness of PBL used in higher education programs for health professionals (Newman, 2003) stated that "existing overviews of the field do not provide high quality evidence with which to provide robust answers to questions about the effectiveness of PBL" (p. 5). Specifically this analysis of research studies attempted to compare PBL with traditional approaches to discover if PBL increased performance in adapting to and participating in change; dealing with problems and making reasoned decisions in unfamiliar situations; reasoning critically and creatively; adopting a more universal or holistic approach; practicing empathy, appreciating the other person's point of view; collaborating productively in groups or teams; and identifying one's own strengths and weaknesses and undertaking appropriate remediation (self-directed learning). A lack of well-designed studies posed a challenge to this research analysis, and an article on the same topic by Sanson-Fisher and Lynagh (2005) concluded that "Available evidence, although methodologically flawed, offers little support for the superiority of PBL over traditional curricula" (p. 260). This gap in the research on the short-term and long-term effectiveness of using a PBL approach with a range of learner populations definitely indicates a need for further study.

Despite this lack of evidence, the adoption of PBL has expanded into elementary schools, middle schools, high schools, universities, and professional schools (Torp & Sage, 2002). The University of Delaware (http://www.udel.edu/pbl/) has an active PBL program and conducts annual training institutes for instructors wanting to become tutors. Samford University in Birmingham, Alabama (http://www.samford.edu/pbl/) has incorporated PBL into various undergraduate programs within the Schools of Arts and Sciences, Business, Education, Nursing, and Pharmacy. The Illinois Mathematics and Science Academy (http://www.imsa.edu/center/) has been providing high school students with a complete PBL curriculum since 1985 and serves thousands of students and teachers as a center for research on problem-based learning. The Problem-based Learning Institute (PBLI) (http://www.pbli.org/) has developed curricular materials (i.e., problems) and teacher-training programs in PBL for all core disciplines in high school (Barrows & Kelson, 1993). PBL is used in multiple domains of medical education (dentists, nurses, paramedics, radiologists, etc.) and in content domains as diverse as MBA programs (Stinson & Milter, 1996), higher education (Bridges & Hallinger, 1996), chemical engineering (Woods, 1994), economics (Gijselaers, 1996), architecture (Kingsland, 1989), and pre-service teacher education (Hmelo-Silver, 2004). This list is by no means exhaustive, but is illustrative of the multiple contexts in which the PBL instructional approach is being utilized.

The widespread adoption of the PBL instructional approach by different disciplines, for different age levels, and in different content domains has produced some misapplications and misconceptions of PBL (Maudsley, 1999). Certain practices that are called PBL may fail to achieve the anticipated learning outcomes for a variety of reasons. Boud and Feletti (1997, p. 5) described several possible sources for the confusion:

- Confusing PBL as an approach to curriculum design with the teaching of problem-solving,
- Adoption of a PBL proposal without sufficient commitment of staff at all levels,
- Lack of research and development on the nature and type of problems to be used,
- Insufficient investment in the design, preparation and ongoing renewal of learning resources,
- Inappropriate assessment methods which do not match the learning outcomes sought in problem-based programs, and
- Evaluation strategies which do not focus on the key learning issues and which are implemented and acted upon far too late.

The possible sources of confusion listed above appear to hold a naïve view of the rigor required to teach with this learner-centered approach. In the next section I will discuss some of the essential characteristics and features of PBL.

Characteristics of PBL

PBL is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem. Critical to the success of the approach is the selection of ill-structured problems (often interdisciplinary) and a tutor who guides the learning process and conducts a thorough debriefing at the conclusion of the learning experience. Several authors have described the characteristics and features required for a successful PBL approach to instruction. The reader is encouraged to read the source documents, as brief quotes do not do justice to the level of detail provided by the authors. Boud and Feletti (1997) provided a list of the practices considered characteristic of the philosophy, strategies, and tactics of problem-based learning. Duch, Groh, and Allen (2001) described the methods used in PBL and the specific skills developed, including the ability to think critically, analyze and solve complex, real-world problems, to find, evaluate, and use appropriate learning resources; to work cooperatively, to demonstrate effective communication skills, and to use content knowledge and intellectual skills to become continual learners. Torp and Sage (2002) described PBL as focused, experiential learning organized around the investigation and resolution of messy, real-world problems. They describe students as engaged problem solvers, seeking to identify the root problem and the conditions needed for a good solution and in the process becoming self-directed learners. Hmelo-Silver (2004) described PBL as an instructional method in which students learn through facilitated problem solving that centers on a complex problem that does not have a single correct answer. She noted that students work in collaborative groups to identify what they need to learn in order to solve a problem, engage in self-directed learning, apply their new knowledge to the problem, and reflect on what they learned and the effectiveness of the strategies employed.

On the website for the PBL Initiative (http://www.pbli.org/pbl/generic_pbl.htm) Barrows (nd) describes in detail a set of Generic PBL Essentials, reduced to bullet points below. Each of these essential characteristics has been extended briefly to provide additional information and resources.

- Students must have the responsibility for their own learning.
  PBL is a learner-centered approach—students engage with the problem with whatever their current knowledge/experience affords. Learner motivation increases when responsibility for the solution to the problem and the process rests with the learner (Savery & Duffy, 1995) and as student ownership for learning increases (Savery, 1998; 1999). Inherent in the design of PBL is a public articulation by the learners of what they know and about what they need to learn more. Individuals accept responsibility for seeking relevant information and bringing that back to the group to help inform the development of a viable solution.
- The problem simulations used in problem-based learning must be ill-structured and allow for free inquiry.
  Problems in the real world are ill-structured (or they would not be problems). A critical skill developed through PBL is the ability to identify the problem and set parameters on the development of a solution. When a problem is well-structured learners are less motivated and less invested in the development of the solution. (See the section on Problems vs. Cases below.)
- Learning should be integrated from a wide range of disciplines or subjects.
  Barrows notes that during self-directed learning, students should be able to access, study and integrate information from all the disciplines that might be related to understanding and resolving a particular problem—just as people in the real world must recall and apply information integrated from diverse sources in their work. The rapid expansion of information has encouraged a cross-fertilization of ideas and led to the development of new disciplines. Multiple perspectives lead to a more thorough understanding of the issues and the development of a more robust solution.
- Collaboration is essential.
  In the world after school most learners will find themselves in jobs where they need to share information and work productively with others. PBL provides a format for the development of these essential skills. During a PBL session the tutor will ask questions of any and all members to ensure that information has been shared between members in relation to the group's problem.
- What students learn during their self-directed learning must be applied back to the problem with reanalysis and resolution.
  The point of self-directed research is for individuals to collect information that will inform the group's decision-making process in relation to the problem. It is essential that each individual share coherently what he or she has learned and how that information might impact on developing a solution to the problem.
- A closing analysis of what has been learned from work with the problem and a discussion of what concepts and principles have been learned are essential.
  Given that PBL is a very engaging, motivating and involving form of experiential learning, learners are often very close to the immediate details of the problem and the proposed solution. The purpose of the post-experience debriefing process (see Steinwachs, 1992; Thiagarajan, 1993 for details on debriefing) is to consolidate the learning and ensure that the experience has been reflected upon. Barrows (1988) advises that learners examine all facets of the PBL process to better understand what they know, what they learned, and how they performed.
- Self and peer assessment should be carried out at the completion of each problem and at the end of every curricular unit.
  These assessment activities related to the PBL process are closely related to the previous essential characteristic of reflection on knowledge gains. The significance of this activity is to reinforce the self-reflective nature of learning and sharpen a range of metacognitive processing skills.
- The activities carried out in problem-based learning must be those valued in the real world.
  A rationale and guidelines for the selection of authentic problems in PBL is discussed extensively in Savery & Duffy (1995), Stinson and Milter (1996), Wilkerson and Gijselaers (1996), and MacDonald (1997). The transfer of skills learned through PBL to a real-world context is also noted by Bransford, Brown, & Cocking (2000, p. 77).
- Student examinations must measure student progress towards the goals of problem-based learning.
  The goals of PBL are both knowledge-based and process-based. Students need to be assessed on both dimensions at regular intervals to ensure that they are benefiting as intended from the PBL approach. Students are responsible for the content in the curriculum that they have "covered" through engagement with problems. They need to be able to recognize and articulate what they know and what they have learned.
- Problem-based learning must be the pedagogical base in the curriculum and not part of a didactic curriculum.

Reflection

The author states, “The problem simulations used in problem-based learning must be ill-structured and allow for free inquiry.” Create your own “messy, real-world” problem. Decide on a main curriculum area (most good problems are interdisciplinary) and an age group. Construct a problem that could be used in a problem-based classroom. Share it with two people and get their feedback. Revise the problem and submit.

Summary

These descriptions of the characteristics of PBL identify clearly 1) the role of the tutor as a facilitator of learning, 2) the responsibilities of the learners to be self-directed and self-regulated in their learning, and 3) the essential elements in the design of ill-structured instructional problems as the driving force for inquiry. The challenge for many instructors when they adopt a PBL approach is to make the transition from teacher as knowledge provider to tutor as manager and facilitator of learning (see Ertmer & Simons, 2006). If teaching with PBL were as simple as presenting the learners with a “problem” and students could be relied upon to work consistently at a high level of cognitive self-monitoring and self-regulation, then many teachers would be taking early retirement. The reality is that learners who are new to PBL require significant instructional scaffolding to support the development of problem-solving skills, self-directed learning skills, and teamwork/collaboration skills to a level of self-sufficiency where the scaffolds can be removed. Teaching institutions that have adopted a PBL approach to curriculum and instruction (including those noted earlier) have developed extensive tutor-training programs in recognition of the critical importance of this role in facilitating the PBL learning experience. An excellent resource is The Tutorial Process by Barrows (1988), which explains the importance of the tutor as the metacognitive coach for the learners.

Given that change to teaching patterns in public education moves at a glacial pace, it will take time for institutions to commit to a full problem-based learning approach. However, there are several closely related learner-centered instructional strategies, such as project-based learning, case-based learning, and inquiry-based learning, that are used in a variety of content domains that can begin to move students along the path to becoming more self-directed in their learning. In the next section I examine some of similarities and differences among these approaches.

Problem-based Learning vs. Case-based and Project-based Learning

Both case-based and project-based approaches are valid instructional strategies that promote active learning and engage the learners in higher-order thinking such as analysis and synthesis. A well-constructed case will help learners to understand the important elements of the problem/situation so that they are better prepared for similar situations in the future. Case studies can help learners develop critical thinking skills in assessing the information provided and in identifying logic flaws or false assumptions. Working through the case study will help learners build discipline/context-specific vocabulary/terminology, and an understanding of the relationships between elements presented in the case study. When a case study is done as a group project, learners may develop improved communication and collaboration skills. Cases may be used to assess student learning after instruction, or as a practice exercise to prepare learners for a more authentic application of the skills and knowledge gained by working on the case.

Project-based learning is similar to problem-based learning in that the learning activities are organized around achieving a shared goal (project). This instructional approach was described by Kilpatrick (1921), as the Project Method and elaborated upon by several researchers, including Blumenfeld, Soloway, Marx, Krajcik, Guzdial, and Palinscar (1991). Within a project-based approach learners are usually provided with specifications for a desired end product (build a rocket, design a website, etc.) and the learning process is more oriented to following correct procedures. While working

on a project, learners are likely to encounter several “problems” that generate “teachable moments” (see Lehman, George, Buchanan, & Rush, this issue). Teachers are more likely to be instructors and coaches (rather than tutors) who provide expert guidance, feedback and suggestions for “better” ways to achieve the final product. The teaching (modeling, scaffolding, questioning, etc.) is provided according to learner need and within the context of the project. Similar to case-based instruction learners are able to add an experience to their memory that will serve them in future situations.

While cases and projects are excellent learner-centered instructional strategies, they tend to diminish the learner’s role in setting the goals and outcomes for the “problem.” When the expected outcomes are clearly defined, then there is less need or incentive for the learner to set his/her own parameters. In the real world it is recognized that the ability to both define the problem and develop a solution (or range of possible solutions) is important.

Problem-based Learning vs. Inquiry-based Learning

These two approaches are very similar. Inquiry-based learning is grounded in the philosophy of John Dewey (as is PBL), who believed that education begins with the curiosity of the learner. Inquiry-based learning is a student-centered, active learning approach focused on questioning, critical thinking, and problem solving. Inquiry-based learning activities begin with a question followed by investigating solutions, creating new knowledge as information is gathered and understood, discussing discoveries and experiences, and reflecting on new-found knowledge. Inquiry-based learning is frequently used in science education (see, for example, the Center for Inquiry-Based Learning http://www.biology.duke.edu/cibl/) and encourages a hands-on approach where students practice the scientific method on authentic problems (questions). The primary difference between PBL and inquiry-based learning relates to the role of the tutor. In an inquiry-based approach the tutor is both a facilitator of learning (encouraging/expecting higher-order thinking) and a provider of information. In a PBL approach the tutor supports the process and expects learners to make their thinking clear, but the tutor does not provide information related to the problem—that is the responsibility of the learners. A more detailed discussion comparing and contrasting these two approaches would be an excellent topic for a future article in this journal.

Challenges Still Ahead for PBL

Problem-based learning appears to be more than a passing fad in education. This instructional approach has a solid philosophical and epistemological foundation (which, due to space constraints, is not discussed fully here; see Duffy & Cunningham, 1996, Savery & Duffy, 1995; Torp & Sage, 2002) and an impressive track record of successful graduates in medical education and many other fields of study. In commenting on the adoption of PBL in undergraduate education, White (1996) observed:

> *Many of the concerns that prompted the development of problem-based learning in medical schools are echoed today in undergraduate education. Content-laden lectures delivered to large enrollment classes typify science courses at most universities and many colleges. Professional organizations, government agencies, and others call for a change in how science is taught as well as what is taught. While problem-based learning is well known in medical education, it is almost unknown in the undergraduate curriculum. (p. 75)*

The use of PBL in undergraduate education is changing gradually (e.g., Samford University, University of Delaware) in part because of the realization by industry and government leaders that this information age is for real. At the Wingspread Conference (1994) leaders from state and federal governments and experts from corporate, philanthropic, higher education, and accreditation communities were asked for their opinions and visions of undergraduate education and to identify some important characteristics of quality performance for college and university graduates. Their report identified as important high-level skills in communication, computation, technological literacy, and information retrieval that would enable individuals to gain and apply new knowledge and skills as needed. The report also cited as important

the ability to arrive at informed judgments by effectively defining problems, gathering and evaluating information related to those problems, and developing solutions; the ability to function in a global community; adaptability; ease with diversity; motivation and persistence (for example being a self-starter); ethical and civil behavior; creativity and resourcefulness; technical competence; and the ability to work with others, especially in team settings. Lastly, the Wingspread Conference report noted the importance of a demonstrated ability to deploy all of the previous characteristics to address specific problems in complex, real-world settings, in which the development of workable solutions is required. Given this set of characteristics and the apparent success of a PBL approach at producing graduates with these characteristics one could hope for increased support in the use of PBL in undergraduate education.

The adoption of PBL (and any other instructional innovation) in public education is a complicated undertaking. Most state-funded elementary schools, middle schools, and high schools are constrained by a state-mandated curriculum and an expectation that they will produce a uniform product. High-stakes standardized testing tends to support instructional approaches that teach to the test. These approaches focus primarily on memorization through drill and practice, and rehearsal using practice tests. The instructional day is divided into specific blocks of time and organized around subjects. There is not much room in this structure for teachers or students to immerse themselves in an engaging problem. However, there are many efforts underway to work around the constraints of traditional classrooms (see, for example, PBL Design and Invention Center -http://www.pblnet.org/, or the PBL Initiative—http://www.pbli.org/core.htm), as well as the article by Lehman and his colleagues in this issue. I hope in future issues of this journal to learn more about implementations of PBL in K–12 educational settings.

We do live in interesting times—students can now access massive amounts of information that was unheard-of a decade ago, and there are more than enough problems to choose from in a range of disciplines. In my opinion, it is vitally important that current and future generations of students experience a problem-based learning approach and engage in constructive solution-seeking activities. The bar has been raised as the 21st century gathers momentum and more than ever, higher-order thinking skills, self-regulated learning habits, and problem-solving skills are necessary for all students. Providing students with opportunities to develop and refine these skills will take the efforts of many individuals—especially those who would choose to read a journal named the Interdisciplinary Journal of Problem-based Learning.

Application Exercises

- What are the pros and cons of PBL?
- For a specific learner audience and set of learning objectives, design four class activities, one that would follow each of the following four learning theories: case-based learning, project-based learning, inquiry-based learning, and problem-based learning.

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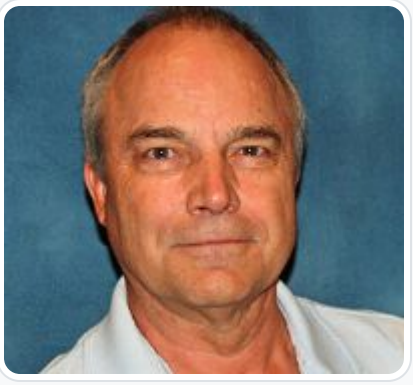

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19

Connectivism

George Siemens

Editor's Note

This landmark paper, originally published on Siemens's personal website in 2004 before being published in the International Journal of Instructional Technology and Distance Learning, has been cited thousands of times and is considered a landmark theory for the Internet age. Siemens has since added a website to explore this concept.

Siemens, G. (2004). *Connectivism: A learning theory for the digital age.* Retrieved from http://www.elearnspace.org/Articles/connectivism.htm

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Introduction

Behaviorism, cognitivism, and constructivism are the three broad learning theories most often utilized in the creation of instructional environments. These theories, however, were developed in a time when learning was not impacted through technology. Over the last twenty years, technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes, should be reflective of underlying social environments. Vaill emphasizes that "learning must be a way of being—an ongoing set of attitudes and actions by individuals and groups that they employ to try to keep abreast of the surprising, novel, messy, obtrusive, recurring events . . ." (1996, p. 42).

Learners as little as forty years ago would complete the required schooling and enter a career that would often last a lifetime. Information development was slow. The life of knowledge was measured in decades. Today, these foundational principles have been altered. Knowledge is growing exponentially. In many fields the life of knowledge is now measured in months and years. Gonzalez (2004) describes the challenges of rapidly diminishing knowledge life:

> *One of the most persuasive factors is the shrinking half-life of knowledge. The "half-life of knowledge" is the time span from when knowledge is gained to when it becomes obsolete. Half of what is known today was not known 10 years ago. The amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months according to the American Society of Training and Documentation (ASTD). To*

combat the shrinking half-life of knowledge, organizations have been forced to develop new methods of deploying instruction.

Some significant trends in learning:

- Many learners will move into a variety of different, possibly unrelated fields over the course of their lifetime.
- Informal learning is a significant aspect of our learning experience. Formal education no longer comprises the majority of our learning. Learning now occurs in a variety of ways—through communities of practice, personal networks, and through completion of work-related tasks.
- Learning is a continual process, lasting for a lifetime. Learning and work related activities are no longer separate. In many situations, they are the same.
- Technology is altering (rewiring) our brains. The tools we use define and shape our thinking.
- The organization and the individual are both learning organisms. Increased attention to knowledge management highlights the need for a theory that attempts to explain the link between individual and organizational learning.
- Many of the processes previously handled by learning theories (especially in cognitive information processing) can now be off-loaded to, or supported by, technology.
- Know-how and know-what is being supplemented with know-where (the understanding of where to find knowledge needed).

Background

Driscoll (2000) defines learning as "a persisting change in human performance or performance potential…[which] must come about as a result of the learner's experience and interaction with the world" (p. 11). This definition encompasses many of the attributes commonly associated with behaviorism, cognitivism, and constructivism—namely, learning as a lasting changed state (emotional, mental, physiological (i.e., skills)) brought about as a result of experiences and interactions with content or other people.

Driscoll (2000, pp. 14–17) explores some of the complexities of defining learning. Debate centers on:

- Valid sources of knowledge—Do we gain knowledge through experiences? Is it innate (present at birth)? Do we acquire it through thinking and reasoning?
- Content of knowledge—Is knowledge actually knowable? Is it directly knowable through human experience?
- The final consideration focuses on three epistemological traditions in relation to learning: Objectivism, Pragmatism, and Interpretivism
    - Objectivism (similar to behaviorism) states that reality is external and is objective, and knowledge is gained through experiences.
    - Pragmatism (similar to cognitivism) states that reality is interpreted, and knowledge is negotiated through experience and thinking.
    - Interpretivism (similar to constructivism) states that reality is internal, and knowledge is constructed.

All of these learning theories hold the notion that knowledge is an objective (or a state) that is attainable (if not already innate) through either reasoning or experiences. Behaviorism, cognitivism, and constructivism (built on the epistemological traditions) attempt to address how it is that a person learns.

Behaviorism states that learning is largely unknowable, that is, we can't possibly understand what goes on inside a person (the "black box theory"). Gredler (2001) expresses behaviorism as being comprised of several theories that make three assumptions about learning:

1. Observable behaviour is more important than understanding internal activities
2. Behaviour should be focused on simple elements: specific stimuli and responses
3. Learning is about behaviour change

Cognitivism often takes a computer information processing model. Learning is viewed as a process of inputs, managed in short term memory, and coded for long-term recall. Cindy Buell details this process: “In cognitive theories, knowledge is viewed as symbolic mental constructs in the learner’s mind, and the learning process is the means by which these symbolic representations are committed to memory.”

Constructivism suggests that learners create knowledge as they attempt to understand their experiences (Driscoll, 2000, p. 376). Behaviorism and cognitivism view knowledge as external to the learner and the learning process as the act of internalizing knowledge. Constructivism assumes that learners are not empty vessels to be filled with knowledge. Instead, learners are actively attempting to create meaning. Learners often select and pursue their own learning. Constructivist principles acknowledge that real-life learning is messy and complex. Classrooms which emulate the “fuzziness” of this learning will be more effective in preparing learners for life-long learning.

Limitations of Behaviorism, Cognitivism, and Constructivism

A central tenet of most learning theories is that learning occurs inside a person. Even social constructivist views, which hold that learning is a socially enacted process, promotes the principality of the individual (and her/his physical presence—i.e., brain-based) in learning. These theories do not address learning that occurs outside of people (i.e., learning that is stored and manipulated by technology). They also fail to describe how learning happens within organizations.

Learning theories are concerned with the actual process of learning, not with the value of what is being learned. In a networked world, the very manner of information that we acquire is worth exploring. The need to evaluate the worthiness of learning something is a meta-skill that is applied before learning itself begins. When knowledge is subject to paucity, the process of assessing worthiness is assumed to be intrinsic to learning. When knowledge is abundant, the rapid evaluation of knowledge is important. Additional concerns arise from the rapid increase in information. In today’s environment, action is often needed without personal learning—that is, we need to act by drawing information outside of our primary knowledge. The ability to synthesize and recognize connections and patterns is a valuable skill.

Many important questions are raised when established learning theories are seen through technology. The natural attempt of theorists is to continue to revise and evolve theories as conditions change. At some point, however, the underlying conditions have altered so significantly, that further modification is no longer sensible. An entirely new approach is needed.

Some questions to explore in relation to learning theories and the impact of technology and new sciences (chaos and networks) on learning:

- How are learning theories impacted when knowledge is no longer acquired in the linear manner?
- What adjustments need to be made with learning theories when technology performs many of the cognitive operations previously performed by learners (information storage and retrieval).
- How can we continue to stay current in a rapidly evolving information ecology?
- How do learning theories address moments where performance is needed in the absence of complete understanding?
- What is the impact of networks and complexity theories on learning?
- What is the impact of chaos as a complex pattern recognition process on learning?
- With increased recognition of interconnections in differing fields of knowledge, how are systems and ecology theories perceived in light of learning tasks?

An Alternative Theory

Including technology and connection making as learning activities begins to move learning theories into a digital age. We can no longer personally experience and acquire learning that we need to act. We derive our competence from

forming connections. Karen Stephenson states:

> *Experience has long been considered the best teacher of knowledge. Since we cannot experience everything, other people's experiences, and hence other people, become the surrogate for knowledge. 'I store my knowledge in my friends' is an axiom for collecting knowledge through collecting people (undated).*

Chaos is a new reality for knowledge workers. ScienceWeek (2004) quotes Nigel Calder's definition that chaos is "a cryptic form of order." Chaos is the breakdown of predictability, evidenced in complicated arrangements that initially defy order. Unlike constructivism, which states that learners attempt to foster understanding by meaning making tasks, chaos states that the meaning exists—the learner's challenge is to recognize the patterns which appear to be hidden. Meaning-making and forming connections between specialized communities are important activities.

Chaos, as a science, recognizes the connection of everything to everything. Gleick (1987) states: "In weather, for example, this translates into what is only half-jokingly known as the Butterfly Effect—the notion that a butterfly stirring the air today in Peking can transform storm systems next month in New York" (p. 8). This analogy highlights a real challenge: "sensitive dependence on initial conditions" profoundly impacts what we learn and how we act based on our learning. Decision making is indicative of this. If the underlying conditions used to make decisions change, the decision itself is no longer as correct as it was at the time it was made. The ability to recognize and adjust to pattern shifts is a key learning task.

Luis Mateus Rocha (1998) defines self-organization as the "spontaneous formation of well organized structures, patterns, or behaviors, from random initial conditions." (p.3). Learning, as a self-organizing process requires that the system (personal or organizational learning systems) "be informationally open, that is, for it to be able to classify its own interaction with an environment, it must be able to change its structure . . ." (p.4). Wiley and Edwards acknowledge the importance of self-organization as a learning process: "Jacobs argues that communities self-organize is a manner similar to social insects: instead of thousands of ants crossing each other's pheromone trails and changing their behavior accordingly, thousands of humans pass each other on the sidewalk and change their behavior accordingly." Self-organization on a personal level is a micro-process of the larger self-organizing knowledge constructs created within corporate or institutional environments. The capacity to form connections between sources of information, and thereby create useful information patterns, is required to learn in our knowledge economy.

Networks, Small Worlds, Weak Ties

A network can simply be defined as connections between entities. Computer networks, power grids, and social networks all function on the simple principle that people, groups, systems, nodes, entities can be connected to create an integrated whole. Alterations within the network have ripple effects on the whole.

Albert-László Barabási states that "nodes always compete for connections because links represent survival in an interconnected world" (2002, p. 106). This competition is largely dulled within a personal learning network, but the placing of value on certain nodes over others is a reality. Nodes that successfully acquire greater profile will be more successful at acquiring additional connections. In a learning sense, the likelihood that a concept of learning will be linked depends on how well it is currently linked. Nodes (can be fields, ideas, communities) that specialize and gain recognition for their expertise have greater chances of recognition, thus resulting in cross-pollination of learning communities.

Weak ties are links or bridges that allow short connections between information. Our small world networks are generally populated with people whose interests and knowledge are similar to ours. Finding a new job, as an example, often occurs through weak ties. This principle has great merit in the notion of serendipity, innovation, and creativity. Connections between disparate ideas and fields can create new innovations.

Connectivism

Connectivism is the integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements—not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing.

Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical.

Principles of connectivism:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Connectivism also addresses the challenges that many corporations face in knowledge management activities. Knowledge that resides in a database needs to be connected with the right people in the right context in order to be classified as learning. Behaviorism, cognitivism, and constructivism do not attempt to address the challenges of organizational knowledge and transference.

Information flow within an organization is an important element in organizational effectiveness. In a knowledge economy, the flow of information is the equivalent of the oil pipe in an industrial economy. Creating, preserving, and utilizing information flow should be a key organizational activity. Knowledge flow can be likened to a river that meanders through the ecology of an organization. In certain areas, the river pools and in other areas it ebbs. The health of the learning ecology of the organization depends on effective nurturing of information flow.

Social network analysis is an additional element in understanding learning models in a digital era. Art Kleiner (2002) explores Karen Stephenson's "quantum theory of trust" which "explains not just how to recognize the collective cognitive capability of an organization, but how to cultivate and increase it." Within social networks, hubs are well-connected people who are able to foster and maintain knowledge flow. Their interdependence results in effective knowledge flow, enabling the personal understanding of the state of activities organizationally.

The starting point of connectivism is the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feed back into the network, and then continue to provide learning to individual. This cycle of knowledge development (personal to network to organization) allows learners to remain current in their field through the connections they have formed.

Landauer and Dumais (1997) explore the phenomenon that "people have much more knowledge than appears to be present in the information to which they have been exposed." They provide a connectivist focus in stating "the simple notion that some domains of knowledge contain vast numbers of weak interrelations that, if properly exploited, can greatly amplify learning by a process of inference." The value of pattern recognition and connecting our own "small worlds of knowledge" are apparent in the exponential impact provided to our personal learning.

John Seely Brown presents an interesting notion that the internet leverages the small efforts of many with the large efforts of few. The central premise is that connections created with unusual nodes supports and intensifies existing large effort activities. Brown provides the example of a Maricopa County Community College system project that links senior citizens with elementary school students in a mentor program. Because the children “listen to these ‘grandparents’ better than they do their own parents, the mentoring really helps the teachers . . . the small efforts of the many—the seniors—complement the large efforts of the few—the teachers” (2002). This amplification of learning, knowledge and understanding through the extension of a personal network is the epitome of connectivism.

Implications

The notion of connectivism has implications in all aspects of life. This paper largely focuses on its impact on learning, but the following aspects are also impacted:

- Management and leadership. The management and marshalling of resources to achieve desired outcomes is a significant challenge. Realizing that complete knowledge cannot exist in the mind of one person requires a different approach to creating an overview of the situation. Diverse teams of varying viewpoints are a critical structure for completely exploring ideas. Innovation is also an additional challenge. Most of the revolutionary ideas of today at one time existed as a fringe element. An organizations ability to foster, nurture, and synthesize the impacts of varying views of information is critical to knowledge economy survival. Speed of “idea to implementation” is also improved in a systems view of learning.
- Media, news, information. This trend is well under way. Mainstream media organizations are being challenged by the open, real-time, two-way information flow of blogging.
- Personal knowledge management in relation to organizational knowledge management
- Design of learning environments

Conclusion

The pipe is more important than the content within the pipe. Our ability to learn what we need for tomorrow is more important than what we know today. A real challenge for any learning theory is to actuate known knowledge at the point of application. When knowledge, however, is needed, but not known, the ability to plug into sources to meet the requirements becomes a vital skill. As knowledge continues to grow and evolve, access to what is needed is more important than what the learner currently possesses.

Connectivism presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. How people work and function is altered when new tools are utilized. The field of education has been slow to recognize both the impact of new learning tools and the environmental changes in what it means to learn. Connectivism provides insight into learning skills and tasks needed for learners to flourish in a digital era.

Application Exercises

- Use a comparison chart (such as a T-chart or Venn Diagram) to compare elements of Connectivism with elements of Behaviorism, Cognitivism, or Constructivism.
- According to connectivism, how has the rapid increase of access to knowledge affected the way we should view knowledge?
- Think of the most recent job you have held. How did the principles of connectivism affect the way you learned in that job?
- How would you summarize the main points of connectivism if you had to explain it to a friend with no background in this area?

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Please complete this short survey to provide feedback on this chapter: http://bit.ly/ConnectivismTheory

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20

An Instructional Theory for the Post-Industrial Age

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Editor's Note

The following article was originally published in *Educational Technology* and is used here by permission.

Reigeluth, C. M. (2011). An instructional theory for the post-industrial age. *Educational Technology*, *51*(5), 25-29.

This article describes instructional theory that supports post-industrial education and training systems—ones that are customized and learner-centered, in which student progress is based on learning rather than time. The author discusses the importance of problem-based instruction (PBI), identifies some problems with PBI, overviews an instructional theory that addresses those problems, and describes the roles that should be played by the teacher, the learner, and technology in the new paradigm.

Introduction

One of the few things that practically everyone agrees on in both education and training is that people learn at different rates and have different learning needs. Yet our schools and training programs typically teach a predetermined, fixed amount of content in a set amount of time. Inevitably, slower learners are forced to move on before they have mastered the content, and they accumulate deficits in their learning that make it more difficult for them to learn related content in the future. Also, faster learners are bored to frustration and waste much valuable time waiting for the group to move on—a considerable squander of talent that our communities, companies, and society sorely need. A system that was truly designed to maximize learning would not force learners to move on before they had learned the current material, and it would not force faster learners to wait for the rest of the class.

Our current paradigm of education and training was developed during the industrial age. At that time, we could not afford to educate or train everyone to high levels, and we did not need to educate or train everyone to high levels. The predominant form of work was manual labor. In fact, if we educated everyone to high levels, few would be willing to work on assembly lines, doing mindless tasks over and over again. What we needed in the industrial age was an educational system that *sorted* students—one that separated the children who should do manual labor from the ones who should be managers or professionals. So the "less bright" students were flunked out, and the brighter ones were promoted to higher levels of education. This is why our schools use norm-referenced assessment systems rather than criterion-referenced assessment—to help sort the students. The same applied to our training systems. We must

recognize that the main problem with our education and training systems is not the teachers or the students, it is the *system*—a system that is designed more for sorting than for learning (see Reigeluth, 1987, 1994, for examples).

Elsewhere, I have presented visions of what a post-industrial education system might be like—a system that is designed to maximize learning (Reigeluth, 1987; Reigeluth & Garfinkle, 1994). With minor adaptations, that vision could be applied to our training systems as well. The purpose of this article is to describe instructional theory that supports such post-industrial education and training systems. In particular, it will:

- discuss the importance of problem-based instruction (PBI);
- identify some problems with PBI;
- overview an instructional theory that addresses those problems; and
- describe the roles that should be played by the teacher, the learner, and technology in the new paradigm.

Problem-based Instruction

Student engagement or motivation is key to learning. No matter how much work the teacher does, if the student doesn't work, the student doesn't learn. The quality and quantity of learning are directly proportional to the amount of effort the student devotes to learning. The industrial-age paradigm of education and training was based on extrinsic motivation, with grades, study halls, detentions, and in the worst cases repeating a grade or flunking out.

In contrast, for a variety of reasons, intrinsic motivation is emphasized in the information-age paradigm. Reasons include the importance of lifelong learning and therefore of developing a love of learning, the decline of discipline in the home and school, and the lower effectiveness of extrinsic motivators now than 30 years ago.

To enhance intrinsic motivation, instructional methods should be learner-centered rather than teacher-centered. They should involve learning by doing, utilize tasks that are of inherent interest to the learner (which usually means they must be "authentic"), and offer opportunities for collaboration. This makes PBI* particularly appropriate as a foundational instructional theory for the information-age paradigm of education and training.

Furthermore, given the importance of student progress being based on learning rather than on time, students progress at different rates and learn different things at any given time. This also lends itself well to PBI, because it is more learner-directed than teacher-directed.

It seems clear that PBI should be used prominently in the new paradigm of education and training. But there are problems with PBI. I explore those next.

Problems With Problem-based Instruction

In my own use of PBI, I have encountered four significant problems with it. Most PBI is collaborative or team-based, and typically the whole team is assessed on a final product. This makes it difficult to assess and ensure that all students have learned what was intended to be learned. I have found that often one student on the team is a "loafer" and doesn't learn much at all. I have also found that teammates often work cooperatively rather than collaboratively, meaning they each perform different tasks and therefore learn different things. In my experience, it is rare for any student to have learned all that was intended. For a system in which student progress is based on learning, it is important to assess and ensure the learning of each and every student on the team. Yet it is rare for this to happen in PBI. This may not be as widespread a problem for higher levels of education, but it is a big problem for lower levels.

Second, the skills and competencies that we teach through PBI are usually ones that our learners will need to transfer to a broad range of situations, especially for complex cognitive tasks. However, in PBI learners typically use a skill only once or twice in the performance of the project. This makes it difficult for them to learn to use the skill in the full range of situations in which they are likely to need it in the future. Many skills require extensive practice to develop to a proficient or expert level, yet that rarely happens in PBI.

Third, some skills need to be automatized in order to free up the expert's conscious cognitive processing for higher-level thinking required during performance of a task. PBI does not address this instructional need.

Finally, much learner time can be wasted during PBI, searching for information and struggling to learn without sufficient guidance or support. It is often important, not just in corporate training, but also in K–12 and higher education, to get the most learning in the least amount of time. Such efficiency is not typically a hallmark of PBI.

Given these four problems with PBI—difficulty ensuring mastery, transfer, automaticity, and efficiency—does this mean we should abandon PBI and go with direct instruction? To quote a famous advertisement, "Not exactly." I now explore this issue.

A Vision of the Post-industrial Paradigm of Instruction

Project and Instructional Spaces

Imagine a small team of students working on an authentic project in a computer-based simulation. Soon they encounter a learning gap (knowledge, skills, understandings, values, attitudes, dispositions, etc.) that they need to fill to proceed with the project. Imagine that the students can "freeze" time and have a virtual mentor in the form of an avatar appear and provide customized tutoring to develop that skill or understanding individually for each student.

Research shows that learning a skill is facilitated to the extent that instruction tells the students how to do it, shows them how to do it for diverse situations, and gives them practice with immediate feedback, again for diverse situations (Merrill, 1983; Merrill, Reigeluth, & Faust, 1979), so the students learn to generalize or transfer the skill to the full range of situations they will encounter in the real world. Each student continues to practice until she or he reaches the standard of mastery for the skill. Upon reaching the standard, the student returns to the "project space" where time is unfrozen, to apply what has been learned to the project and continue working on it until the next learning gap is encountered, and this learning-doing cycle is repeated.

Well-validated instructional theories have been developed to offer guidance for the design of both the project space and the instructional space (see Reigeluth, 1999; Reigeluth & Carr-Chellman, 2009, for examples). In this way we transcend the either/or thinking so characteristic of industrial-age thinking and move to both/and thinking, which is better suited to the much greater complexity inherent in the information age—we utilize instructional theory that combines the best of behaviorist, cognitivist, and constructivist theories and models. This theory pays attention to mastery of individual competencies, but it also avoids the fragmentation characteristic of many mastery learning programs in the past.

Team and Individual Assessment

One of the problems with most PBI (identified earlier) is that students are assessed on the quality of the team product. Team assessment is important, but you also need individual assessment, and the instructional space offers an excellent opportunity to meet this need. Like the project space, the instructional space is performance oriented. The practice opportunities (offered primarily in a computer simulation for immediate, customized feedback and authenticity) continue to be offered to a student until the student reaches the criterion for number of correct performances in a row required by the standard. Formative evaluation is provided immediately to the student on each incorrect performance. When automatization of a skill (Anderson, 1996) is important, there is also a criterion for speed of performance that must be met.

In this manner, student assessment is fully integrated into the instruction, and there is no waste of time in conducting a separate assessment. Furthermore, the assessment assures that each student has attained the standard for the full range of situations in which the competency will be needed.

When a performance cannot be done on a computer (e.g., a ballet performance), an expert has a hand-held device with a rubric for assessment, the expert fills in the rubric while observing the performance, provides formative evaluation when appropriate during the performance, allows the student to retry on a substandard performance when appropriate

for further assessment, and the information is automatically fed into the computer system, where it is stored in the student's record and can be accessed by the student and other authorized people.

Instructional Theory for the Project Space

There is much validated guidance for the design of the project space, including universal and situational principles for the project space (see, e.g., Barrows, 1986; Barrows & Tamblyn, 1980; Duffy & Raymer, 201 0; Savery, 2009). They include guidance for selection of a good problem or project, formation of groups, facilitation of higher learning by a tutor, use of authentic assessment, and use of thorough debriefing activities. Computer-based simulations are often highly effective for creating and supporting the project environment, but the project space could be comprised entirely of places, objects, and people in the real world (in which case the instructional space could be accessed on a mobile device), or it could be a combination of virtual and real-world environments. STAR LEGACY (Schwartz, Lin, Brophy, & Bransford, 1999) is a good example of a computer-based simulation for the project space.

Instructional Theory for the Instructional Space

Selection of instructional strategies in the instructional space is primarily based on the type of learning (the ends of instruction) involved (see Unit 3 in Reigeluth & Carr-Chellman, 2009). For *memorization,* drill and practice is most effective (Salisbury, 1990), including chunking, repetition, prompting, and mnemonics. For *application* (skills), tutorials with generality, examples, practice, and immediate feedback are most effective (Merrill, 1983; Romiszowski, 2009). For *conceptual understanding,* connecting new concepts to existing concepts in a student's cognitive structures requires the use of such methods as analogies, context (advance organizers), comparison and contrast, analysis of parts and kinds, and various other techniques based on the dimensions of understanding required (Reigeluth, 1983). For *theoretical understanding,* causal relationships are best learned through exploring causes (explanation), effects (prediction), and solutions (problem solving); and natural processes are best learned through description of the sequence of events in the natural process (Reigeluth & Schwartz, 1989). These sorts of instructional strategies have been well researched for their effectiveness, efficiency, and appeal. And they are often best implemented through computer-based tutorials, simulations, and games.

This is one vision of instructional theory for the post-industrial paradigm of instruction. I encourage the reader to try to think of additional visions that meet the needs of the post-industrial era: principally intrinsic motivation, customization, attainment-based student progress, collaborative learning, and self-directed learning. To do so, it may be helpful to consider the ways that roles are likely to change in the new paradigm of instruction.

Key Roles in the Post-industrial Paradigm of Instruction

This information-age paradigm of instruction requires new roles for teachers, students, and technology. Each of these roles is briefly described next.

New Roles for Teachers

The teacher's role has changed dramatically in the new paradigm of instruction from the "sage on the stage" to the "guide on the side." I currently see three major roles involved in being a guide on the side. First, the teacher is a *designer of student work* (Schlechty, 2002). The student work includes that which is done in both the project space and the instructional space. Second, the teacher is a *facilitator of the learning process.* This includes helping to develop a personal learning plan, coaching or scaffolding the student's learning when appropriate, facilitating discussion and reflection, and arranging availability of various human and material resources. Third, and perhaps most important in the public education sector, the teacher is a *caring mentor,* a person who is concerned with the full, well-rounded development of the student.

Teacher as designer, facilitator, and mentor are only three of the most important new roles that teachers serve, but not all teachers need to perform all the roles. Different kinds of teachers with different kinds and levels of training and

expertise may focus on one or two of these roles (including students as teachers—see next section).

New Roles for Students

First, learning is an active process. The student must exert effort to learn. The teacher cannot do it for the student. This is why Schlechty (2002) characterizes the new paradigm as one in which *the student is the worker,* and that the teacher is the designer of the student's work.

Second, to prepare the student for lifelong learning, the teacher helps each student to become a *self-directed and self-motivated learner.* Students are self-motivated to learn from when they are born to when they first go to school. The industrial-age paradigm systematically destroys that self-motivation by removing all self-direction and giving students boring work that is not relevant to their lives. In contrast the post-industrial system is designed to nurture self-motivation through self-direction and active learning in the context of relevant interesting projects. Student motivation is key to educational productivity and helping students to realize their potential. It also greatly reduces discipline problems, drug use, and much more.

Third, it is often said that the best way to learn something is to teach it. Students are perhaps the most under-utilized resource in our school systems. Furthermore, someone who has just learned something is often better at helping someone else learn it, than is someone who learned it long ago. In addition to older students teaching slightly younger ones, peers can learn from each other in collaborative projects, and they can also serve as peer tutors.

Therefore, new student roles include student as worker, self-directed learner, and teacher.

New Roles for Technology

I currently see four main roles for technology to make the new paradigm of instruction feasible and cost-effective. These roles were first described by Reigeluth and colleagues (Reigeluth & Carr-Chellman, 2009; Reigeluth *et al.,*2008). They include record keeping for student learning, planning for student learning, instruction for student learning, and assessment for/of student learning. These four roles are seamlessly integrated in a special kind of learning management system called a Personalized Integrated Educational System. These four roles are equally relevant in K–12 education, higher education, corporate training, military training, and education and training in other contexts.

Military Personnel, one is using a computer-based simulation while the other is on stand-by

It should be apparent that technology will play a crucial role in the success of the post-industrial paradigm of education. It will enable a quantum improvement in student learning, and likely at a lower cost per student per year than in the current industrial-age paradigm. Just as the electronic spreadsheet made the accountant's job quicker, easier, less expensive, and more enjoyable, so the kind of technology system described here will make the teacher's job quicker, easier, less expensive, and more enjoyable. But the new paradigm of instructional theory plays an essential role for technology to realize its potential contribution.

Conclusion

While much instructional theory has been generated to guide the design of the new paradigm of instruction, much remains to be learned. We need to learn how to better address the strong emotional basis of learning (Greenspan, 1997), foster emotional and social development, and promote the development of positive attitudes, values, morals, and ethics, among other things. It is my hope that you, the reader, will rise to the challenge and help further advance the knowledge we need to greatly improve our ability to help every student reach his or her potential.

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Application Exercises

- In the section on "New Roles for Students," Reigeluth describes three new major tasks for students in the post industrial theory. How would your schooling (K-12) have been different if your school system had included these major tasks? Write a paragraph explaining some of the changes.
- Which of the four challenges facing PBI seems to be the most difficult to overcome? Explain your reasoning.
- Reigeluth suggests four areas where technology can greatly assist teachers in supporting student learning: 1) record keeping 2) planning 3) instruction 4) assessing. Chose one of these areas and discuss how you think technology could improve the way one of these areas could be done better to improve and support student learning.
- What aspects of our current learning system are still from the industrial era? Now share your thoughts on what you would recommend to change that to a post-industrial environment.

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*I use the term “problem-based instruction” rather than “problem-based learning” because the latter (PBL) is what the learner does, whereas the former (PBI) is what the teacher or instructional system does to support the learning. Furthermore, I use the term PBI broadly to encompass instruction for project-based learning and inquiry learning.

Further Resources

In 2012, Harvard’s Clayton Christensen gave the Cluff Lecture at Brigham Young University on the topic of disruptive innovation, which can be viewed at https://vimeo.com/39639865. This lecture draws on ideas from his many books, including Disruptive Class, *which has many parallels to Dr. Reigeluth’s ideas.*

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Charles M. Reigeluth

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Charles M. Reigeluth is a distinguished educational researcher and consultant who focuses on paradigm change in education. He has a B.A. in economics from Harvard University, and a Ph.D. in instructional psychology from Brigham Young University. He taught high-school science for three years, was a professor at Syracuse University for 10 years, was a professor at Indiana University for 25 years, and is currently a professor emeritus in the School of Education at Indiana University. While at Indiana University, he facilitated a paradigm change effort in a small school district in Indianapolis for 11 years. His latest books are *Instructional-Design Theories and Models, Volume IV: The Learner-Centered Paradigm of Education* (www.reigeluth.net/volume-iv), *Vision and Action: Reinventing Schools through Personalized Competency-Based Education* (www.reigeluth.net/vision-and-action), and *Merging the Instructional Design Process with Learner-Centered Theory: The Holistic 4D Model* (www.reigeluth.net/holistic-4d). They chronicle and offer guidance for a national transformation in K-12 education to the learner-centered, competency-based paradigm. He offers presentations and consulting on this topic..

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21

Using the First Principles of Instruction to Make Instruction Effective, Efficient, and Engaging

M. David Merrill

For over 50 years my career has been focused on one very important question: “What makes instruction effective, efficient, and engaging?” I decided that e-learning should refer to the quality of the instruction, not merely to how it is delivered, so I labeled effective, efficient, and engaging instruction as e3 instruction. In this brief presentation I will try to share a little of what I’ve learned. Perhaps the underlying message of my studies and this presentation is this simple statement: **“Information alone is not instruction!”**

In 1964, in our research lab at the University of Illinois, we were sending messages from one computer to another via ARPANET. Little did we realize the fantastic potential of this experimental communication from computer to computer. Unfortunately for our subsequent fortunes, none of us in that lab envisioned the Internet and the World Wide Web and the impact that this invention would have on communication, the availability of information, social interaction, commerce, education, and almost every other aspect of our lives.

“Information Alone is Not Instruction!”

In 1963, I was doing my student teaching in a junior high school; my subject was American history. Unfortunately for this experience, my major was psychology with a minor in mathematics. I never had an American history class in my entire college career. The students’ textbook was woefully inadequate, so I spent my evenings poring through the American Encyclopedia, which fortunately was resident in my home. This paucity of information left me very underprepared for teaching these students. However, thanks to the ongoing presidential election (Nixon vs Kennedy), there was a debate on television that I could use as a springboard to teach a little about the electoral process, the Electoral College, and something about our two-party system of government.

But today, thanks to the Internet, interested learners can find information about almost anything in the world, whether current events or historical events. Teaching American history to junior high students today would be so much easier because of the almost unlimited amount of information in all different media that is available, including audio, video, animation, as well as text. But is access to this wealth of information instruction? What I’ve learned from my study of this question is that the answer is an emphatic NO! I repeat, **Information alone is not instruction**.

Motivation

All of us have heard the saying that “students didn’t learn because they just weren’t motivated.” Or that “motivation is the most important part of learning.” Or “we really need to find a way to motivate our students.” What is it that causes motivation? People have often asked me, “Is motivation one of your first principles of instruction?” The answer is no; motivation is not something we can do, motivation is an outcome. So, if it is an outcome, what causes motivation?

Motivation comes from learning; the greatest motivation comes when people learn. We are wired to learn; all of us love to learn; every student loves to learn. And, generally, we are motivated by those things that we find we are good at. For example, I'm not much of an athlete. I look back on my past and ask, "Why am I not an athlete?" I remember that I was very small as a child. In my elementary school we used to divide up into teams during recess to play softball. I always ended up as last shag on the girls' team. That was very embarrassing for me, so, I lost interest in sports; I did not want to be a sports person. Consequently, I never pursued sports. On the other hand, somewhere in my youth I was given a scale model train. I was very interested in trains, but in this case one of my father's friends showed me how to build scenery and how to make a model railroad that looked like the real world. I became very interested in building a model railroad. I have continued to follow this interest throughout my life. Why was I motivated to do this? Because I was good at it, because I learned things about how to build a realistic model. The more I learned, the more interested I became. We need to find ways to motivate our students, and that comes from promoting learning. Learning comes when we apply the effective and engaging principles of instruction.

Typical Instructional Sequence

In my experience I have had the opportunity to review many courses. Figure 1 illustrates a common instructional sequence that I have observed.

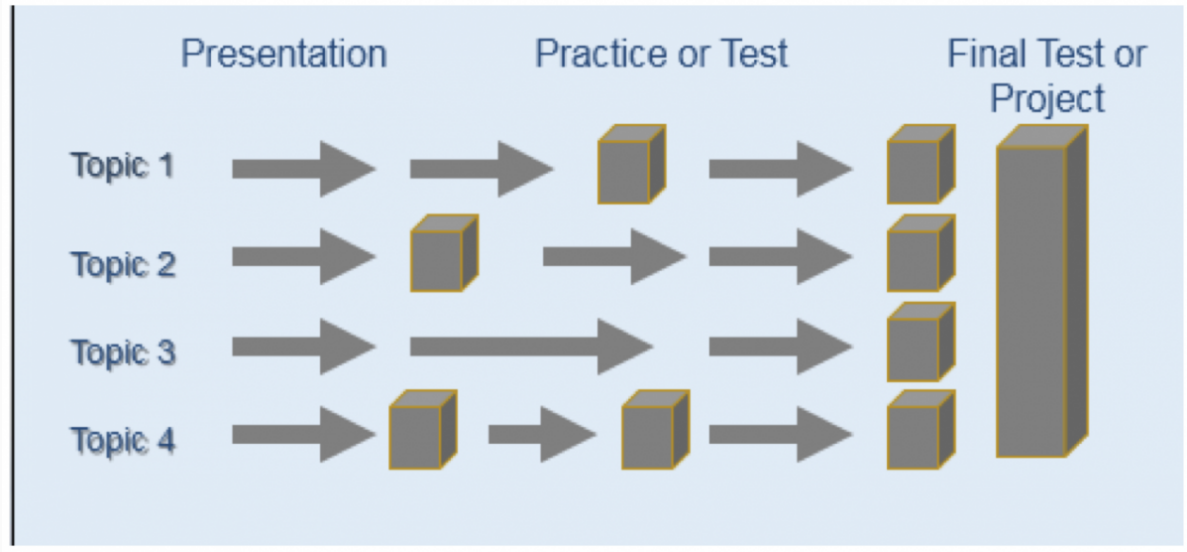

Figure 1. Typical Instructional Sequence

The course or module consists of a list of topics representing the content of the course. Information about the topic is presented, represented by the arrows. Occasionally a quiz or exercise is inserted to help illustrate the topic, represented by the boxes. The sequence is to teach one topic at a time. At the end of the course or module there is a culminating final test, or in some cases a final project, that asks the students to apply the topic to complete some t*ask* or solve some problem.

Sometimes this sequence is very effective in enabling students to gain skills or to learn to solve problems. Too often, however, this sequence is ineffective and not engaging for students. The effectiveness of this sequence and the degree of engagement it promotes for learners depends on the type of learning events that are represented by the arrows and the boxes in this diagram.

Instructional Events

There are many different types of instructional or learning events. Perhaps the most frequently used learning event is to present information or *Tell*. This *Tell* can take many forms, including lectures, videos, text books, and PowerPoint presentations.

The next most frequent instructional or learning event is to have learners remember what they were told, what they read, or what they saw. This remember instructional event we will label as *Ask*. Even though *Tell* and *Ask* are the most frequently used instructional events, if they are the only instructional events used then the *Tell–Ask* instructional sequence is the least effective instructional strategy.

If the arrows in Figure 1 represent *Tell* learning events and the boxes represent *Ask* learning events, then this module is not going to be very effective and most likely will not prepare learners to adequately complete a project using the information taught. If the culminating learning activity is an *Ask* final exam, learners may be able to score well on this exam. However, a good score on an *Ask* exam does little to prepare learners to apply the ideas taught to the solution of a complex problem or completion of a complex t*ask*.

A little history is in order. In 1999 Charles Reigeluth published a collection of papers on Instructional Design Theories and Models. In the preface to this book he indicates that there are many different kinds of instructional theories and that instructional designers need to be familiar with these different approaches and select the best approach or combination of approaches that they feel are appropriate for their particular instructional situation. I challenged Dr. Reigeluth, suggesting that while these different theories stressed different aspects of instruction and used different vocabulary to describe their model and methods, that fundamentally, at a deep level, they were all based on a common set of principles. Dr. Reigeluth kindly suggested that he didn't think that my assumption was correct, but if I felt strongly about it that perhaps I should try to find evidence for my assumption.

I took the challenge and spent the next year or two studying these various instructional theories. The result was the publication in 2002 of my often-referenced paper on First principles of Instruction (Merrill, 2002). I have spent the time since in refining my proposition in a series of papers and chapters on First Principles. In 2013, I finally published my book *First Principles of Instruction* (Merrill, 2013) that elaborated these principles, provided a set of suggestions for how these principles might be implemented in various models of instruction, and provided a variety of instructional samples that illustrate the implementation of First Principles in a range of content areas and in different educational contexts, including training, public schools, and higher education.

First Principles of Instruction

Principles are statements of relationships that are true under appropriate conditions. In instruction these relationships are between different kinds of learning events and the effect that participating in these learning events has on the acquisition of problem-solving skills. I identified five general principles that comprise First Principles of Instruction. As I reviewed the literature on instructional design theories and models, I tried to be as parsimonious as possible by selecting only a few general principles that would account for the most fundamental learning activities that are necessary for effective, efficient, and engaging instruction.

Activation: Learning is promoted when learners activate a mental model of their prior knowledge as a foundation for new skills. A frequently cited axiom of education is to start where the learner is. Activation is the principle that attempts to activate a relevant mental model already acquired by the learner in order to assist him or her to adapt this mental model to the new skills to be acquired.

Demonstration: Learning is promoted when learners observe a demonstration of the skills to be learned. I carefully avoided the word presentation for this principle. Much instruction consists largely or entirely of presentation. What is often missing is demonstration, show me. Hence, the demonstration principle is best implemented by *Tell–Show* learning events where appropriate information is accompanied by appropriate examples.

Application: Learning is promoted when learners engage in application of their newly acquired knowledge or skill that is consistent with the type of content being taught. Way too much instruction uses remembering information as a primary assessment tool. But remembering information is insufficient for being able to identify newly encountered instances of some object or event. Remembering is also insufficient to be able to execute a set of steps in a procedure or to grasp the events of a process. Learners need to apply their newly acquired skills to actually doing a t*ask* or actually solving a problem.

Integration: Learning is promoted when learners share, reflect on, and defend their work by peer-collaboration and peer-critique. Deep learning requires learners to integrate their newly acquired skills into those mental models they have already acquired. One way to insure this deep processing is for learners to collaborate with other learners in solving problems or doing complex tasks. Another learning event that facilitates deep processing is when learners go public with their knowledge in an effort to critique other learners or to defend their work when it is critiqued by other learners.

Problem-centered: Learning is promoted when learners are engaged in a problem-centered strategy involving a progression of whole real-world *task*s. The eventual purpose of all instruction is to learn to solve complex problems or complete complex tasks, either by themselves or in collaboration with other learners. This is accomplished best when the problem to be solved or the *task* to be completed is identified and demonstrated to learners early in the instructional sequence. Subsequent component skills required for problem solving or for completing a complex task are best acquired in the context of trying to solve a real instance of the problem or complete a real instance of the task.

Support for First Principles of Instruction

Do First Principles of Instruction actually promote more effective, efficient, and engaging instruction?

A study conducted by NETg (Thompson Learning, 2002), a company that sells instruction to teach computer applications, compared their off-the-shelf version of their Excel instruction, which is topic-centered, with a problem-centered version of this course that was developed following First Principles. Participants in the experiment came from a number of different companies that were clients of NETg. The assessment for both groups consisted of developing a spreadsheet for three real-world Excel problems. The problem-centered group scored significantly higher, required significantly less time to complete the problems, and expressed a higher level of satisfaction than the topic-centered group. All differences were statistically significant beyond the .001 level.

A doctoral student at Florida State University completed a dissertation study comparing a topic-centered course teaching Flash programing with a problem-centered course (Rosenberg-Kima, 2011). This study was carefully controlled so that the variable was merely the arrangement of the skill instruction in the context of problems or taught skill-by-skill. The learning events for both groups were identical except for the order and context in which they were taught. On a transfer Flash problem that required students to apply their Flash programing skills to a new problem, the problem-centered group scored significantly higher than the topic-centered group and felt the instruction was more relevant and resulted in more confidence in their performance. There was no time difference between the two groups for completing the final project.

A professor at Indiana University designed a student evaluation questionnaire that had students indicate whether the course being evaluated included First Principles of Instruction (Frick, Chadha, Watson, & Zlatkovska, 2010). The correlations all showed that the extent to which First Principles are included in a course correlates with student rating of instructor quality and their rating of satisfaction with the course. Students also spent more time on task and were judged by their instructors to have made more learning progress when the courses involved First Principles of Instruction. This data was collected in three different studies.

The conclusion that can be drawn from these three different and independent studies of First Principles clearly shows that courses based on First Principles do facilitate effectiveness, efficiency, and learner satisfaction.

Demonstration Principle

When I'm asked to review course material, my approach is to immediately turn to Module 3 of the material. By then the course is usually into the heart of the content, and the introductory material is finished. What do I look for first? Examples. Does the content include examples, demonstrations, or simulations of the ideas being taught? Adding demonstration to a course will result in a significant increment in the effectiveness of the course.

Do most courses include such demonstration? MOOCs are a recent very popular way to deliver instruction. How well do these *Massive Open Online Courses* implement First Principles of Instruction? Anoush Margaryan and her colleagues (Margaryan, Bianco, Littlejohn, 2015) published an important paper titled Instructional Quality of Massive Online Courses (MOOCs) that addresses this question. They carefully analyzed 76 MOOCs representing a wide variety of content sponsored by a number of different institutions to determine the extent that these courses implemented First Principles of Instruction. Their overall conclusion was that most of these courses failed to implement these principles.

The demonstration principle, providing examples of the content being taught, is fundamental for effective instruction and engaging instruction. How many of these MOOCs implemented this principle? Only 3 out of the 76 MOOCs analyzed included appropriate demonstration. The effectiveness and engagement in these MOOCs could be significantly increased by adding relevant and appropriate demonstration.

Application Principle

When I'm asked to review a course, the second type of learning event I look for is application that is consistent with and appropriate for the type of learning involved. Remembering a definition or series of steps is not application. There are two types of application that are most important but too often not included. *DOid* or *DOidentify* requires learners to recognize new divergent examples of an object or event when they encounter it. *DOidentify* is also the initial application required when learning the steps of a procedure or process. The learner must first recognize a correctly executed step when they see it, and they must also recognize the consequence that resulted from the execution of the step. Once they can recognize appropriate steps and appropriate consequences for these steps, then *DOexecute* is the next level of application. *DOexecute* requires learners to actually perform or execute the steps of a procedure. When appropriate application is missing, the effectiveness of a course is significantly increased when appropriate application learning events are added.

MOOCs are often about teaching learners new skills. Did the MOOCs in the study cited above include appropriate application for these skills? They fared better than they did for demonstration. At least 46 of the 76 MOOCs did include some form of application. This still leaves 30 MOOCs in this study without application of any kind. However, on careful analysis of the sufficiency and appropriateness of the application included, it was found that only 13 of the MOOCs in this study had appropriate and sufficient application.

Learning Events

While *Tell* and *Ask* are the most frequently used learning events, as we have seen, a strategy that uses only these two learning events is not an effective or engaging strategy. Learning to solve problems and to do complex tasks is facilitated when a *Tell* instructional strategy is enhanced by adding demonstration or *Show* learning events. A *Tell-Show* sequence is more effective than a *Tell* only sequence.

Learning to solve problems and to do complex tasks is facilitated even more when a *Tell-Show* strategy is further enhanced by adding *Do* instructional events. These *Do* learning events are most appropriate when they require learners to identify unencountered instances of some object or event (*DOidentify* learning events) and when they require learners to execute the steps in a procedure or observe the steps in a process (*DOexecute* learning events). A *Tell-Show-Do* sequence is even more effective than a *Tell-Show* instructional sequence.

Much existing instruction can be considerably enhanced by the addition of appropriate *Show* and *Do* learning events. If the arrows in Figure 1 consist of *Tell* and *Show* learning events and the boxes consist of *Do* learning events and if the final project is not merely a remember or *Ask* assessment but the opportunity for learners to apply the skills they have

acquired from the *Tell-Show-Do* instruction to a more complete problem or task, then the resulting learning will be more effective, efficient, and engaging for learners. Much existing instruction can be significantly enhanced by converting from *Tell-Ask* learning events in this typical instructional sequence to *Tell-Show-Do* learning events.

How to Revise Existing Instruction

Much existing instruction is primarily *Tell-Ask* instruction. This instruction can be significantly enhanced by the demonstration of appropriate examples (*Show* learning events) and even further enhanced by the addition of appropriate application activities (*Do* learning events).

The fundamental instructional design procedure to enhance existing instruction is fairly straightforward. Start by identifying the topics that are taught in a given module. Create a matrix and list these topics in the left column of a matrix. Across the top of the matrix list the four primary learning event types: *Tell, Ask, Show, and Do.*

Second, identify the *Tell* information for each topic and reference it in the *Tell* column. Review this information to ensure that each topic is accurate and sufficient for the goals of the instruction.

Third, identify existing *Show* learning events for each topic. If the existing instruction does not include appropriate or sufficient examples of each of the concepts, principles, procedures, or processes listed, then identify or create appropriate examples for inclusion in the module. Creating a matrix to use as a cross reference for the new content examples can help identify areas where new activities need to be placed in the course.

Fourth, identify existing *Do* learning events for each topic. If the existing instruction does not include appropriate or sufficient *Do* learning events, then identify or create appropriate *Do-identify* or *Do-execute* learning events for inclusion in the module.

Finally, assemble the new demonstrations and applications into the module for more effective, efficient, and engaging instruction.

The Context Problem

Even after appropriate demonstration and application learning events are added to this traditional instructional sequence, there is still a potential problem that keeps this instructional sequence from being as effective, efficient, and engaging as possible. In this sequence topics are taught one-on-one. The demonstration and application learning events added to a *Tell* sequence are usually examples that apply to only a single component skill and are merely a small part of solving a whole problem. Too often learners fail to see the relevance of some of these individual skills learned out of context. We have all experienced the often used explanation: “You won’t understand this now, but later it will be very important to you.” If “later” in this situation is several days or weeks there is a good possibility that the learners will have forgotten the component skill before they get to actually use this skill in solving a whole problem or doing a whole task. Or, if learners do not see the relevance of a particular skill they may fail to actually learn the skill or they are unable to identify a mental model into which they can incorporate this skill. Then, when it is time to use this skill in the solution of a whole problem, learners are unable to retrieve the skill because it was merely memorized rather than understood. Furthermore, if solving a whole problem or doing a whole task is the final project for a module or course, there may be no opportunity to get feedback and revise the project.

Is there a better sequence that is more effective, efficient, and engaging than this typical sequence?

Problem-centered

To maximize engagement in learning a new problem solving skill, learners need to acquire these skills in the context of the problem they are learning to solve or the task they are learning to complete. If learners first activate a relevant mental model (activation principle) and then are shown an example of the problem they will learn to solve and how to solve this problem, they are more likely to see the relevance of each individual component skill when it is taught, and

they will have a framework into which they can incorporate this new skill, greatly increasing the probability of efficient retrieval and application when they are confronted with a new instance of the problem.

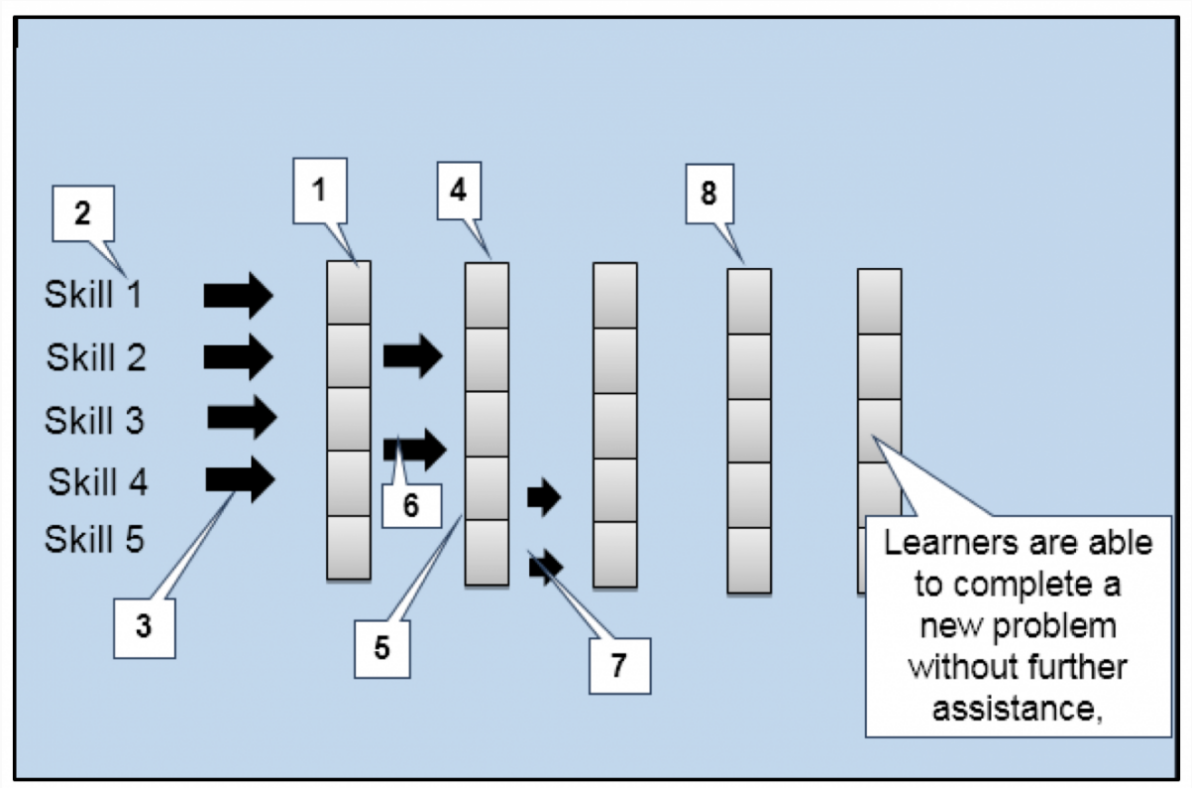

Figure 2. Problem-Centered Instructional Sequence

Does existing instruction use a problem-centered sequence in instruction? Even though many MOOCs are designed to facilitate problem solving, Margaryan and her colleagues found that only 8 of the 76 MOOCs they analyzed were problem-centered. Several previous surveys of existing instruction in a variety of contexts found that most courses do not use a problem-centered instructional sequence or even involve students in the solution of real-world problems as a final project.

A typical instructional sequence is topic-centered; that is, each topic is taught one-by-one, and then at the end of the module or course learners are expected to apply each of these topics in the solution of a final problem or the completion of a final task. Figure 2 illustrates a problem-centered sequence that turns this sequence around. Rather than telling an objective for the module, which is a form of information, the (1) first learning activity is to show a whole instance of the problem that learners are being taught to solve. This demonstration also provides an overview of the solution to the problem or the execution of the task. (2) Students are then told information about the component skills necessary for the solution of this instance of the problem and (3) shown how each of these component skills contributes to the solution of the problem. (4) After this *Tell–Show* demonstration for the first instance of the problem is complete, a second problem instance is identified and shown to learners. (5) The learner is then required to apply the previously acquired component skills to this second problem (*Do*). (6) Some of the component skills may require some additional information or a different way of using the skill to solve this second instance of the problem. Learners are then told this new information and (7) shown its application to another instance of the problem. Note that the *Tell-Show-Do* for each component skill or topic is now distributed across different instances of the problem. The first instance of the problem was primarily *Tell-Show*. The second instance of the problem is a combination of *Tell-Show* for

new parts of each component skill and *Do* for those component skills already acquired. (8) Additional instances of the problem are identified. Learners apply those skills already acquired (*Tell-Show*) and apply those skills already acquired (*Do*) for each new instance of the problem. The sequence is complete when learners are required to solve a new instance of the problem without additional guidance.

In a problem-centered instructional sequence learners are more likely to see the relevance of each new component skill. This sequence will provide multiple opportunities for learners to apply these newly acquired component skills in the context of real instances of the problem. It enables learners to see the relationship among the individual component skills in the context of each new instance of the problem. It also provides gradually diminishing guidance to learners until they are able to solve a new instance of the problem with little guidance.

Instruction that is revised to include a *Tell-Show-Do* sequence of learning events all in the context of solving a progression of instances of a whole problem or a whole task has the potential ofmaximally engaging students while providing efficient and effective learning activities.

Recommendation

In summary: Designers may want to analyze their courses. Perhaps the effectiveness, efficiency, and especially the engagement of a course may be enhanced by adding appropriate demonstration and application and by using a problem-centered instructional sequence. Does the course include appropriate and adequate demonstration? Does it include appropriate and adequate application? Are the skills taught in the context of an increasingly complex progression of instances of the problem?

Conclusion

Motivation is an outcome, not a cause. What promotes engagement and hence motivation? Effective, efficient, and engaging instruction. What promotes effective, efficient, and engaging instruction? First Principles of Instruction: Activation, Demonstration, Application, Integration, and Problem-centered. In this paper we have emphasized the demonstration and application principle and a problem-centered instructional sequence.

First Principles of Instruction is available in English in both print and electronic formats. It is also available in Korean, and Chinese.

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III. Design

Andrew Gibbons and Vic Bunderson (2005) wrote a classic article on three ways of seeking knowledge about the real world: through exploration (often with qualitative research methods), through explanation (often through quantitative methods) and design. As LIDT professionals, we consider design and design knowledge to be core to our work, and key to our understanding of teaching and learning. At our core, we are interventionists: we do not simply observe the world, but seek to influence it in effective ways. This is done through design processes and design research, which is the focus of this section. This section begins with a chapter on classic instructional design approaches, followed by a look at more current perspectives on design thinking and agile design. You will also read about some current issues in the field around design, including design mindsets, design-based research, how to design for effective systemic change, makerspace design, and user experience design. Included also is a chapter on Human Performance Technology, which is a similar field to our own, applying many of the same skill sets and knowledge bases in slighty different ways to the world of corporate learning.

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Instructional Design Models

Design Thinking and Agile Design

What and how do designers design?

The Development of Design-Based Research

A Survey of Educational Change Models

Performance Technology

Defining and Differentiating the Makerspace

User Experience Design

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22

Instructional Design Models

Tonia A. Dousay

Researchers and practitioners have spent the past 50 years attempting to define and create models of design with the intent to improve instruction. As part of a joint, inter-university project, Barson (1967) defined instructional development as the systematic process for improving instruction. Perhaps most interesting about this project and subsequent report is the caution that many different conditions influence learning, including the use of media, and that generalizing any sort of model would potentially be hazardous at best and disastrous at worst. Shortly thereafter, however, Twelker, Urbach, and Buck (1972) noted that a systematic approach to developing instruction was an increasingly popular idea, but cautioned that instructional design (ID) methods varied from simple to complex. These historical observations predicted the reality that every instructional design project is unique every time with no two projects ever progressing through the process identically. These differences, sometimes subtle while at other times significant, have given way to literally dozens of different models used with varying popularity in a wide variety of learning contexts.

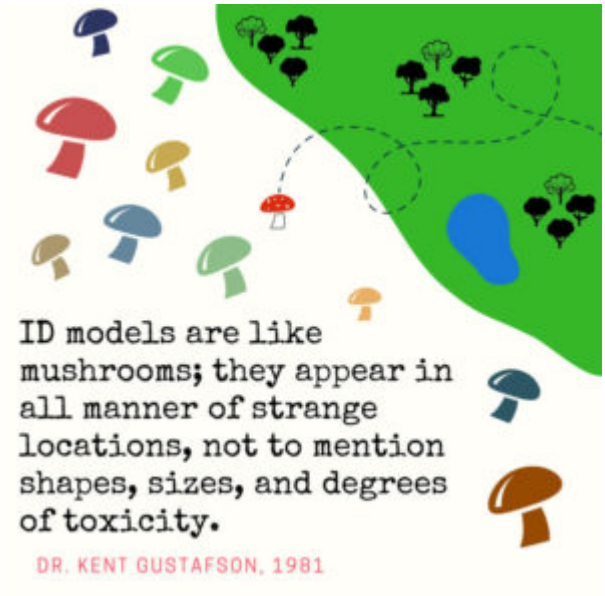

Figure 1. Mushrooms

In the midst of this explosion of models and theories, Gustafson (1991) drafted his first monograph that would go on to become the Survey of Instructional Development Models, now in its fifth edition (Branch & Dousay, 2015). The book provides brief overviews of instructional design models, classifying them within the context of classroom product- and process-oriented instructional problems. The Surveys book provides a concise summary to help beginning instructional designers visualize the different design approaches as well as assist more advanced instructional designers. However, this text is just one of many often used in the study and practice of instructional design, and those seeking to expand

their knowledge of design process can learn much from the rich history and theoretical development over decades in our field. (See Resources section for suggestions.) In this chapter, we explore a brief history of instructional design models, common components of models, commonly referenced models, and resources and advice for instructional designers as they engage in the instructional design process.

Historical Context

The field of Learning and Instructional Design Technology (LIDT) has had many periods of rapid development. Reiser (2001) noted that training programs during World War II sparked the efforts to identify efficient, systematic approaches to learning and instructional design. It would be another 20 years before the first models emerged, but the 1960s and 1970s gave way to extracting instructional technology and design processes from conversations about multimedia development (Reiser, 2017), which in turn produced more than three dozen different instructional design models referenced in the literature between 1970 and 2005 (Branch & Dousay, 2015; Gustafson, 1991, 1991; Gustafson & Branch, 1997, 2002). These models help designers, and sometimes educational stakeholders, simplify the complex reality of instructional design and apply generic components across multiple contexts (Gustafson & Branch, 2002), thus creating standardized approaches to design within an organization. In turn, Molenda (2017) noted that the standardization of processes and terminology triggered interest in the field. Thus, an interesting relationship exists between defining the field of instructional design and perpetuating its existence. As designers seek to justify their role in education–whether K-12, higher education, or industry–they often refer to existing models or generate a new model to fit their context. These new models then become a reference point for other designers and/or organizations.

But Where Do We Go From Here?

Despite some claims that classic instructional design is dead, or at least seriously ill (Gordon & Zemke, 2000), there remains considerable interest in and enthusiasm for its application (Beckschi & Doty, 2000). This dichotomous view situates the perceived ongoing debate between the theory of instructional design and its practice and application. On one hand, scholars and faculty in higher education often continue to research and practice based upon historical foundations. On the other hand, scholars and practitioners in industry often eschew the traditional literature, favoring instead more business-oriented practices. Looking at the authors of various texts consulted in higher education (see Branch, 2009; Carr-Chellman & Rowland, 2017; Richey, Klein, & Tracey, 2010 for examples) versus those consulted in industry (see Allen & Seaman, 2013; Biech, 2014; Carliner, 2015; Hodell, 2015 for examples) confirms this dichotomy. New professionals entering the field, should be aware of this tension and how they may help mitigate potential pitfalls from focusing either too much on foundational theory or too much on practitioner wisdom. Both are essential to understanding how to design instruction for any given audience.

Process vs. Models

The progression of analyzing, designing, developing, implementing, and evaluating (ADDIE) forms the basic underlying process (illustrated in Figure 2) that is a distinct component of instructional design regardless of which model is used (Gustafson & Branch, 1997). Branch (2009) said it well when he conceptualized the phases of the ADDIE process as follows:

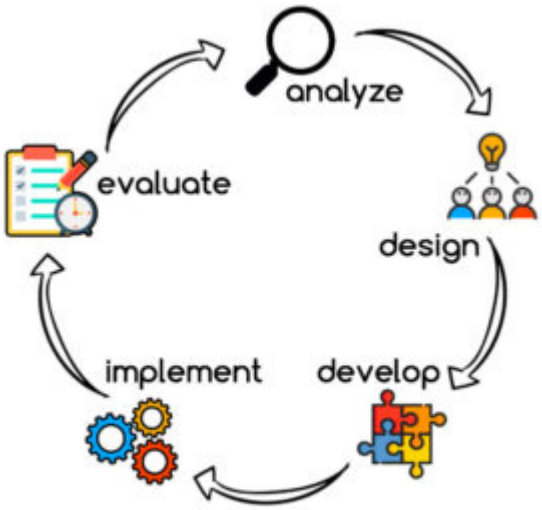

Figure 2. The ADDIE Process

1. Analyze – identify the probable causes for a performance gap,
2. Design –verify the desired performances and appropriate testing methods,
3. Develop – generate and validate the learning resources,
4. Implement – prepare the learning environment and engage the students,
5. Evaluate – assess the quality of the instructional products and processes, both before and after implementation (p. 3).

Notice the use of the phrase process rather than model. For instructional design purposes, a process is defined as a series of steps necessary to reach an end result. Similarly, a model is defined as a specific instance of a process that can be imitated or emulated. In other words, a model seeks to personalize the generic into distinct functions for a specific context. Thus, when discussing the instructional design process, we often refer to ADDIE as the overarching paradigm or framework by which we can explain individual models. The prescribed steps of a model can be mapped or aligned back to the phases of the ADDIE process.

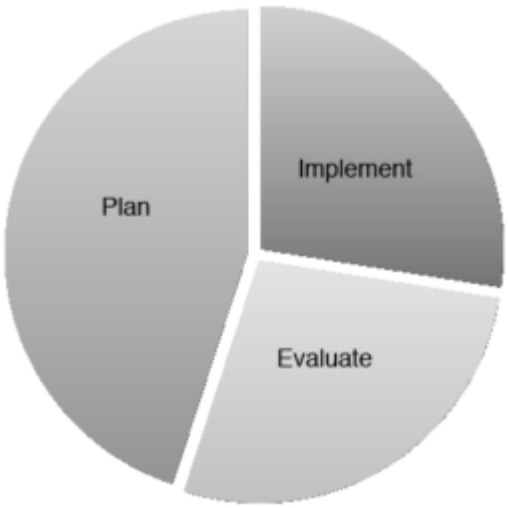

Figure 3. The PIE Model

Consider the following examples. The Plan, Implement, Evaluate (PIE) model from Newby, Stepich, Lehman, and Russell (1996) encourages an emphasis on considering how technology assists with instructional design, focusing on the what, when, why, and how. This phase produces an artifact or plan that is then put into action during implementation followed by evaluating both learner performance and instruction effectiveness. During planning, designers work through a series of questions related to the teacher, learner, and technology resources. The questions are answered while also taking into consideration the implementation and evaluation components of the instructional problem. When considered through the lens of the ADDIE process, PIE combines the analyzing, designing, and developing phases into a singular focus area, which is somewhat illustrated by the depiction in Figure 3. Similarly, the Diamond (1989) model prescribes two phases: "Project Selection and Design" and "Production, Implementation, and Evaluation for Each Unit." Phase I of the Diamond model essentially combines analyzing and designing, while Phase II combines developing, implementing, and evaluating. (See Figure 4 for a depiction of the model.) Diamond placed an emphasis on the second phase of the model by prescribing an in-depth, parallel development system to write objectives, design evaluation instruments, select instructional strategies, and evaluate existing resources. Then, as new resources are produced, they are done so with consideration to the previously designed evaluation instruments. The evaluation is again consulted during the implementation, summative evaluation, and revision of the instructional system. These two examples help demonstrate what is meant by ADDIE being the general process and models being specific applications. (For further discussion of how aspects of specific models align with the ADDIE process, see Dousay and Logan (2011).)

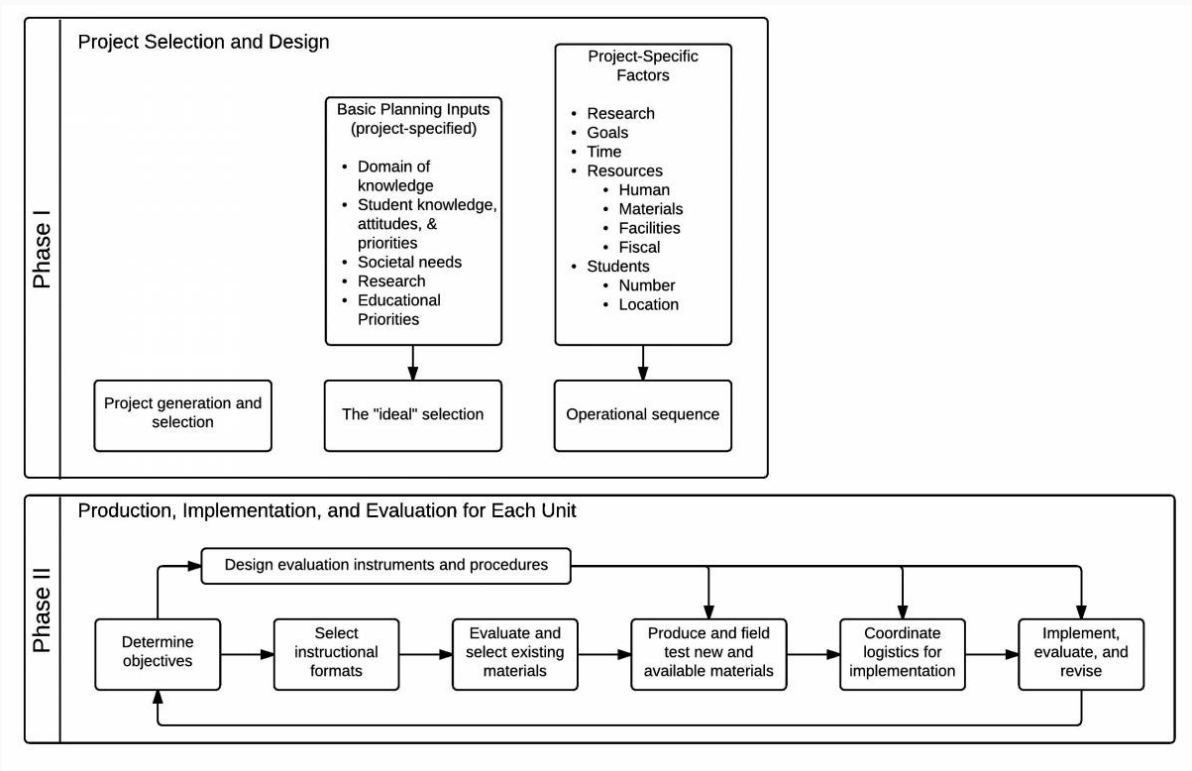

Figure 4. The Diamond Model

This discussion might also be facilitated with a business example. Consider the concept of process mapping; it helps organizations assess operational procedures as they are currently practiced (Hunt, 1996). Mapping the process analytically to identify the steps carried out in practice leads to process modeling, an exercise in optimization. In other words, modeling helps move processes to a desired state tailored to the unique needs of an organization. Many

businesses of a similar type find that they have similar processes. However, through process modeling, their processes are customized to meet their needs.

The relationship between ADDIE and instructional design models functions much like this business world scenario. As instructional designers, we often follow the same process (ADDIE). However, through modeling, we customize the process to meet the needs of our instructional context and of our learners, stakeholders, resources, and modes of delivery. Models assist us in selecting or developing appropriate operational tools and techniques as we design.

Finally, models serve as a source of research questions as we seek to develop a comprehensive theory of instructional development. Rarely are these models tested through rigorous assessment of their results against predetermined criteria. Rather, those ID models with wide distribution and acceptance gain their credibility by being found useful by practitioners, who frequently adapt and modify them to match specific conditions (Branch & Dousay, 2015, p. 24). Thus, popularity serves as a form of validation for these design models, but a wise instructional designer knows when to use, adapt, or create a new model of instructional design to fit their purposes.

Models

Because there are so many different ID models, how do we choose which one to use? In framing this conversation, the Survey of ID models (Branch & Dousay, 2015) serves as a foundation, but by no means should be the sole reference. A total of 34 different instructional design models (see Table 1 for a summary) have been covered in the Survey text since its first edition, and this list does not include every model. Still, this list of models is useful in providing a concise guide to some of the more common approaches to instructional design.

Table 1

Instructional Design Models included in editions of the Survey text

Model Name	1st Ed 1981	2nd Ed 1991	3rd Ed 1997	4th Ed 2002	5th Ed 2015
Banathy (1968)	x				
DeCecco (1968)	x				
Blake & Mouton (1971)	x				
Briggs (1970)	x				
Baker & Schutz (1971)	x				
Gerlach & Ely (1971)	x	x	x	x	x
Instructional Development Institute (Twelker et al., 1972)	x	x	x		
Learning Systems Design (Davis, Alexander, & Yelon, 1974)	x				
IPISD (Branson, Rayner, Cox, Furman, & King, 1975)	x	x	x	x	x
Blondin (1977)	x				
Morrison, Ross, Kemp, & Kalman (Kemp, 1977)	x	x	x	x	x
Dick, Carey, & Carey (Dick & Carey, 1978)		x	x	x	x

Gilbert (1978) Front End Analysis	x				
Courseware Development Process (Control Data Corporation, 1979)	x				
ASSURE (Heinich, Molenda, & Russell, 1982)		x	x	x	x
Diamond (1989)		x	x	x	x
Dick & Reiser (1989)		x	x		
Van Patten (1989)		x	x		
Bergman & Moore (1990)		x	x	x	x
Leshin, Pollock, & Reigeluth, (1992)		x	x		
IPDM (Gentry, 1993)			x	x	x
Smith & Ragan (1993)			x	x	x
de Hoog, de Jong, & de Vries (1994)				x	x
Bates (1995)				x	x
PIE (Newby et al., 1996)				x	x
4C/ID (van Merriënboer, 1997)					x
ISD Model 2 (Seels & Glasgow, 1997)		x		x	x
CASCADE (Nieveen, 1997)				x	x
Rapid Collaborative Prototyping (Dorsey, Goodrum, & Schwen, 1997)				x	x
UbD (Wiggins & McTigue, 2000)					x
Agile (Beck et al., 2001)					x
3PD (Sims & Jones, 2002)					x
Pebble in the Pond (Merrill, 2002)					x
ILDF (Dabbagh & Bannan-Ritland, 2004)					x
TOTAL	13	12	13	15	21

Note. All references refer to the original or first edition of a model; however, the current name of the model as well as current scholars affiliated with the model may vary from the original iteration.

When considering the models featured in Table 1, determining which one to use might best be decided by taking into account a few factors. First, what is the anticipated delivery format? Will the instruction be synchronous online, synchronous face to face, asynchronous online, or some combination of these formats? Some models are better tailored for online contexts, such as Dick and Carey (1978); Bates (1995); Dabbagh and Bannan-Ritland (2004); or Morrison, Ross, Kemp, Kalman, and Kemp (2012). Another way to think about how to select a model involves accounting for the context or anticipated output. Is the instruction intended for a classroom? In that case, consider

Gerlach and Ely (1971); ASSURE (Smaldino, Lowther, Mims, & Russell, 2015); PIE (Newby et al., 1996); UbD (Wiggins & McTigue, 2000); 4C/ID (van Merriënboer & Kirschner, 2007); or 3PD (Sims & Jones, 2002). Perhaps the instructional context involves producing an instructional product handed over to another organization or group. In this case, consider Bergman and Moore (1990); de Hoog et al. (1994); Nieveen (1997); Seels and Glasgow (1997); or Agile (Beck et al., 2001). Lastly, perhaps your context prescribes developing a system, such as a full-scale curriculum. These instructional projects may benefit from the IPISD (Branson et al., 1975); Gentry (1993); Dorsey et al. (1997); Diamond (1989); Smith and Ragan (2004); or Pebble in the Pond (Merrill, 2002) models. Deciding which model to use need not be a cumbersome or overwhelming process. So long as a designer can align components of an instructional problem with the priorities of a particular model, they will likely be met with success through the systematic process.

Other ID Models

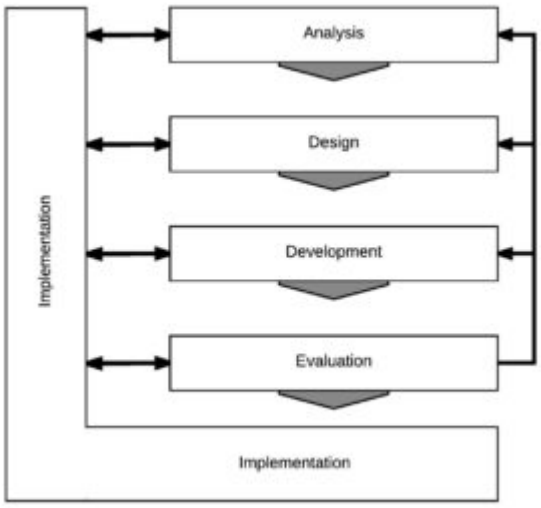

Figure 5. Plompt's OKT Model

While we cannot possibly discuss all of the ID models used in practice and/or referenced in the literature, there are a few other instructional design models that are useful to mention because of their unique approaches to design. For example, Plomp's (1982) OKT model (see Figure 5), which is taught at the University of Twente in The Netherlands, looks quite similar to the ADDIE process, but adds testing/revising the instructional solution prior to full implementation. When OKT was initially introduced, online or web-based instructional design had not yet become part of the conversation. Yet, his model astutely factors in the technology component not yet commonly seen in other ID models referenced at the time. Notice how the OKT process calls for a close relationship between implementation and the other phases as well as alignment between evaluation and the other phases. This design facilitates internal consistency in decision making. The intent here was to ensure that design decisions relating to technology-based resources were consistently applied across the instructional problem.

At their core, instructional design models seek to help designers overcome gaps in what is learned due to either instruction, motivation, or resources. Thus, some models seek to address non-instructional gaps, like motivation. See Keller's (2016) work on motivational design targeting learner attention, relevance, confidence, satisfaction, and volition (ARCS-V). Other models examine strategies related to resources, like technology or media integration. Examples here include Action Mapping (Moore, 2016); Substitution, Augmentation, Modification, Redefinition (SAMR) Model (see Hamilton, Rosenberg, & Akcaoglu, 2016 for a discussion); and TPACK-IDDIRR model (Lee & Kim, 2014). And still other models consider other gaps and needs like rapid development. (See the Successive Approximation Model (SAM) from Allen Interaction, n.d.)

Recently, many instructional designers have emphasized the design gaps in ID, drawing upon the broader field of design theory to guide how designers select and arrange constructs or components. One model, known as Design Layers (Gibbons, 2013), helps designers prioritize concerns encountered during the ID process and may overlay with an existing or adapted ID model being followed. In other words, a designer may use design layers to organize the problems to be addressed, but still use other models based on ADDIE processes to solve some of these problems. While unintentional, the field of instructional design often focuses on corporate and adult learning contexts, sometimes feeling exclusionary to the K-12 instructional designer (note: UbD, Wiggins & McTigue, 2000, is one of the more well-known ID models also used by K-12 teachers and instructional facilitators). Carr-Chellman's (2015) Instructional Design for Teachers (ID4T) model and Larson and Lockee's (2013) Streamlined ID represent attempts to break down some of the complex perceptions of ID, making it more accessible for K-12 teachers and newer instructional designers.

The primary takeaway from this entire discussion should be that ID is rarely a simple process. In practice, designers often draw upon personal experience and the wide variety of models, strategies, and theories to customize each instance of instructional design.

Tips From the Field

While working on this chapter, I thought it might be interesting to crowdsource advice and tips. We live, research, and teach in the age of social constructivism. So, why not apply the theory in a way that might have a far reaching and lasting impact? The following short quotes about the practice of ID and ID models from scholars, students, and (above all) practitioners provide focused advice that are good tips for the beginning designer and great reminders for the more advanced designer.

- Focus on the systematic and iterative process of instructional design. Models are not discrete steps to be checked off. [Kay Persichitte, University of Wyoming]
- The ADDIE paradigm is fundamental to most models, with appropriate evaluation of each step implied. [Jon Anderle, University of Wyoming]
- Be aware of the tension in the field between theory and practice. [Tara Buñag, University of the Pacific]
- Practicing ID means considering all of the available tools. It's too easy for a designer to fixate on a single instructional technique as a panacea. [Rhonda Gamble, Sweetwater County School District #1]
- In addition to the regular resources often referenced, don't forget to look at the works of Robert F. Mager. They are foundational to the field. [Landra Rezabek, retired University of Wyoming]
- It bears repeating often; the reality of the instructional design practice is unique and complex each and every time. [Camille Dickson-Deane, University of Melbourne]
- Careful and purposeful instructional design brings an inherent positivity to learning. [Terry Callaghan, Albany County School District #1]
- A dollar spent on formative evaluation pays off tenfold when it comes to implementation of a new course or program. [Tom Reeves, retired The University of Georgia]
- Consider Robert Mager's performance analysis flowchart or Ruth Clark's Content-Performance Matrices for teaching procedures, processes, facts, concepts, and principles. All are brilliant! [Marcy Brown, The CE Shop, Inc.]
- When building out your toolbox, take a look at Cathy Moore and her Action Mapping. [David Glow, Restaurant Magic Software]
- Build opportunities into online courses to collect data and conduct research about the course design, organization, assessments, and teaching effectiveness. This can be used for iterative enhancements. [Athena Kennedy, ASU Online]
- Educate stakeholders involved in the ID process on what you do and why you do it. This is crucial for successful collaboration in design and development. [Megan C. Murtaugh, IDT Consultant]
- Instructional design is a creative process. [Rob Branch, The University of Georgia]
- Understand the systemic implications of what you propose. If you don't know the difference between systemic and systematic, please familiarize yourself—it will have vast implications. Please know that models of ID are specifically pedagogical in purpose. They teach you the basics, but the real ID process is not captured by a model. Instead you have to approach it more as art, as a holistic process. [Ali Carr-Chellman, University of Idaho]
- Think about what good instruction means. Are you following a sound design procedure, e.g., ADDIE? Are you adhering to best practices of the professional community? Are your strategies supported by learning theory? Are design decisions validated by demonstrated gains on pre- and post- measures? Each of these has a role in creating good instruction, but don't forget to meet the needs of learners, especially those at the margins. [Brent Wilson, University of Colorado Denver]
- Robert F. Mager (1968) once noted that, "If telling were teaching, we'd all be so smart we could hardly stand it." When working on the phase of any model that involves material development, designers must be careful with overloading learners with information. Further, presenting information must consider what Hugh Gardner, a professor at the University of Georgia, used to call the "COIK" phenomenon; Clear Only If Known. This phenomenon encourages breaking down complex language, avoiding jargon, and making expert knowledge accessible. These tasks are not easy, but must be part of the process. [Marshall Jones, Winthrop University]

Acknowledgement

Thanks to Jeroen Breman, Northwest Lineman College, for the OKT-model recommendation.

Application Exercises

- While processes and models can be useful, why do you think it is important to maintain flexibility in designing instruction?
- What are some things to consider when selecting an instructional design model?

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Further Resources

The following textbooks, chapters, and articles represent a broad collection of discussion, debate, and research in the field of learning and instructional design. The list has been compiled from resources such as the Survey of Instructional Design Models (Branch & Dousay, 2015), reading lists from graduate programs in LIDT, and publications sponsored by the Association for Educational Communications & Technology. However, the list should not be considered exhaustive. It is merely provided here as a possible starting point for individuals or organizations seeking to learn more about the field and how models are developed and implemented.

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Please complete this short survey to provide feedback on this chapter: http://bit.ly/IDmodels

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Tonia A. Dousay, Ph.D., is a first-generation college graduate and the daughter of two U.S. Navy veterans. Known by her students as "Dr. D," Tonia graduated with a B.S. in Agricultural Science and M.S. in Agricultural Education from Texas A&M University, falling in love with experiential education and nontraditional approaches to learning. With more than 20 years of project management experience in PK-20, industry, and law enforcement/military learning environments, she now holds a Ph.D. in Learning, Design & Technology from the University of Georgia. Tonia's lifelong love of learning has taken her to the University of Wyoming as an Assistant Professor (2013-2017); the University of Idaho as an Associate Professor and Associate Dean for Assessment & Accreditation (2017-2022); and the University of Alaska Anchorage as the Dean of the School of Education (2022-Present). Whether she's working with middle schoolers or retired community members, Tonia focuses on stimulating natural curiosity to self-regulate and motivate in any learning environment.

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23

Design Thinking and Agile Design

New Trends or Just Good Designs?

Vanessa Svihla

Abstract

While most instructional design courses and much of the instructional design industry focuses on ADDIE, approaches such as design thinking, human-centered design, and agile methods like SAM (Successive Approximation Model)—have drawn attention. This chapter unpacks what we know about design thinking and presents a concise history of design thinking to situate it within the broader design research field and then traces its emergence in other fields. I consider lessons for instructional designers and conclude by raising concerns for scholarship and teaching—and thereby practice—and set an agenda for addressing these concerns.

Introduction

Many depictions of design process, and a majority of early design learning experiences, depict design as rather linear—a "waterfall" view of design (Figure 1). This depiction was put forward as a *flawed* model (Royce, 1970), yet it is relatively common. It also contrasts what researchers have documented as expert design practice.

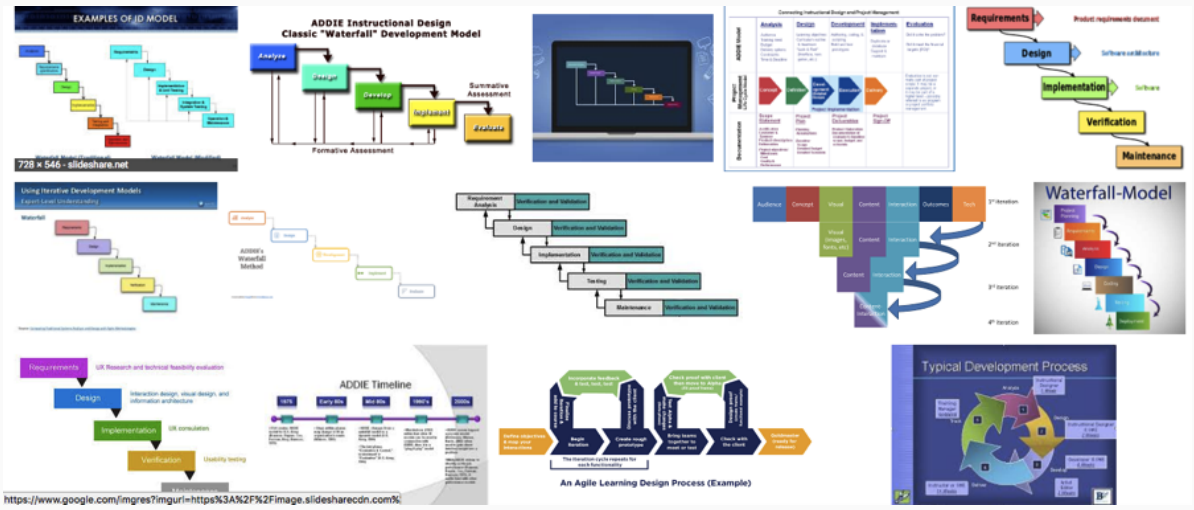

Figure 1. Google Image search results of design as a waterfall model

Fortunately, as instructional designers, we have many models and methods of design practice to guide us. While ADDIE is ubiquitous, it is not a singular, prescriptive approach, though it is sometimes depicted—and even practiced—as such. When we look at what experienced designers do, we find they tend to use iterative methods that sometimes appear a bit messy or magical, leveraging their past experiences as precedent. Perhaps the most inspiring approaches that reflect this are agile, human-centered design, and design thinking. However, most of us harbor more than a few doubts and questions about these approaches, such as the following:

- Design thinking seems both useful and *cool*, but I have to practice a more traditional approach like ADDIE or waterfall. Can I integrate agile methods and design thinking into my practice?
- Design thinking—particularly the work by IDEO—is inspiring. As an instructional designer, can design thinking guide me to create instructional designs that really help people?
- Given that design thinking seems to hold such potential for instructional designers, I want to do a research study on design thinking. Because it is still so novel, what literature should I review?
- As a designer, I sometimes get to the end of the project, and then have a huge insight about improvements. Is there a way to shift such insights to earlier in the process so that I can take advantage of them?
- If design thinking and agile design methods are so effective, why aren't we taught to do them from beginning?

To answer these questions, I explore how research on design thinking sheds light on different design methods, considering how these methods originated and focusing on lessons for instructional designers. I then share a case to illustrate how different design methods might incorporate design thinking. I close by raising concerns and suggesting ways forward.

What is Design Thinking?

There is no single, agreed-upon definition of design thinking, nor even of what being adept at it might result in, beyond *good design* (Rodgers, 2013), which is, itself, subjective. If we look at definitions over time and across fields (Table 1), we see most researchers reference design thinking as methods, practices or processes, and a few others reference cognition or mindset. This reflects the desire to understand both what it is that designers do and how and when they know to do it (Adams, Daly, Mann, & Dall'Alba, 2011). Some definitions emphasize identity (Adams et al., 2011), as well as values (e.g., practicality, empathy) (Cross, 1982). In later definitions, design thinking is more clearly connected to creativity and innovation (Wylant, 2008); we note that while mentioned in early design research publications (e.g., Buchanan, 1992), innovation was treated as relatively implicit.

Table 1. Characterizations of design thinking (DT) across fields, authors, and over time

Design research field characterizes DT (1992)	*IDEO president introduces DT to the business world, 2008*	*Stanford d.school (2012) & IDEO (2011) introduce DT resources for educators*	*Education researchers characterize DT for education research & practice, 2012*	*Design researchers continue to develop nuanced characterizations of DT in practice, 2013*
"how designers formulate problems, how they generate solutions, and the cognitive strategies they employ." These include framing the problem, oscillating between possible solutions and reframing the problem, imposing constraints to generate ideas, and reasoning abductively. (Cross, Dorst, & Roozenburg, 1992, p. 4)	"uses the designer's sensibility and methods [empathy, integrative thinking, optimism, experimentalism, collaboration] to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity." (Brown, 2008, p. 2)	"a mindset." It is human-centered, collaborative, optimistic, and experimental. The "structured" process of design includes discovery, interpretation, ideation, experimentation, and evolution (d.school, 2012; IDEO, 2011)	"analytic and creative process that engages a person in opportunities to experiment, create and prototype models, gather feedback, and redesign" (Razzouk & Shute, 2012, p. 330)	"a methodology to generate innovative ideas." These include switching between design tasks and working iteratively. (Rodgers, 2013, p. 434)

Additional Reading

For another great summary of various approaches to design thinking, see this article by the Interaction Design Foundation. This foundation has many other interesting articles on design that would be good reading for an instructional design student.

https://edtechbooks.org/-nh

Where Did Design Thinking Come From? What Does It Mean for Instructional Designers?

Design thinking emerged from the *design research* field[1]—an interdisciplinary field that studies how designers do their work. Initially, design thinking was proposed out of a desire to differentiate the work of designers from that of scientists. As Nigel Cross explained, "We do not have to turn design into an imitation of science, nor do we have to treat design as a mysterious, ineffable art" (Cross, 1999, p. 7). By documenting what accomplished designers do and how they explain their process, design researchers argued that while scientific thinking can be characterized as reasoning inductively and deductively, designers reason *constructively* or *abductively* (Kolko, 2010). When designers think

abductively, they fill in gaps in knowledge about the problem space and the solution space, drawing inferences based on their past design work and on what they understand the problem to be.

Lesson #1 for ID

Research on design thinking should inspire us to critically consider how we use precedent to fill in gaps as we design. Precedent includes our experiences as learners, which may be saturated with uninspired and ineffective instructional design.

A critical difference between scientific thinking and design thinking is the treatment of the problem. Whereas in scientific thinking the problem is treated as solvable through empirical reasoning, in design thinking problems are tentative, sometimes irrational conjectures to be dealt with (Diethelm, 2016). This type of thinking has an *argumentative grammar,* meaning the designer considers suppositional if-then and what-if scenarios to iteratively frame the problem and design something that is valuable for others (Dorst, 2011). As designers do this kind of work, they are jointly framing the problem and posing possible solutions, checking to see if their solutions satisfy the identified requirements (Cross et al., 1992; Kimbell, 2012). From this point of view, we don't really know what the design problem is until it is solved! And when doing design iteratively, this means we are changing the design problem multiple times. But how can we manage such changes efficiently? One answer is agile design.

Agile design, with its emphasis on rapid prototyping, testing and iteration, was proposed to improve software design processes. Later canonized in the *Manifesto for Agile Software Development* (Beck et al., 2001), early advocates argued that this *paradigm shift* in software design process was urgently needed in "the living human world" that was affected by "increasingly computer-based systems

while the existing discipline of software engineering has no way of dealing with this systematically" (Floyd, 1988, p. 25). With the influence new technologies were having on educational settings, it was natural that instructional designers might look to software design for inspiration. Indeed, Tripp and Bichelmeyer introduced instructional designers to rapid prototyping methods while these same methods were still being developed in the software design field (1990). They explained that traditional ID models were based on "naive idealizations of how design takes place," (p. 43), and that ID practice already included similar approaches (e.g., formative evaluation and prototyping), suggesting that agile design could be palatable to instructional designers, particularly when the context or learning approach is relatively new or unfamiliar.

Lesson #2 for ID

Our instructional designs tend to be short lived in use, making them subject to iteration and adaptation to meet emergent changes. Each new solution is linked to a reframing of the problem. As agile designers, we can embrace this iteration agentively, reframing the problem as we work based on insights gained from testing early, low fidelity prototypes with stakeholders.

As practiced, agile methods, including SAM (Allen, 2012) and user-centered design (Norman & Draper, 1986), bring the end user into the design process frequently (Fox, Sillito, & Maurer, 2008). Working contextually and iteratively can help clients see the value of a proposed design solution and understand better how—and if—it will function as needed (Tripp & Bichelmeyer, 1990).

Other design methods that engage stakeholders early in the design process, such as participatory design (Muller & Kuhn, 1993; Schuler & Namioka, 1993) and human-centered design (Rouse, 1991) have also influenced research on design thinking. While these approaches differed in original intent, these differences have been blurred as they have come into practice. Instead of defining each, let's consider design characteristics made salient by comparing them with more traditional, linear methods. Like agile design, these methods tend to be iterative. They also tend to bring stakeholders into the process more deeply to better understand their experiences, extending the approach taken in ADDIE, or even to invite stakeholders to generate possible design ideas and help frame the design problem.

When designing *with* end-users, we get their perspective and give them more ownership over the design, but it can be difficult to help them be visionary. As an example, consider early smartphone design. Early versions had keyboards and very small screens and each new version was incrementally different from the prior version. If we had asked users what they wanted, most would have suggested minor changes in line with the kinds of changes they were seeing with each slightly different version. Likewise, traditional approaches to instruction should help inspire stakeholder expectations of what is possible in a learning design.

Lesson #3 for ID

Inviting stakeholders into instructional design process early can lead to more successful designs, but we should be ready to support them to be visionary, while considering how research on how people learn might inform the design.

Designers who engage with end-users must also attend to power dynamics (Kim, Tan, & Kim, 2012). As instructional designers, when we choose to include learners in the design process, they may be uncertain about how honest they can be with us. This is especially true when working with children or adults from marginalized communities or cultures unfamiliar to us. For instance, an instructional designer who develops a basic computer literacy training for women fleeing abuse may well want to understand more about learner needs, but should consider carefully the situations in which learners will feel empowered to share.

Lesson #4 for ID

With a focus on understanding human need, design thinking and agile methods should also draw our attention to inclusivity, diversity, and participant safety.

We next turn to an example, considering what design thinking might look like across different instructional design practices.

Design Thinking in ID Practice

To understand how design thinking might play out in different instructional design methods, let's consider a case, with the following four different instructional design practices:

- Waterfall design proceeds in a linear, stepwise fashion, treating the problem as known and unchanging
- ADDIE design, in this example, often proceeds in a slow, methodical manner, spending time stepwise on each phase
- Agile design proceeds iteratively, using low fidelity, rapid prototyping to get feedback from stakeholders early and often
- Human-centered design prioritizes understanding stakeholder experiences, sometimes co-designing with stakeholders

A client—a state agency—issued a call for proposals that addressed a design brief for instructional materials paired with new approaches to assessment that would be "worth teaching to." They provided information on the context, learners, constraints, requirements, and what they saw as the failings of current practice. They provided evaluation reports conducted by an external contractor and a list of 10 sources of inspiration from other states.

They reviewed short proposals from 10 instructional design firms. In reviewing these proposals, they noted that even though all designers had access to the same information and the same design brief, the solutions were different, yet all were *satisficing*, meaning they met the requirements without violating any constraints. They also realized that not only were there 10 different solutions, there were also 10 *different* problems being solved! Even though the client had issued a design brief, each team defined the problem differently.

The client invited four teams to submit long proposals, which needed to include a clear depiction of the designed solution, budget implications for the agency, and evidence that the solution would be viable. Members of these teams were given a small budget to be spent as they chose.

Team Waterfall, feeling confident in having completed earlier design steps during the short proposal stage, used the funds to begin designing their solution, hoping to create a strong sense of what they would deliver if chosen. They focused on details noted in the mostly positive feedback on their short proposal. They felt confident they were creating a solution that the client would be satisfied with because their design met all identified requirements, because they used their time efficiently, and because as experienced designers, they knew they were doing quality, professional design. Team Waterfall treated the problem as adequately framed and solved it without iteration. Designers often do this when there is little time or budget[2], or simply because the problem appears to be an *another-of* problem—"this is just another of something I have designed before." While this can be an efficient way to design, it seldom gets at the problem *behind* the problem, and does not account for changes in who might need to use the designed solution or what their needs are. Just because Team Waterfall used a more linear process does not mean that they did not engage in design thinking. They used design thinking to frame the problem in their initial short proposal, and then again as they used design precedent—their past experience solving similar problems—to deliver a professional, timely, and complete solution.

Team ADDIE used the funds to conduct a traditional needs assessment, interviewing five stakeholders to better understand the context, and then collecting data with a survey they created based on their analysis. They identified specific needs, some of which aligned to those in the design brief and some that demonstrated the complexity of the problem. They reframed the problem and created a low fidelity prototype. They did not have time to test it with stakeholders, but could explain how it met the identified needs. They felt confident the investment in understanding needs would pay off later, because it gave them insight into the problem. Team ADDIE used design thinking to fill gaps in their understanding of context, allowing them to extend their design conjectures to propose a solution based on a reframing of the design problem.

Team Agile used the budget to visit three different sites overseen by the state agency. They shared a low fidelity prototype with multiple stakeholders at the first site. In doing so, they realized they had misunderstood key aspects of the problem from one small but critical stakeholder group. They revised both their framing of the problem and their idea about the solution significantly and shared a revised prototype with stakeholders at the remaining sites. They submitted documentation of this process with their revised prototype. Team Agile prioritized iteration and diversity of point of view in their work. They committed to treating their solution ideas as highly tentative, but gave stakeholders something new

and different to react to. This strategy helped the team reframe the problem, but could have failed had they only sought feedback on improvements, rather than further understanding of the problem. They used design thinking to reframe their understanding of the problem, and this led them to iterate on their solution. Design researchers describe this as a co-evolutionary process, in which changes to the problem framing affect the solution, and changes to the solution affect the framing (Dorst & Cross, 2001).

Team Human-centered used the budget to hold an intensive five-day co-design session with a major stakeholder group. Stakeholders shared their experiences and ideas for improving on their experience. Team Human crafted three personas based on this information and created a prototype, which the stakeholder group reviewed favorably. They submitted this review with their prototype. Team Human-centered valued stakeholder point of view above all else, but failed to consider that an intensive five-day workshop would limit who could attend. They used design thinking to understand differences in stakeholder point of view and reframed the problem based on this; however, they treated this as covering the territory of stakeholder perspectives. They learned a great deal about the experiences these stakeholders had, but failed to help the stakeholders think beyond their own experiences, resulting in a design that was only incrementally better than existing solutions and catered to the desires of one group over others.

The case above depicts ways of proceeding in design process and different ways of using design thinking. These characterizations are not intended to privilege one design approach over others, but rather to provoke the reader to consider them in terms of how designers fill in gaps in understanding, how they involve stakeholders, and how iteratively they work. Each approach, however, also carries potential risks and challenges (Figure 2). For instance, designers may not have easy access to stakeholders, and large projects may make agile approaches unwieldy to carry out (Turk, France, & Rumpe, 2002).

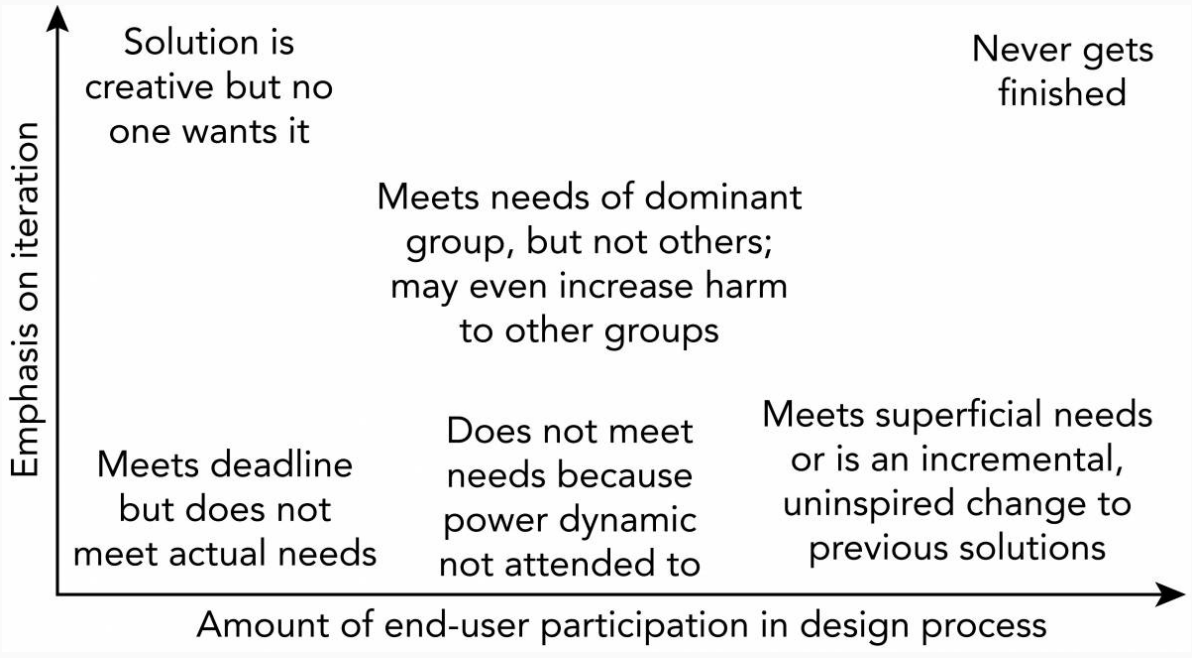

Figure 2. Risks and pitfalls associated with different levels of end-user participation and iteration

Critiques of Design Thinking

While originally a construct introduced by design researchers to investigate how designers think and do their work, design thinking became popularized, first in the business world (Brown, 2008) and later in education. Given this popularity, design thinking was bound to draw critique in the public sphere. To understand these critiques, it is worth

returning to the definitions cited earlier (Table 1). Definitions outside of the design research field tend to be based in specific techniques and strategies aimed at innovation; such accounts fail to capture the diversity of actual design practices (Kimbell, 2011). They also tend to privilege the designer as a savior, an idea at odds with the keen focus on designing ***with*** stakeholders that is visible in the design research field (Kimbell, 2011). As a result, some have raised concerns that design thinking can be a rather privileged process—e.g., upper middle class white people drinking wine in a museum while solving poverty with sticky note ideas—that fails to lead to sufficiently multidimensional understandings of complex processes (Collier, 2017). Still others argue that much of design thinking is nothing new (Merholz, 2009), to which researchers in the design research field have responded: design thinking, as represented externally might not be new, but the rich body of research from the field could inform new practices (Dorst, 2011).

These critiques should make us cautious about how we, as instructional designers, take up design thinking and new design practices. Below, I raise a few concerns for new instructional designers, for instructional designers interested in incorporating new methods, for those who teach instructional design, and for those planning research studies about new design methods.

My first concern builds directly on critiques from the popular press and my experience as a reviewer of manuscripts. Design thinking is indeed trendy, and of course people want to engage with it. But as we have seen, it is also complex and subtle. Whenever we engage with a new topic, we necessarily build on our past understandings and beliefs as we make connections. It should not be surprising, then, that when our understanding of a new concept is nascent, it might not be very differentiated from previous ideas. Compare, for example, Polya's "How to Solve it" from 1945 to Stanford's d.school representation of design thinking (Table 2). While Polya did not detail a design process, but rather a process for solving mathematics problems, the two processes are superficially very similar. These general models of complex, detailed processes are *zoomed out* to such a degree that we lose the detail. These details matter, whether you are a designer learning a new practice or a researcher studying how designers do their work. For those learning a new practice, I advise you to attend to the differences, not the similarities. For those planning studies of design thinking, keep in mind that "design thinking" is too broad to study effectively as a whole. Narrow your scope and *zoom in* to a focal length that lets you investigate the details. As you do so, however, do not lose sight of how the details function in a complex process. For instance, consider the various approaches being investigated to measure design thinking; some treat these as discrete, separable skills, and others consider them in tandem (Carmel-Gilfilen & Portillo, 2010; Dolata, Uebernickel, & Schwabe, 2017; Lande, Sonalkar, Jung, Han, & Banerjee, 2012; Razzouk & Shute, 2012).

Table 2. Similarities between "How to Solve it" and a representation of design thinking

Polya, 1945 How to solve it	***Stanford's d.school design thinking representation***
Understand the problem	Empathize, Define
Devise a plan	Ideate
Carry out the plan	Prototype
Look back	Test

My second concern is that we tend, as a field, to remain naïve about the extant and extensive research on design thinking and other design methods, in part because many of these studies were conducted in other design fields (e.g., architecture, engineering) and published in journals such as *Design Studies* (which has seldom referenced instructional design). Not attending to past and current research, and instead receiving information about alternative design methods filtered through other sources is akin to the game of telephone. By the time the message reaches us, it can be distorted. While we need to adapt alternative methods to our own ID practices and contexts, we should do more to learn from other design fields, and also contribute our findings to the design research field. As designers, we would do well to learn from fields that concern themselves with human experience and focus somewhat less on efficiency.

My third concern is about teaching alternative design methods to novice designers. The experience of learning ID is often just a single pass, with no or few opportunities to iterate. As a result, agile methods may seem the perfect way to begin learning to design, because there is no conflicting traditional foundation to overcome. However, novice designers tend to jump to solutions too quickly, a condition no doubt brought about in part by an emphasis in schooling on getting to the right answer using the most efficient method. Methods like agile design encourage designers to come to a tentative solution right away, then get feedback by testing low fidelity prototypes. This approach could exacerbate a new designer's tendency to leap to solutions. And once a solution is found, it can be hard to give alternatives serious thought. Yet, I argue that the solution is not to ignore agile and human-centered methods in early instruction. By focusing only on ADDIE, we may create a different problem by signaling to new designers that the ID process is linear and tidy, when this is typically not the case.

Instead, if we consider ADDIE as a scaffold for designers, we can see that its clarity makes it a useful set of supports for those new to design. Alternative methods seldom offer such clarity, and have far fewer resources available, making it challenging to find the needed supports. To resolve this, we need more and better scaffolds that support novice designers to engage in agile, human-centered work. For instance, I developed a *Wrong Theory Design Protocol* (https://edtechbooks.org/-ub) that helps inexperienced designers get unstuck, consider the problem from different points of view, and consider new solutions. Such scaffolds could lead to a new generation of instructional designers who are better prepared to tackle complex learning designs, who value the process of framing problems ***with*** stakeholders, and who consider issues of power, inclusivity, and diversity in their designing.

Concluding Thoughts

I encourage novice instructional designers, as they ponder the various ID models, approaches, practices and methods available to them, to be suspicious of any that render design work tidy and linear. If, in the midst of designing, you feel muddy and uncertain, unsure how to proceed, you are likely exactly where you ought to be.

In such situations, we use design thinking to fill in gaps in our understanding of the problem and to consider how our solution ideas might satisfy design requirements. While experienced designers have an expansive set of precedents to work with in filling these gaps, novice designers need to look more assiduously for such inspiration. Our past educational experiences may covertly convince us that just because something is common, it is best. While a traditional instructional approach may be effective for some learners, I encourage novice designers to consider the following questions to scaffold their evaluation of instructional designs:

- Does its effectiveness depend significantly on having *compliant learners* who do everything asked of them without questioning why they are doing it?
- Is it a design *worth* engaging with? Would you want to be the learner? Would your mother, child, or next-door neighbor want to be? If yes on all counts, consider who *wouldn't,* and why they wouldn't.
- Is the design, as one of my favorite project-based teachers used to ask, "provocative" for the learners, meaning, will it provoke a strong response, a curiosity, and a desire to know more?
- Is the design "chocolate-covered broccoli" that tricks learners into engaging?

To be clear, the goal is not to make all learning experiences fun or easy, but to make them worthwhile. And I can think of no better way to ensure this than using iterative, human-centered methods that help designers understand and value multiple stakeholder perspectives. And if, in the midst of seeking, analyzing, and integrating such points of view, you find yourself thinking, "This is difficult," that is because it *is difficult.* Providing a low fidelity prototype for stakeholders to react to can make this process clearer and easier to manage, because it narrows the focus.

However, success of this approach depends on several factors. First, it helps to have forthright stakeholders who are at least a little hard to please. Second, if the design is visionary compared to the current state, stakeholders may need to be coaxed to envision new learning situations to react effectively. Third, designers need to resist the temptation to settle on an early design idea.

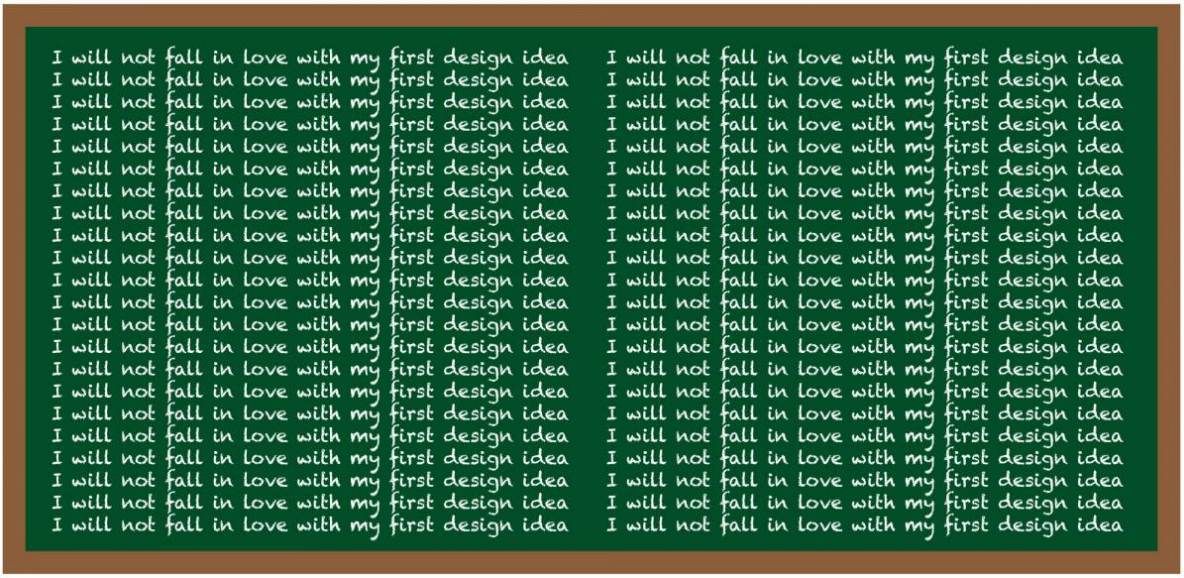

Figure 3. Designers need to resist the temptation to settle on an early design idea

Finally, I encourage instructional designers—novice and expert alike—to let themselves be inspired by the design research field and human-centered approaches, and then to give back by sharing their design work as design cases (such as in the *International Journal of Designs for Learning*) and by publishing in design research journals .

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The Design Society publishes several relevant journals:

Design Science

CoDesign: International Journal of CoCreation in Design and the Arts

International Journal of Design Creativity and Innovation

Journal of Design Research

The Design Research Society has conferences and discussion forums.

Other journals worth investigating:

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Sign up for monthly emails from **Design Research News** to find out about conferences, calls for special issues, and job announcements.

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1. For those interested in learning more, refer to the journal, *Design Studies,* and the professional organization, *Design Research Society.* Note that this is not a reference to educational researchers who do design-based research. ↵
2. Waterfall might also be used when designing a large, expensive system that cannot be tested and iterated on as a whole and when subsystems cannot easily or effectively be prototyped. ↵

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24

What and how do designers design?

A Theory of Design Structure and Layers

Andrew Gibbons

Editor's Note

The following was originally published in *Techtrends,* and is published here by permission.

Gibbons, A. S. (2003). What and how do designers design? *TechTrends*, *47*(5), 22-25.

A question I always ask my Instructional Technology students at Utah State University is, "What do instructional designers design?" We have had interesting discussions on this question, and I try to revisit the question at several points throughout all of my classes. I find that the students' perceptions of what instructional designers design changes over time. This is no doubt a product of the faculty's teaching, but it also represents a personal commitment that the student makes. What the student commits to is what I would like to talk about. My thesis will be that it is a commitment to a particular layer of the evolving instructional design. I will talk about the layering of instructional designs and the implications for both teaching and practicing instructional design.

The Centrisms

Here are some of the phases I see students evolving through as they mature in their theoretic and practical knowledge:

Media-centrism. Media-centric designs place great emphasis on the constructs related to the instructional medium. The technology itself holds great attraction for new designers. They often construct their designs in the vocabulary of the medium rather than seeing the medium as a plastic and preferably invisible channel for learning interaction (See Norman, 1988; 1999). We are currently experiencing a wave of new media-centric designers due to the accessibility of powerful multimedia tools and large numbers of designers "assigned into" computer-based and Web-based training design. Most of these designers speak in terms of the medium's constructs (the "page," the "hyperlink,", the "site," etc.) as the major design building blocks. Many struggle as they attempt to apply inadequate thought tools to complex design problems.

Message-centrism. Realizing that media design building blocks do not automatically lead to effective designs, most designers begin to concentrate on "telling the message better" in order to "get the idea across" or "make it stick." This is

a phase I call message-centrism. Message-centric design places primary importance on message-related constructs—main idea, explanation, line of argument, dramatization, etc.— and employs media constructs secondarily, according to the demands of the message. The media constructs are used, but they are used to serve the needs of better messaging. Better message telling means different things to different designers: providing better illustrations, using animations, wording the message differently, using analogies, or focusing learner attention using attention-focusing questions, emphasis marks, repetition, or increased interactivity.

Strategy-centrism. Message-centrism is normally followed by a recognition of underlying structural similarities within messages and interactions that cross subject-matter boundaries and that have important instructional implications. This leads to a new viewpoint I call strategy-centric design thinking. Strategy-centrism considers the structured plan of messaging and interaction as a main source of instructional effectiveness. Therefore, the designer's first attention is to strategic constructs that are appropriate to instruction in categorized varieties of learning. Strategy-centric design can be viewed as the use of rules to governing the delivery of compartmentalized information and interaction elements (Gagne, 1985; Merrill, 1994). This can be a very useful conception for both the designer and the learner, and structured strategy is an important key to logic templating and design automation.

Model-centrism. Whereas strategy centrism permits the use of instructional experts (Zhang, Gibbons, & Merrill, 1997), it does not lead the designer to design interactive micro-worlds in which instruction can take place through problem solving. This realization leads to model-centered design thinking. Model centering encourages the designer to think first in terms of the system and model constructs that lie at the base of subject-matter knowledge. The designer therefore gives first consideration to identifying, capturing, and representing in interactive form the substance of these constructs. Then to this base of design is added strategy, message, and media constructs. Model-centrism is the common thread running through virtually all new-paradigm instructional approaches (for a review, see Gibbons & Fairweather, 2000). Many current researchers consider learning to be a problem-solving activity (Anderson, 1993; Brown & Palincsar, 1989; Schank, 1994; VanLehn, 1993). If this view is correct, then the designer must also give first preference to decisions about the problems the learner will be asked to solve. A model-centered view prescribes instructional augmentations that support problem solving in the form of coaching and feedback systems, representation systems, control systems, scope dynamics, and embedded didactics (see Gibbons, Fairweather, Anderson, & Merrill, 1997).

These phases in the maturation of design thinking tend to be encountered by new designers in the same order, and one could make the argument that these phases describe the history of research interests in the field of instructional technology as a whole. A good place to see this trend in cross-section is the articles in the *Annual Review of Psychology* beginning with the review by Lumsdaine and May (1965) and progressing through subsequent chapters by Anderson (1967); Gagne & Rohwer (1969); Glaser & Resnick (1972); McKeachie (1974); Wittrock & Lumsdaine (1977); Resnick (1981); Gagne & Dick (1983); Pintrich, Cross, Kozma & McKeachie (1986); Snow & Swanson (1992); Voss, Wiley & Carretero (1995); Sandoval (1995); VanLehn (1996); Carroll (1997); Palincsar (1998); and Medin, Lynch & Solomon (2000).

I am interested in this paper in exploring the roots of this progression. Important clues can be found in design areas outside of instructional design. A provocative statement on design structure is given by Brand (1994) in a description of how buildings are seen by architects and structural engineers. Brand begins by stating that architects see a building as a system of layers rather than as a unitary designed entity. He names six general layers, illustrated in Figure 1 and described below in his own words:

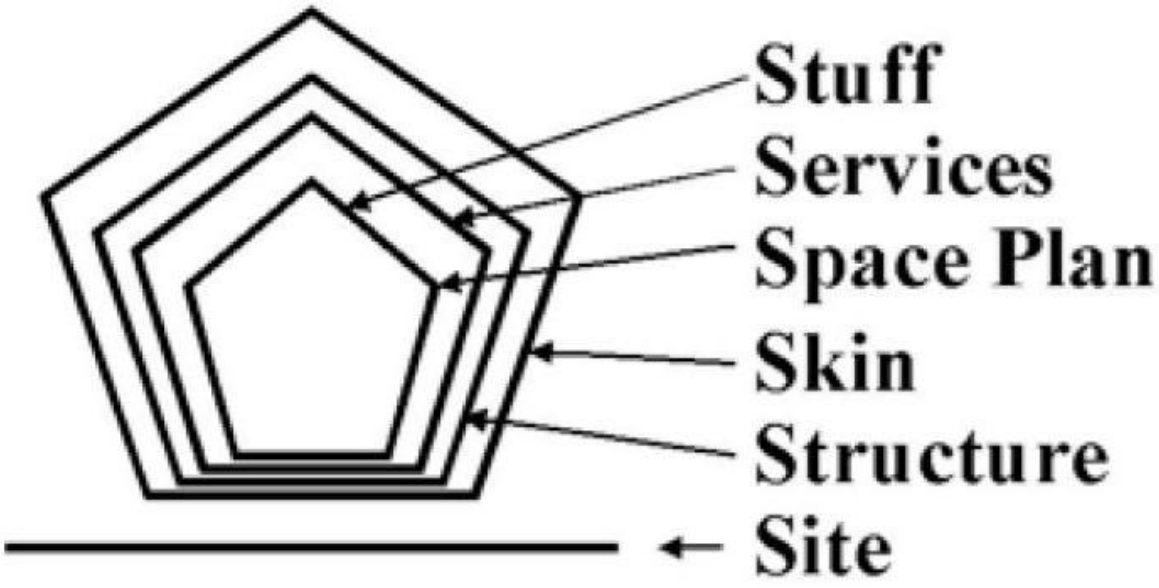

Figure 1. Layers of building design.

- SITE – This is the geographical setting, the urban location, and the legally defined lot, whose boundaries and context outlast generations of ephemeral buildings. "Site is eternal," Duffy agrees.
- STRUCTURE – The foundation and load-bearing elements are perilous and expensive to change, so people don't. These **are** the building. Structural life ranges from 30 to 300 years (but few buildings make it past 60, for other reasons).
- SKIN – Exterior surfaces now change every 20 years or so, to keep with fashion and technology, or for wholesale repair. Recent focus on energy costs has led to reengineered Skins that are air-tight and better insulated.
- SERVICES – These are the working guts of a building: communications wiring, electrical wiring, plumbing, sprinkler system, HVAC (heating, ventilating, air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every 7 to 15 years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily.
- SPACE PLAN – The interior layout—where walls, ceilings, floors, and doors go. Turbulent commercial space can change every 3 years or so; exceptionally quiet homes might wait 30 years.
- STUFF – Chairs, desks, phones, pictures, kitchen appliances, lamps, hair brushes; all the things that twitch around daily to monthly. Furniture is called **mobilia** in Italian for good reason. (p. 13)

Brand points out some important implications of the layered view of design:

1. That layers of a design age at different rates,
2. That layers must be replaced or modified on different time schedules,
3. That the layers must be articulated with each other somehow, and
4. That designs should provide for articulation in such a way that change to one layer entails minimum disruption to the others.

In work for the Center for Human-Systems Simulation, my colleagues Jon Nelson and Bob Richards and I have applied Brand's ideas to instructional design (Gibbons, Nelson & Richards, 2000). We have found that instructional designs can indeed be conceived of as multiple layers of decision making with respect to different sets of design constructs, and we find a rough correspondence between the layers and the phases of designer thinking already described. Gibbons, Lawless, Anderson and Duffin (2001) show how layers of a design are compressed at a "convergence zone" with tool constructs that give them real existence and embody them in a product.

Tables 1 through 7 following this article, summarize what we think are the important layers of an instructional design: model/content, strategy, control, message, representation, media-logic, and management. Each layer is characterized in the tables by the following sets:

- A set of design goals unique to the layer,
- A set of design constructs unique to the layer,
- A set of theoretic principles for the selection and use of design constructs,
- A set of design and development tools, and
- A set of specialized design processes.

In addition, a layer often corresponds with a set of specialized design skills with its own lore, design heuristics, technical data, measurements, algorithms, and practical considerations. The boundaries of these skills over time tend to harden into lines of labor division, especially as technical sophistication of tools and techniques increases.

More detailed principles of design layering are outlined in Gibbons, Nelson, and Richards (2000). The purpose of the present paper is to show how design layering influences the designer's thinking and allows it to change over time into entirely new ways of approaching the design task. The media, message, strategy, and model-centric phases designers experience can be explained as the necessary focus of the designer first and foremost on a particular layer of the design. That is, the designer enters the design at the layer most important to the design or with which the designer is most familiar and comfortable.

Media-centric designers do not ignore decisions related to other layers, but because they may not yet be fully acquainted with the principles of design at other layers, they naturally think in terms of the structures they do know or can acquire most rapidly—media structures. As designers become aware of principles at other layers through experience and the evaluation of their own designs, focus can shift to the constructs of the different layers: message structurings, strategy structurings, and model and content structurings. Each step of the progression in turn gives the designer a new set of constructs and structuring principles to which to give the most attention, with other layers of the design being determined secondarily, but not ignored.

Is there a "right" layer priority in designs? Should designers always be counseled to enter the design task with a particular layer in mind? It is not possible to say, because design tasks most often come with constraints attached, and one of those constraints may predetermine a primary focus on a layer. An assignment to create a set of videotapes will lead the designer to pay first and last attention to the media-logic and representation layers, and other layers are forced to comply with the constraint within the limits of the designer's ingenuity.

Conclusion

The design layering concept has many implications. In this paper I have explored one of them that explains the maturation in designer thinking over time. In order to move to a new perspective of design it is not necessary to leave older views behind. The new principles added as the designer becomes knowledgeable about each new layer adds to the designer's range and to the sophistication of the designs that are possible. Further consideration of the layering concept will expand our ability to communicate designs in richer detail, achieve more sophisticated designs, and add to our understanding of the design process itself.

Table 1. Model/Content Layer Description

Layer Design Goals	Common Layer Design Constructs
To define the units of content segmentation	(Incomplete sample list)

To define the method of content capture	Model
To gather content elements	Relation
To articulate content structures:	Production rule
With the Strategy layer	Working Memory Element
With the Control layer	Proposition
With the Message layer	Fact
With the Representation layer	Concept
With the Logic layer	Rule
With the Management layer	Principle
	Task
	Task grouping
	Theme
	Topic
	Main idea
	Semantic relationship
	Chapter

Design Processes: Task Analysis, Cognitive Task Analysis, Rule Analysis, Content Analysis, Concept Mapping
Design/Production Tools: Data base software, Analysis software

Table 2. Strategy/Event Layer Description

Layer Design Goals	Common Layer Design Constructs
To define event structures (time structures)	(Incomplete sample list)
To define event hierarchies	Problem
To define rules for event generation	Information event
To articulate strategy structures:	Interaction event
With the Content layer	Exercise

With the Control layer	Instructional period
With the Message layer	Discovery challenge
With the Representation layer	Unit
With the Logic layer	Lesson
With the Management layer	Strategy component
	Argument
	Argument support

Design Processes: Strategy planning, Problem planning, Challenge formation, Activity planning, Exercise design
Design/Production Tools: Data base software

Table 3. Control Layer Description

Layer Design Goals	Common Layer Design Constructs
To define the set of possible user actions	(Incomplete sample list)
To define the rules of control availability	Menu item
To define the rules for control action	Administrative control
To define the rules/processes for response	Strategy control
recognition, parsing, and judging	Message control
To articulate control structures:	Representation control
With the Content layer	Logic control
With the Strategy layer	Content control
With the Message layer	Forward, Back
With the Representation layer	Play, FF, FR, Stop, Pause
With the Logic layer	Exit, Quit
With the Management layer	

Design Processes: Flow planning, Control walk-through, Diagramming
Design/Production Tools: Flowcharting, GUI-logic construction authoring systems

Table 4. Message Layer Description

Layer Design Goals	Common Layer Design Constructs
To define message types	(Incomplete sample list)
To define message composition by type	Main idea
To define rules for message generation	Example
To articulate message structures:	Non-Example
With the Content layer	Discussion block
With the Strategy layer	Commentary
With the Control layer	Advance organizer
With the Representation layer	Primitive message element
With the Logic layer	Spatial relationship
With the Management layer	Temporal relationship
	Causal relationship
	Hierarchical relationship
	Explanation
	Stem
	Distractor
	Response request
	Transition message
	Goal statement
	Directions
	“Resource”
	Database entry
	Coaching message
	Feedback message
	Hint
Design Processes: Message design, Strongly related to Strategy design	
Design/Production Tools: Timeline-building tools, Flow diagrams	

Table 5. Representation Layer Description

Layer Design Goals	Common Layer Design Constructs
To select media	(Incomplete sample list)
To define media channels	Background
To define channel synchronizations	Resource file (audio, video)
To define representation structures by type	Resource file (BMP, JPG, GIF, MPG)
To select representation production tools	Headline, Body
To match production tool structures	Placeholder
To define rules display structure	3-D object
To define rules for display generation	Rendering
To define rules for structure generation	Animation
To define rules for display management	Tag parameter
To articulate representation structures:	Sprite
With the Content layer	Control icon
With the Strategy layer	Layer (e.g., Photoshop, Dreamweaver)
With the Control layer	
With the message layer	
With the Logic layer	
With the Management layer	
Design Processes: Display design, Formatting, Display event sequencing, Media channel synchronization, Media channel assignment	
Design/Production Tools: All content/resource production tools for all media, All layout or formatting tools for all media, Display managers	

Table 6. Logic Layer Description

Layer Design Goals	Common Layer Design Constructs
To define media-logic structures by type	(Incomplete sample list)
To define rules to apply logic structures	Display
To select logic construction tools	Branch

To define segmentation/packaging plan	Program
To define logic distribution plan (time)	Command
To articulate logic structures:	Procedure
With the Content layer	Program object
With the Strategy layer	Applet
With the Control layer	Application
With the Message layer	Book, object
With the Representation layer	Movie, stage, actor
With the Management layer	Object, Method, Data
	Site, Page

Design Processes: Program design, Program construction
Design/Production Tools: All logic production tools, Modeling languages (e.g., UML)

Table 7. Management Layer Description

Layer Design Goals	Common Layer Design Constructs
To define session control rules/procedures	(Incomplete sample list)
To define the rules for initiative sharing	Menu
To define transition between events	Record
To define record keeping and recording	Variable
To define variable-keeping and use	Database entry
To define outside communications:	
Host, Peer, Net, Libraries, Databases	
To define data reporting:	
Learner, Instructor, System	
To plan security/privacy policy/provisions	
To plan evaluation activities	
To plan implementation activities	
To plan management activities	
To articulate management structures:	

With the Content layer

With the Strategy layer

With the Control layer

With the Message layer

With the Representation layer

With the Logic layer

Design Processes: Management planning, Implementation planning, Evaluation planning
Design/Production Tools: Data base software

Application Exercises

- Select one centrism and describe its strengths and weaknesses.
- Examine an online course that you have taken in the past. Identify the elements included in each design layer.

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Further Resources

For more information on Andrew Gibbons' theory of design layers, see the following resources:

- Gibbons, A. S. & Rogers, P. C. (2009). The architecture of instructional theory. In C. M. Reigeluth & A. Carr-Chellman (Eds.), *Instructional-design theories and models, Volume III: Building a common knowledge base*. New York: Routledge.
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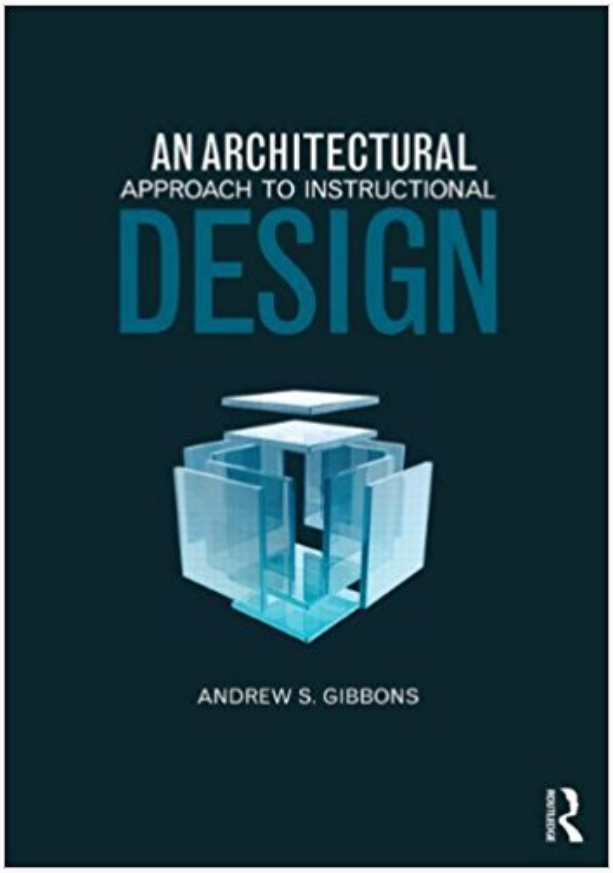

Please complete this short survey to provide feedback on this chapter: http://bit.ly/DesignLayers

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25

The Development of Design-Based Research

Kimberly Christensen & Richard E. West

Editor's Note

The following paper was originally published online as part of a design-based research conference funded by AERA and held at the University of Georgia in 2013. It was then revised for inclusion in this book.

Design-Based Research (DBR) is one of the most exciting evolutions in research methodology of our time, as it allows for the potential knowledge gained through the intimate connections designers have with their work to be combined with the knowledge derived from research. These two sources of knowledge can inform each other, leading to improved design interventions as well as improved local and generalizable theory. However, these positive outcomes are not easily attained, as DBR is also a difficult method to implement well. The good news is that we can learn much from other disciplines who are also seeking to find effective strategies for intertwining design and research. In this chapter, we will review the history of DBR as well as Interdisciplinary Design Research (IDR) and then discuss potential implications for our field.

Shared Origins With IDR

These two types of design research, both DBR and IDR, share a common genesis among the design revolution of the 1960s, where designers, researchers, and scholars sought to elevate design from mere practice to an independent scholarly discipline, with its own research and distinct theoretical and methodological underpinnings. A scholarly focus on design methods, they argued, would foster the development of design theories, which would in turn improve the quality of design and design practice (Margolin, 2010). Research on design methods, termed *design research,* would be the foundation of this new discipline.

Design research had existed in primitive form—as market research and process analysis—since before the turn of the 20th century, and, although it had served to improve processes and marketing, it had not been applied as scientific research. John Chris Jones, Bruce Archer, and Herbert Simon were among the first to shift the focus from research *for* design (e.g., research with the intent of gathering data to support product development) to research *on*design (e.g., research exploring the design process). Their efforts framed the initial development of design research and science.

John Chris Jones

An engineer, Jones (1970) felt that the design process was ambiguous and often too abstruse to discuss effectively. One solution, he offered, was to define and discuss design in terms of methods. By identifying and discussing design

methods, researchers would be able to create transparency in the design process, combating perceptions of design being more or less mysteriously inspired. This discussion of design methods, Jones proposed, would in turn raise the level of discourse and practice in design.

Bruce Archer

Archer, also an engineer, worked with Jones and likewise supported the adoption of research methods from other disciplines. Archer (1965) proposed that applying systematic methods would improve the assessment of design problems and foster the development of effective solutions. Archer recognized, however, that improved practice alone would not enable design to achieve disciplinary status. In order to become a discipline, design required a theoretical foundation to support its practice. Archer (1981) advocated that design research was the primary means by which theoretical knowledge could be developed. He suggested that the application of systematic inquiry, such as existed in engineering, would yield knowledge about not only product and practice, but also the theory that guided each.

Herbert Simon

It was multidisciplinary social scientist Simon, however, that issued the clarion call for transforming design into design science (Buchanan, 2007; Collins, 1992; Collins, Joseph, & Bielaczyc, 2004; Cross, 1999; Cross, 2007; Friedman, 2003; Jonas, 2007; Willemien, 2009). In *The Sciences of the Artificial,* Simon (1969) reasoned that the rigorous inquiry and discussion surrounding naturally occurring processes and phenomena was just as necessary for man-made products and processes. He particularly called for "[bodies] of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process" (p. 132). This call for more scholarly discussion and practice resonated with designers across disciplines in design and engineering (Buchanan, 2007; Cross, 1999; Cross, 2007; Friedman, 2003; Jonas, 2007; Willemien, 2009). IDR sprang directly from this early movement and has continued to gain momentum, producing an interdisciplinary body of research encompassing research efforts in engineering, design, and technology.

Years later, in the 1980s, Simon's work inspired the first DBR efforts in education (Collins et al., 2004). Much of the DBR literature attributes its beginnings to the work of Ann Brown and Allan Collins (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Collins et al., 2004; Kelly, 2003; McCandliss, Kalchman, & Bryant, 2003; Oh & Reeves, 2010; Reeves, 2006; Shavelson, Phillips, Towne, & Feuer, 2003; Tabak, 2004; van den Akker, 1999). Their work, focusing on research and development in authentic contexts, drew heavily on research approaches and development practices in the design sciences, including the work of early design researchers such as Simon (Brown, 1992; Collins, 1992; Collins et al., 2004). However, over generations of research, this connection has been all but forgotten, and DBR, although similarly inspired by the early efforts of Simon, Archer, and Jones, has developed into an isolated and discipline-specific body of design research, independent from its interdisciplinary cousin.

Current Issues in DBR

The initial obstacle to understanding and engaging in DBR is understanding what DBR is. What do we call it? What does it entail? How do we do it? Many of the current challenges facing DBR concern these questions. Specifically, there are three issues that influence how DBR is identified, implemented, and discussed. First, proliferation of terminology among scholars and inconsistent use of these terms have created a sprawling body of literature, with various splinter DBR groups hosting scholarly conversations regarding their particular brand of DBR. Second, DBR, as a field, is characterized by a lack of definition, in terms of its purpose, its characteristics, and the steps or processes of which it is comprised. Third, the one consistent element of DBR across the field is an unwieldy set of considerations incumbent upon the researcher.

Because it is so difficult to define and conceptualize DBR, it is similarly difficult to replicate authentically. Lack of scholarly agreement on the characteristics and outcomes that define DBR withholds a structure by which DBR studies can be identified and evaluated and, ultimately, limits the degree to which the field can progress. The following sections

will identify and explore the three greatest challenges facing DBR today: proliferation of terms, lack of definition, and competing demands.

Proliferation of Terminology

One of the most challenging characteristics of DBR is the quantity and use of terms that identify DBR in the research literature. There are seven common terms typically associated with DBR: *design experiments, design research, design-based research, formative research, development research, developmental research,* and *design-based implementation research.*

Synonymous Terms

Collins and Brown first termed their efforts *design experiments* (Brown, 1992; Collins, 1992). Subsequent literature stemming from or relating to Collins' and Brown's work used *design research* and *design experiments* synonymously (Anderson & Shattuck, 2012; Collins et al., 2004). *Design-based research* was introduced to distinguish DBR from other research approaches. Sandoval and Bell (2004) best summarized this as follows:

> *We have settled on the term design-based research over the other commonly used phrases "design experimentation," which connotes a specific form of controlled experimentation that does not capture the breadth of the approach, or "design research," which is too easily confused with research design and other efforts in design fields that lack in situ research components. (p. 199)*

Variations by Discipline

Terminology across disciplines refers to DBR approaches as *formative research, development research, design experiments,* and *developmental research.* According to van den Akker (1999), the use of DBR terminology also varies by educational sub-discipline, with areas such as (a) curriculum, (b) learning and instruction, (c) media and technology, and (d) teacher education and didactics favoring specific terms that reflect the focus of their research (Figure 1).

Subdiscipline	Design research terms	Focus
Curriculum	development research	To support product development and generate design and evaluation methods (van den Akker & Plomp, 1993).
development research	To inform decision-making during development and improve product quality (Walker & Bresler, 1993).	
formative research	To inform decision-making during development and improve product quality (Walker, 1992).	
Learning & Instruction	design experiments	To develop products and inform practice (Brown, 1992; Collins, 1992).
design-based research	To develop products, contribute to theory, and inform practice (Bannan-Ritland, 2003; Barab & Squire, 2004; Sandoval & Bell, 2004).	
formative research	To improve instructional design theory and practice (Reigeluth & Frick, 1999).	
Media & Technology	development research	To improve instructional design, development, and evaluation processes (Richey & Nelson, 1996).
Teacher Education & Didactics	developmental research	To create theory- and research-based products and contribute to local instructional theory (van den Akker, 1999).

Figure 1. Variations in DBR terminology across educational sub-disciplines.

Lack of Definition

This variation across disciplines, with design researchers tailoring design research to address discipline-specific interests and needs, has created a lack of definition in the field overall. In addition, in the literature, DBR has been conceptualized at various levels of granularity. Here, we will discuss three existing approaches to defining DBR: (a) statements of the overarching purpose, (b) lists of defining characteristics, and (c) models of the steps or processes involved.

General Purpose

In literature, scholars and researchers have made multiple attempts to isolate the general purpose of design research in education, with each offering a different insight and definition. According to van den Akker (1999), design research is distinguished from other research efforts by its simultaneous commitment to (a) developing a body of design principles and methods that are based in theory and validated by research and (b) offering direct contributions to practice. This

position was supported by Sandoval and Bell (2004), who suggested that the general purpose of DBR was to address the "tension between the desire for locally usable knowledge, on the one hand, and scientifically sound, generalizable knowledge on the other" (p. 199). Cobb et al. (2003) particularly promoted the theory-building focus, asserting "design experiments are conducted to develop theories, not merely to empirically tune 'what works'" (p. 10). Shavelson et al. (2003) recognized the importance of developing theory but emphasized that the testing and building of instructional products was an equal focus of design research rather than the means to a theoretical end.

The aggregate of these definitions suggests that the purpose of DBR involves theoretical and practical design principles and active engagement in the design process. However, DBR continues to vary in its prioritization of these components, with some focusing largely on theory, others emphasizing practice or product, and many examining neither but all using the same terms.

Specific Characteristics

Another way to define DBR is by identifying the key characteristics that both unite and define the approach. Unlike other research approaches, DBR can take the form of multiple research methodologies, both qualitative and quantitative, and thus cannot be recognized strictly by its methods. Identifying characteristics, therefore, concern the research process, context, and focus. This section will discuss the original characteristics of DBR, as introduced by Brown and Collins, and then identify the seven most common characteristics suggested by DBR literature overall.

Brown's concept of DBR. Brown (1992) defined design research as having five primary characteristics that distinguished it from typical design or research processes. First, a design is engineered in an authentic, working environment. Second, the development of research and the design are influenced by a specific set of inputs: classroom environment, teachers and students as researchers, curriculum, and technology. Third, the design and development process includes multiple cycles of testing, revision, and further testing. Fourth, the design research process produces an assessment of the design's quality as well as the effectiveness of both the design and its theoretical underpinnings. Finally, the overall process should make contributions to existing learning theory.

Collins's concept of DBR. Collins (1990, 1992) posed a similar list of design research characteristics. Collins echoed Brown's specifications of authentic context, cycles of testing and revision, and design and process evaluation. Additionally, Collins provided greater detail regarding the characteristics of the design research processes—specifically, that design research should include the comparison of multiple sample groups, be systematic in both its variation within the experiment and in the order of revisions (i.e., by testing the innovations most likely to succeed first), and involve an interdisciplinary team of experts including not just the teacher and designer, but technologists, psychologists, and developers as well. Unlike Brown, however, Collins did not refer to theory building as an essential characteristic.

Current DBR characteristics. The DBR literature that followed expanded, clarified, and revised the design research characteristics identified by Brown and Collins. The range of DBR characteristics discussed in the field currently is broad but can be distilled to seven most frequently referenced identifying characteristics of DBR: design driven, situated, iterative, collaborative, theory building, practical, and productive.

Design driven. All literature identifies DBR as focusing on the evolution of a design (Anderson & Shattuck, 2012; Brown, 1992; Cobb et al., 2003; Collins, 1992; Design-Based Research Collective, 2003). While the design can range from an instructional artifact to an intervention, engagement in the design process is what yields the experience, data, and insight necessary for inquiry.

Situated. Recalling Brown's (1992) call for more authentic research contexts, nearly all definitions of DBR situate the aforementioned design process in a real-world context, such as a classroom (Anderson & Shattuck, 2012; Barab & Squire, 2004; Cobb et al., 2003).

Iterative. Literature also appears to agree that a DBR process does not consist of a linear design process, but rather multiple cycles of design, testing, and revision (Anderson & Shattuck, 2012; Barab & Squire, 2004; Brown, 1992; Design-Based Research Collective, 2003; Shavelson et al., 2003). These iterations must also represent systematic adjustment

of the design, with each adjustment and subsequent testing serving as a miniature experiment (Barab & Squire, 2004; Collins, 1992).

Collaborative. While the literature may not always agree on the roles and responsibilities of those engaged in DBR, collaboration between researchers, designers, and educators appears to be key (Anderson & Shattuck, 2012; Barab & Squire, 2004; McCandliss et al., 2003). Each collaborator enters the project with a unique perspective and, as each engages in research, forms a role-specific view of phenomena. These perspectives can then be combined to create a more holistic view of the design process, its context, and the developing product.

Theory building. Design research focuses on more than creating an effective design; DBR should produce an intimate understanding of both design and theory (Anderson & Shattuck, 2012; Barab & Squire, 2004; Brown, 1992; Cobb et al., 2003; Design-Based Research Collective, 2003; Joseph, 2004; Shavelson et al., 2003). According to Barab & Squire (2004), "Design-based research requires more than simply showing a particular design works but demands that the researcher . . . generate evidence-based claims about learning that address contemporary theoretical issues and further the theoretical knowledge of the field" (p. 6). DBR needs to build and test theory, yielding findings that can be generalized to both local and broad theory (Hoadley, 2004).

Practical. While theoretical contributions are essential to DBR, the results of DBR studies "must do real work" (Cobb et al., 2003, p. 10) and inform instructional, research, and design practice (Anderson & Shattuck, 2012; Barab & Squire, 2004; Design-Based Research Collective, 2003; McCandliss et al., 2003).

Productive. Not only should design research produce theoretical and practical insights, but also the design itself must produce results, measuring its success in terms of how well the design meets its intended outcomes (Barab & Squire, 2004; Design-Based Research Collective, 2003; Joseph, 2004; McCandliss et al., 2003).

Steps and Processes

The third way DBR could possibly be defined is to identify the steps or processes involved in implementing it. The sections below illustrate the steps outlined by Collins (1990) and Brown (1992) as well as models by Bannan-Ritland (2003), Reeves (2006), and an aggregate model presented by Anderson & Shattuck (2012).

Collins's design experimentation steps. In his technical report, Collins (1990) presented an extensive list of 10 steps in design experimentation (Figure 2). While Collins's model provides a guide for experimentally testing and developing new instructional programs, it does not include multiple iterative stages or any evaluation of the final product. Because Collins was interested primarily in development, research was not given much attention in his model.

Brown's design research example. The example of design research Brown (1992) included in her article was limited and less clearly delineated than Collins's model (Figure 2). Brown focused on the development of educational interventions, including additional testing with minority populations. Similar to Collins, Brown also omitted any summative evaluation of intervention quality or effectiveness and did not specify the role of research through the design process.

Bannan-Ritland's DBR model. Bannan-Ritland (2003) reviewed design process models in fields such as product development, instructional design, and engineering to create a more sophisticated model of design-based research. In its simplest form, Bannan-Ritland's model is comprised of multiple processes subsumed under four broad stages: (a) informed exploration, (b) enactment, (c) evaluation of local impact, and (d) evaluation of broad impact. Unlike Collins and Brown, Bannan-Ritland dedicated large portions of the model to evaluation in terms of the quality and efficacy of the final product as well as the implications for theory and practice.

Reeves's development research model. Reeves (2006) provided a simplified model consisting of just four steps (Figure 2). By condensing DBR into just a few steps, Reeves highlighted what he viewed as the most essential processes, ending with a general reflection on both the process and product generated in order to develop theoretical and practical insights.

Anderson and Shattuck's aggregate model. Anderson and Shattuck (2012) reviewed design-based research abstracts over the past decade and, from their review, presented an eight-step aggregate model of DBR (Figure 2). As an aggregate of DBR approaches, this model was their attempt to unify approaches across DBR literature, and includes similar steps to Reeves's model. However, unlike Reeves, Anderson and Shattuck did not include summative reflection and insight development.

Comparison of models. Following in Figure 2, we provide a comparison of all these models side-by-side.

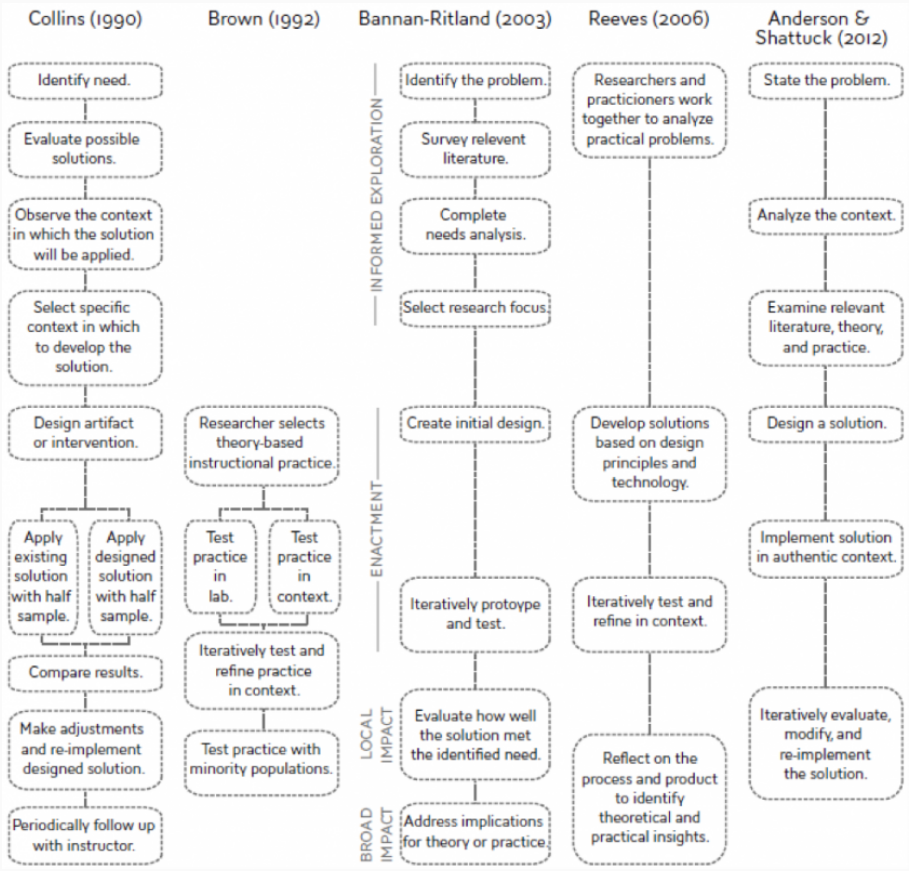

Figure 2. EDR process models by Collins (1990), Brown (1992), Bannan-Ritland (2003), Reeves (2006), and Anderson and Shattuck (2012).

Competing Demands and Roles

The third challenge facing DBR is the variety of roles researchers are expected to fulfill, with researchers often acting simultaneously as project managers, designers, and evaluators. However, with most individuals able to focus on only one task at a time, these competing demands on resources and researcher attention and faculties can be challenging to balance, and excess focus on one role can easily jeopardize others. The literature has recognized four major roles that a DBR professional must perform simultaneously: researcher, project manager, theorist, and designer.

Researcher as Researcher

Planning and carrying out research is already comprised of multiple considerations, such as controlling variables and limiting bias. The nature of DBR, with its collaboration and situated experimentation and development, innately

intensifies some of these issues (Hoadley, 2004). While simultaneously designing the intervention, a design-based researcher must also ensure that high-quality research is accomplished, per typical standards of quality associated with quantitative or qualitative methods.

However, research is even more difficult in DBR because the nature of the method leads to several challenges. First, it can be difficult to control the many variables at play in authentic contexts (Collins et al., 2004). Many researchers may feel torn between being able to (a) isolate critical variables or (b) study the comprehensive, complex nature of the design experience (van den Akker, 1999). Second, because many DBR studies are qualitative, they produce large amounts of data, resulting in demanding data collection and analysis (Collins et al., 2004). Third, according to Anderson and Shattuck (2012), the combination of demanding data analysis and highly invested roles of the researchers leaves DBR susceptible to multiple biases during analysis. Perhaps best expressed by Barab and Squire (2004), "if a researcher is intimately involved in the conceptualization, design, development, implementation, and researching of a pedagogical approach, then ensuring that researchers can make credible and trustworthy assertions is a challenge" (p. 10). Additionally, the assumption of multiple roles invests much of the design and research in a single person, diminishing the likelihood of replicability (Hoadley, 2004). Finally, it is impossible to document or account for all discrete decisions made by the collaborators that influenced the development and success of the design (Design-Based Research Collective, 2003).

Quality research, though, was never meant to be easy! Despite these challenges, DBR has still been shown to be effective in simultaneously developing theory through research as well as interventions that can benefit practice—the two simultaneous goals of any instructional designer.

Researcher as Project Manager

The collaborative nature of DBR lends the approach one of its greatest strengths: multiple perspectives. While this can be a benefit, collaboration between researchers, developers, and practitioners needs to be highly coordinated (Collins et al., 2004), because it is difficult to manage interdisciplinary teams and maintain a productive, collaborative partnership (Design-Based Research Collective, 2003).

Researcher as Theorist

For many researchers in DBR, the development or testing of theory is a foundational component and primary focus of their work. However, the iterative and multi-tasking nature of a DBR process may not be well-suited to empirically testing or building theory. According to Hoadley (2004), "the treatment's fidelity to theory [is] initially, and sometimes continually, suspect" (p. 204). This suggests that researchers, despite intentions to test or build theory, may not design or implement their solution in alignment with theory or provide enough control to reliably test the theory in question.

Researcher as Designer

Because DBR is simultaneously attempting to satisfy the needs of both design and research, there is a tension between the responsibilities of the researcher and the responsibilities of the designer (van den Akker, 1999). Any design decision inherently alters the research. Similarly, research decisions place constraints on the design. Skilled design-based researchers seek to balance these competing demands effectively.

What We Can Learn From IDR

IDR has been encumbered by similar issues that currently exist in DBR. While IDR is by no means a perfect field and is still working to hone and clarify its methods, it has been developing for two decades longer than DBR. The history of IDR and efforts in the field to address similar issues can yield possibilities and insights for the future of DBR. The following sections address efforts in IDR to define the field that hold potential for application in DBR, including how professionals in IDR have focused their efforts to increase unity and worked to define sub-approaches more clearly.

Defining Approaches

Similar to DBR, IDR has been subject to competing definitions as varied as the fields in which design research has been applied (i.e., product design, engineering, manufacturing, information technology, etc.) (Findeli, 1998; Jonas, 2007; Schneider, 2007). Typically, IDR scholars have focused on the relationship between design and research, as well as the underlying purpose, to define the approach. This section identifies three defining conceptualizations of IDR—the prepositional approach trinity, Cross's *-ologies,* and Buchanan's strategies of productive science—and discusses possible implications for DBR.

The Approach Trinity

One way of defining different purposes of design research is by identifying the preposition in the relationship between research and design: research *into* design, research *for* design, and research *through* design (Buchanan, 2007; Cross, 1999; Findeli, 1998; Jonas, 2007; Schneider, 2007).

Jonas (2007) identified *research into design* as the most prevalent—and straightforward—form of IDR. This approach separates research from design practice; the researcher observes and studies design practice from without, commonly addressing the history, aesthetics, theory, or nature of design (Schneider, 2007). Research into design generally yields little or no contribution to broader theory (Findeli, 1998).

Research for design applies to complex, sophisticated projects, where the purpose of research is to foster product research and development, such as in market and user research (Findeli, 1998; Jonas, 2007). Here, the role of research is to build and improve the design, not contribute to theory or practice.

According to Jonas's (2007) description, *research through design* bears the strongest resemblance to DBR and is where researchers work to shape their design (i.e., the research object) and establish connections to broader theory and practice. This approach begins with the identification of a research question and carries through the design process experimentally, improving design methods and finding novel ways of controlling the design process (Schneider, 2007). According to Findeli (1998), because this approach adopts the design process as the research method, it helps to develop authentic theories of design.

Cross's-ologies

Cross (1999) conceived of IDR approaches based on the early drive toward a science of design and identified three bodies of scientific inquiry: epistemology, praxiology, and phenomenology. *Design epistemology* primarily concerns what Cross termed "designerly ways of knowing" or how designers think and communicate about design (Cross, 1999; Cross, 2007). *Design praxiology* deals with practices and processes in design or how to develop and improve artifacts and the processes used to create them. *Design phenomenology* examines the form, function, configuration, and value of artifacts, such as exploring what makes a cell phone attractive to a user or how changes in a software interface affect user's activities within the application.

Buchanan's Strategies of Productive Science

Like Cross, Buchanan (2007) viewed IDR through the lens of design science and identified four research strategies that frame design inquiry: design science, dialectic inquiry, rhetorical inquiry, and productive science (Figure 2). *Design science* focuses on designing and decision-making, addressing human and consumer behavior. According to Buchanan (2007), *dialectic inquiry* examines the "social and cultural context of design; typically [drawing] attention to the limitations of the individual designer in seeking sustainable solutions to problems" (p.57). *Rhetorical inquiry*focuses on the design experience as well as the designer's process to create products that are usable, useful, and desirable. *Productive science* studies how the potential of a design is realized through the refinement of its parts, including materials, form, and function. Buchanan (2007) conceptualized a design research—what he termed design inquiry—that includes elements of all four strategies, looking at the designer, the design, the design context, and the refinement process as a holistic experience.

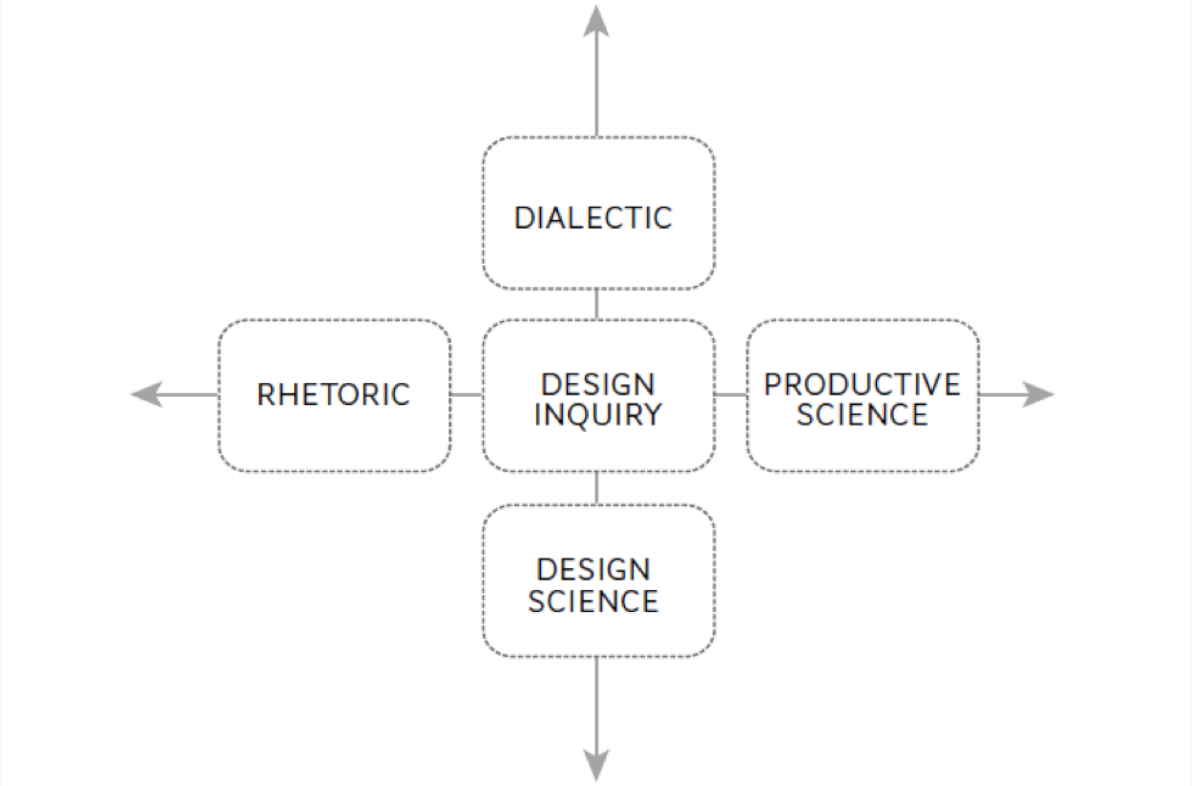

Figure 3. Buchanan's productive science strategies, adapted from Buchanan (2007)

Implications for DBR

While the literature has yet to accept any single approach to defining types of IDR, it may still be helpful for DBR to consider similar ways of limiting and defining sub-approaches in the field. The challenges brought on by collaboration, multiple researcher roles, and lack of sufficient focus on the design product could be addressed and relieved by identifying distinct approaches to DBR. This idea is not new. Bell and Sandoval (2004) opposed the unification of DBR, specifically design-based research, across educational disciplines (such as developmental psychology, cognitive science, and instructional design). However, they did not suggest any potential alternatives. Adopting an IDR approach, such as the approach trinity, could serve to both unite studies across DBR and clearly distinguish the purpose of the approach and its primary functions. Research into design could focus on the design process and yield valuable insights on design thinking and practice. Research for design could focus on the development of an effective product, which development is missing from many DBR approaches. Research through design would use the design process as a vehicle to test and develop theory, reducing the set of expected considerations. Any approach to dividing or defining DBR efforts could help to limit the focus of the study, helping to prevent the diffusion of researcher efforts and findings.

Conclusion

In this chapter we have reviewed the historical development of both design-based research and interdisciplinary design research in an effort to identify strategies in IDR that could benefit DBR development. Following are a few conclusions,

leading to recommendations for the DBR field.

Improve Interdisciplinary Collaboration

Overall, one key advantage that IDR has had—and that DBR presently lacks—is communication and collaboration with other fields. Because DBR has remained so isolated, only rarely referencing or exploring approaches from other design disciplines, it can only evolve within the constraints of educational inquiry. IDR's ability to conceive solutions to issues in the field is derived, in part, from a wide variety of disciplines that contribute to the body of research. Engineers, developers, artists, and a range of designers interpose their own ideas and applications, which are in turn adopted and modified by others. Fostering collaboration between DBR and IDR, while perhaps not the remedy to cure all scholarly ills, could yield valuable insights for both fields, particularly in terms of refining methodologies and promoting the development of theory.

Simplify Terminology and Improve Consistency in Use

As we identified in this paper, a major issue facing DBR is the proliferation of terminology among scholars and the inconsistency in usage. From IDR comes the useful acknowledgement that there can be research *into* design, *for*design, and *through* design (Buchanan, 2007; Cross, 1999; Findeli, 1998; Jonas, 2007; Schneider, 2007). This framework was useful for scholars in our conversations at the conference. A resulting recommendation, then, is that, in published works, scholars begin articulating which of these approaches they are using in that particular study. This can simplify the requirements on DBR researchers, because instead of feeling the necessity of doing all three in every paper, they can emphasize one. This will also allow us to communicate our research better with IDR scholars.

Describe DBR Process in Publications

Oftentimes authors publish DBR studies using the same format as regular research studies, making it difficult to recognize DBR research and learn how other DBR scholars mitigate the challenges we have discussed in this chapter. Our recommendation is that DBR scholars publish the messy findings resulting from their work and pull back the curtain to show how they balanced competing concerns to arrive at their results. We believe it would help if DBR scholars adopted more common frameworks for publishing studies. In our review of the literature, we identified the following characteristics, which are the most frequently used to identify DBR:

- DBR is design driven and intervention focused
- DBR is situated within an actual teaching/learning context
- DBR is iterative
- DBR is collaborative between researchers, designers, and practitioners
- DBR builds theory but also needs to be practical and result in useful interventions

One recommendation is that DBR scholars adopt these as the characteristics of their work that they will make explicit in every published paper so that DBR articles can be recognized by readers and better aggregated together to show the value of DBR over time. One suggestion is that DBR scholars in their methodology sections could adopt these characteristics as subheadings. So in addition to discussing data collection and data analysis, they would also discuss ***Design Research Type*** (research into, through, or of design), ***Description of the Design Process and Product,Design and Learning Context, Design Collaborations,*** and a discussion explicitly of the ***Design Iterations,*** perhaps by listing each iteration and then the data collection and analysis for each. Also in the concluding sections, in addition to discussing research results, scholars would discuss ***Applications to Theory*** (perhaps dividing into *Local Theory and Outcomes* and *Transferable Theory and Findings)* and ***Applications for Practice.*** Papers that are too big could be broken up with different papers reporting on different iterations but using this same language and formatting to make it easier to connect the ideas throughout the papers. Not all papers would have both local and transferable theory (the latter being more evident in later iterations), so it would be sufficient to indicate in a paper that local theory and outcomes were developed and met with some ideas for transferable theory that would be developed in future iterations. The important thing would be to refer to each of these main characteristics in each paper so that scholars can

recognize the work as DBR, situate it appropriately, and know what to look for in terms of quality during the review process.

Application Exercises

- According to the authors, what are the major issues facing DBR and what are some things that can be done to address this problem?
- Imagine you have designed a new learning app for use in public schools. How would you go about testing it using design-based research?

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Further Video Resource

Video Interviews with many of leading scholars of design-based research are available at https://edtechbooks.org/-iQ

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26

A Survey of Educational Change Models

James B. Ellsworth

Editor's Note

The following was originally published in the public domain as an ERIC digest: "A Survey of Educational Change Models. ERIC Digest." It is based on Ellsworth's excellent book, *Surviving Change: A Survey of Educational Change Models*, which is available for free online through ERIC.

Ellsworth, J. B. (2000). A survey of educational change models. ERIC digest. (Report No. ED444597). Retrieved from https://eric.ed.gov/?id=ED444597

Change isn't new, and neither is its study. We have a rich set of frameworks, solidly grounded in empirical studies and practical applications. Most contributions may be classified under a set of major perspectives, or "models" of change. These perspectives are prevalent in the research and combine to yield a 360-degree view of the change process. In each case, one author or group of authors is selected as the epitome of that perspective (Ellsworth, 2000). A small group of studies from disciplines outside educational change (in some cases outside education) also contribute to key concepts not found elsewhere in the literature.

Everett Rogers, one of the "elder statesmen" of change research, notes that change is a specialized instance of the general communication model (Rogers, 1995, pp. 5–6). Ellsworth expands on this notion to create a framework that organizes these perspectives to make the literature more accessible to the practitioner (Ellsworth, 2000).

Ellsworth's framework might be summarized as follows: a change agent wishes to communicate an innovation to an intended adopter. This is accomplished using a change process, which establishes a channel through the change environment. However, this environment also contains resistance that can disrupt the change process or distort how the innovation appears to the intended adopter (Ellsworth, p. 26). By uniting these tactics in service to a systemic strategy, we improve our chances of effective, lasting change.

Pulling All Together

We must strive to guide all our change efforts with a systemic understanding of the context in which we undertake them. Nevertheless, depending on the circumstance, or as the implementation effort progresses, it may be most effective to focus interventions on a particular component of the framework at a time.

Anyone trying to improve schools, for example teachers, principals, students, district administrators, consultants, parents, community leaders, or government representatives may look to *The New Meaning of Educational Change*(Fullan & Stiegelbauer, 1991) to decide where to start (or to stop an inappropriate change).

From there, read *Systemic Change in Education* (Reigeluth & Garfinkle, 1994), to consider the system being changed. Consider all assumptions about the nature of that system (its purpose, members, how it works, its governing constraints, and so forth). Question those assumptions, to see whether they still hold true. Look inside the system to understand its subsystems or stakeholders and how they relate to one another and to the system as a whole. Look outside the system too, to know how other systems (like business or higher education) are interrelated with it and how it (and these other systems) in turn relate to the larger systems of community, nation, or human society. The new understanding may illuminate current goals for the proposed innovation (or concerns for the change you are resisting) and may indicate some specific issues that may emerge.

This understanding is crucial for diagnosing the system's needs and how an innovation serves or impedes them. Now, clearly embarked upon the change process, read a discussion of that change process in *The Change Agent's Guide* (Havelock & Zlotolow, 1995) to guide and plan future efforts. The Guide serves as the outline for a checklist, to ensure that the right resources are acquired at the proper time. The Guide will also help you conduct and assess a trial of the innovation in a way that is relevant and understandable to stakeholders. It will help extend implementation both in and around the system . . . and it will help to prepare others within the system to recognize when it is time to change again.

At some point one must commit to a plan, and act. The Concerns-Based Adoption Model (Hall & Hord, 1987) provides tools to "keep a finger on the pulse" of change and to collect the information needed. The model's guidelines help readers to understand the different concerns stakeholders experience as change progresses. This, in turn, will help readers to design and enact interventions when they will be most effective.

Even the most effective change effort usually encounters some resistance. *Strategies for Planned Change* (Zaltman & Duncan, 1977) can help narrow down the cause(s) of resistance. Perhaps some stakeholders see the innovation as eroding their status. Possibly others would like to adopt the innovation but lack the knowledge or skills to do so. Opposition may come from entrenched values and beliefs or from lack of confidence that the system is capable of successful change.

One way to approach such obstacles is to modify or adapt the innovation's attributes. Even if the actual innovation cannot be altered, it may be possible to change the perceptions of the innovation among stakeholders. For example, instead of competing with them, perhaps it is more appropriately seen as a tool that will help others achieve appropriate goals. Whether one modifies the attributes or merely their perceptions, *Diffusion of Innovations* (Rogers, 1995) identifies the ones that are generally most influential and will help readers select an approach.

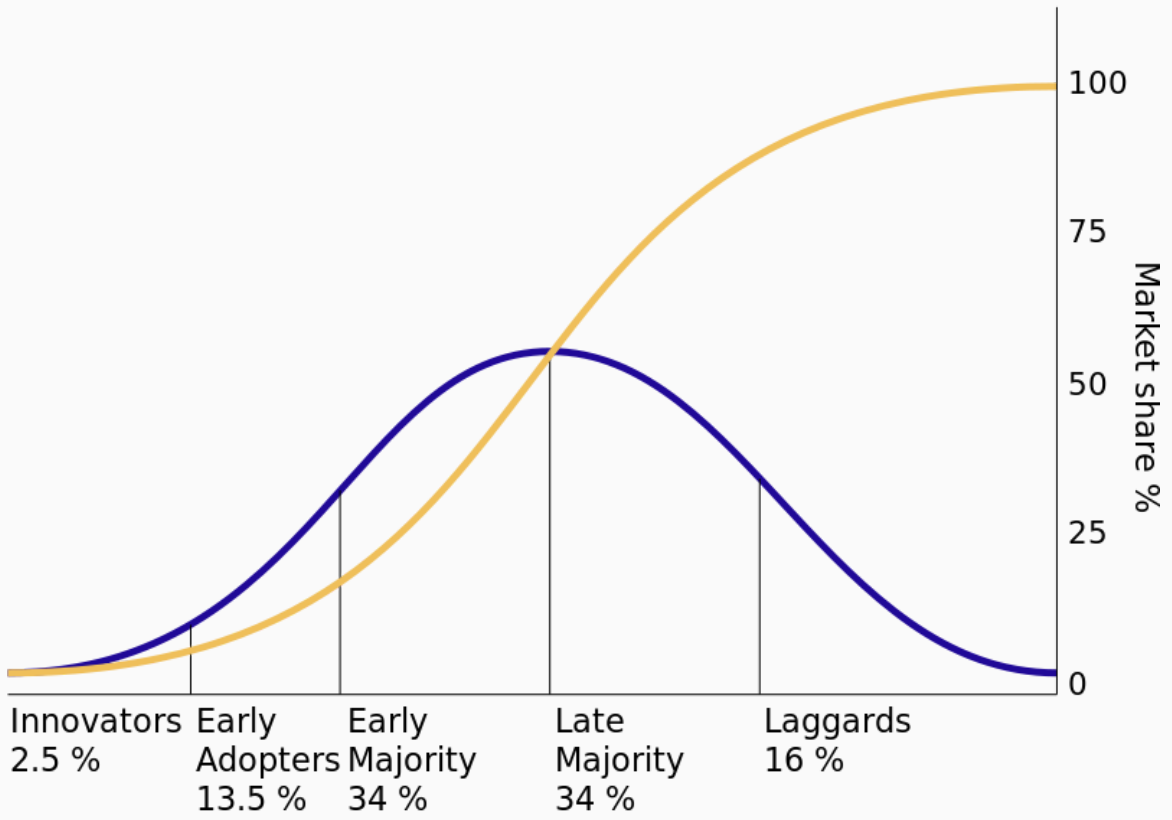

Figure 1. Diffusion of Innovations

Other obstacles may arise from the environment in which change is implemented. The “Conditions for Change” (Ely, 1990) can help you address those deficiencies. Possibly a clearer statement of commitment by top leaders (or more evident leadership by example) is needed. Or maybe more opportunity for professional development is required, to help the stakeholders learn how to use their new tool(s).

Of course, this is not a fixed sequence. Involvement may start when resistance to an innovation is noticed. If so, begin with Zaltman and Duncan (1977); then turn to Reigeluth and Garfinkle (1994) to identify the systemic causes of that resistance. If you are an innovation developer, begin with Rogers (1995), then use the systemic diagnosis in Reigeluth and Garfinkle to guide selection of the attributes needed for your innovation. The professional change agent may begin with Havelock and Zlotolow (1995), to plan an overall change effort. The models are also frequently interrelated.

For example, when modifying innovation attributes pursuant to Rogers (1995), one might make an IC Component Checklist (see Hall & Hord, 1987) to avoid accidental elimination of a critical part of the innovation. When assessing the presence or absence of the conditions for change (Ely, 1990), verify that the systemic conditions mentioned in Reigeluth and Garfinkle (1994) are present as well. While using the Concerns-Based Adoption Model (Hall & Hord, 1987) to design interventions aimed at stakeholders at a particular level of use or stage of concern, consider the psychological barriers to change presented by Zaltman and Duncan (1977).

Reaching Out, Reaching Across

Much useful knowledge of the change process comes from other fields as well—particularly the business-inspired domains of Human Performance Technology (HPT) and Human Resource Development (HRD). Include these other

knowledge bases as an involvement with educational change grows.

Reach out to other disciplines to share experiences and to benefit from theirs. Reach across to other stakeholders to build the sense of community and shared purpose necessary for the changes that must lie ahead. The road won't always be easy, and everyone won't always agree which path to take when the road forks . . . but with mutual respect, honest work, and the understanding that we all have to live with the results, we can get where we need to go.

Succeeding Systematically

The lessons of the classical change models are as valid today—and just as essential for the change agent to master—as they have ever been. Yet a single innovation (like a new technology or teaching philosophy) that is foreign to the rest of the system may be rejected, like an incompatible organ transplant is rejected by a living system. Success depends on a coordinated "bundle" of innovations—generally affecting several groups of stakeholders—that results in a coherent system after implementation.

These are exciting times to be a part of education. They are not without conflict . . . but conflict is what we make of it. Its Chinese ideogram contains two characters: one is "danger" and the other "hidden opportunity." We choose which aspect of conflict—and of change—we emphasize.

Application Exercises

- Choose some kind of education innovation or theory (e.g. blended learning, OER, Flow, or Constructivism) and imagine you are introducing it to a school that has not used it before. What choices can you make to improve the likelihood it will be adopted?
- In your own words, explain why educators who are seeking changes should look both inside and outside of the system.
- Think of a change you recently initiated in your workplace, family, class, or another system. List in a two-sided table as many factors as you can think of that supported and resisted the change.
- Think of a time when an organization you were in underwent change (initiated by you or someone else). What model best explained their change process, and in what ways?

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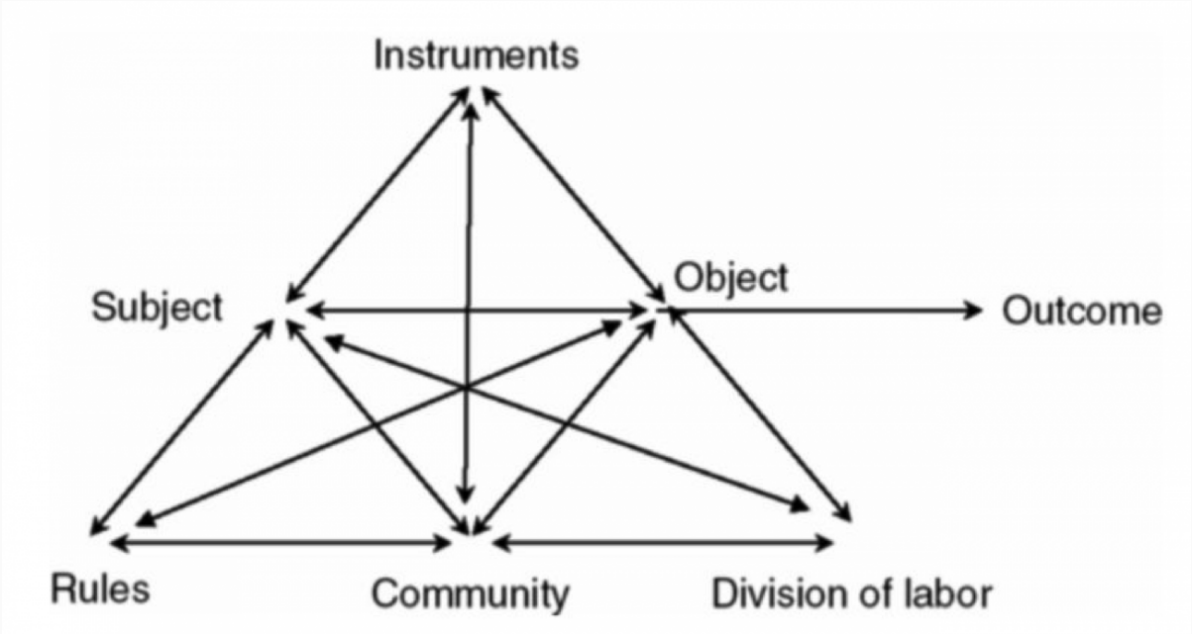

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27

Performance Technology

Jill E. Stefaniak

The goal for all instructional designers is to facilitate learning and improve performance regardless of learning environments and assigned tasks. When working within professional organizations particularly, the goal is often to develop interventions that yield measurable outcomes in improving employee performance. This may be accomplished through conducting needs assessments and learner analyses, designing and developing instructional materials to address a gap in performance, validating instructional materials, developing evaluation instruments to measure the impact of learning, and conducting evaluations to determine to what extent the instructional materials have met their intended use.

Depending on their level of involvement in implementing change with their organization, instructional designers may need to apply concepts from the field of human performance technology. By definition, "human performance technology is the study and ethical practice of improving productivity in organizations by designing and developing effective interventions that are results-oriented, comprehensive, and systemic" (Pershing, 2006, p. 6). Instructional design and human performance technology are similar in that they are rooted in general systems and behavioral psychology theoretical bases. Specifically, the International Society for Performance Improvement (ISPI) has established 10 performance standards for doing effective performance improvement design (see callout box).

ISPI Standards

Standard 1: Focus on Results or Outcomes
Standard 2: Take a Systemic View
Standard 3: Add Value
Standard 4: Work in Partnership with Clients and Stakeholders
Standard 5: Determine Need or Opportunity
Standard 6: Determine Cause
Standard 7: Design Solutions including Implementation and Evaluation
Standard 8: Ensure Solutions' Conformity and Feasibility
Standard 9: Implement Solutions
Standard 10: Evaluation Results and Impact
(ISPI, Standards of Performance, 2018)

Instructional designers should recognize that they perform a number, if not all, of these standards in their assigned projects. However, there are subtle but important differences between performance technology/improvement and

instructional design. This chapter presents an overview for how instructional designers can use performance analysis and non-instructional interventions. . It also discusses how a relationship between instructional design and human performance technology can leverage the impact of instructional design activities. It concludes with an overview of professional resources available related to the topic of human performance technology.

Differentiating Between Human Performance Technology and Instructional Design

Human performance technology emerged in the 1960s with publications and research promoting systematic processes for improving performance gaining traction in the 1970s. The foundations of human performance technology are grounded in behaviorism, with the *father of HPT*, Thomas Gilbert, being a student of B.F. Skinner. Seminal works of human performance technology include Gilbert's (1978) Behavioral Engineering Model; Rummler's (1972) anatomy of performance, Mager and Pipe's (1970) early introduction of measurable learning objectives, and Harless' (1973) approach to systematic instruction in the workplace. All of these contributions were grounded in behaviorism and sought to create a systematic approach to measuring employee performance in the workplace. While these concepts can be applied to school settings, the majority of research exploring the application of human performance technology strategies has been predominant in workplace environments.

When differentiating between human performance technology and instructional design, HPT focuses on applying systematic and systemic processes throughout a system to improve performance. Emphasis is placed on analyzing performance at multiple levels within an organization and understanding what processes are needed for the organization to work most effectively. Systemic solutions take into account how the various functions of an organization interact and align with one another. Through organizational analyses, performance technologists are able to identify gaps in performance and create systematic solutions (Burner, 2010).

While instruction may be one of the strategies created as a result of a performance analysis, it is often coupled with other non-instructional strategies. Depending on an instructional designer's role in a project or organization, they may not be heavily involved in conducting performance assessments. When given the opportunity, it is good practice to understand how performance is being assessed within the organization in order to align the instructional solutions with other solutions and strategies.

While human performance technology and instructional design have two different emphases, they do share four commonalities: (1) evidence-based practices, (2) goals, standards, and codes of ethics, (3) systemic and systematic processes, and (4) formative, summative, confirmative evaluations (Foshay, Villachica, Stepich, 2014). Table 1 provides an overview of how these four commonalities are applied in human performance technology and instructional design.

Table 1

Four commonalities shared across human performance technology and instructional design

Commonalities	Human Performance Technology	Instructional Design
Evidence-based practices	Organizational analyses are conducted to collect data from multiple sources to evaluate workplace performance.	Emphasis is placed on learner assessment to ensure instruction has been successful.
Goals, standards, and codes of ethics	ISPI and ATD are two professional organizations that have created workplace standards and professional certification programs.	AECT and ATD are two professional organizations that have created standards for learning and performance.

Systematic and systemic processes	Systematic frameworks have been designed to conduct needs assessments and other performance analyses throughout various levels of an organization.	Systematic instructional design models have been designed to guide the design of instruction for a variety of contexts.
Formative, summative, and confirmative evaluations	Multiple evaluation methods are utilized to measure workplace performance throughout the organization.	Multiple assessments are conducted throughout the design phase of instruction as well as afterwards to ensure the instructional solutions have been successful.

The Role of Systems in Instructional Design Practice

Instructional designers understand that anytime they are designing, they are operating within a system. Many of our instructional design models, for example, promote a systematic process and take into account a variety of elements that must be considered for design (Dick, Carey, & Carey, 2009; Merrill, 2002; Smith & Ragan, 2005). Similarly, human performance technology originates from behavioral psychology but also general systems theory. "General systems theory refers to one way of viewing our environment" (Richey, Klein, & Tracey, 2011, p. 11). Through this theoretical lens, instructional designers or performance technologists must take into account the whole environment and organization in which they are working.

In general terms, a "system is a set of objects together with relationships between the objects and between their attributes" (Hall & Fagen, 1975, p. 52). Systems can be open or closed (Bertalanffy, 1968). Open systems operate in a manner where they rely on other systems or can be modified based on actions occurring outside of a system. Closed systems are contained and can demonstrate resistance to changes or actions occurring outside the system in order to keep their value (Richey et al., 2011). Examples of systems could include the instructional design or training department within a larger organization. While the department is a system, it is also viewed as a subsystem functioning within something much larger. In addition, those receiving human performance training also work within systems. For example, an instructional designer may be asked to provide training based on values espoused by the CEO, but which may conflict with culture within an individual department in the organization. Other times, they may be asked to identify other instructional solutions to address performance gaps identified in a needs assessment. Or they may seek to improve employees' performance in one area, when that performance depends on the success of another department in the organization—something outside of the employees' control. Thus, seeking to improve organizational performance requires a broader understanding of the organization than is sometimes typical in instructional design practices.

Systems thinking impacts instructional design practices by promoting systematic and systemic processes over narrower solutions. A systems view has three characteristics:

1. "It is holistic.
2. It focuses primarily on the interactions among the elements rather than the elements themselves.
3. It views systems as "nested" with larger systems made up of smaller ones" (Foshay et al., 2014, p. 42).

These characteristics affect instruction design practices in a variety of ways. Designers must take the holistic nature of the system and consider the effects on learning from all elements that exist within the system. Not only does this consider the specific instructional design tasks that learners are currently completing, but also various layers of the organization including the people, politics, organizational culture, and resources—in other words, the inputs and outputs that are driving the development and implementation of a project (Rummler & Brache, 2013). Regardless of their role on a project, the instructional designer must be aware of all the various components within their system and how it affects the instruction they create. For example, an instructional designer may be asked by senior leadership of an organization

to develop health and safety training for employees working on the frontline of a manufacturing plant. It would be advantageous to understand the unique tasks and nuances associated with the frontline work responsibilities to ensure they are developing training that will be beneficial to the employees. Another example where it would be important for an instructional designer to be aware of an organization's system or subsystems would be if they were asked to design instruction for a company that has multiple locations across the country or world. The instructional designer should clarify whether or not there are distinct differences (i.e. organizational culture, politics, processes) among these various locations and how these differences may impact the results of training.

In addition, considering that the fundamental goals of instructional design are to facilitate learning and improve performance, the instructional designer working within organizations should strive to create design solutions that promote sustainability. As stated by the second systems characteristic, it is important to not only be aware of the various elements within a system, but also develop an understanding of how they interact with each other. The instructional designer should be aware of how their work may influence or affect, positively or negatively, other aspects of the organization. For example, if an organization is preparing to launch training on a new organizational philosophy, how will that be perceived by other departments or divisions within the organization? If an organization is changing their training methods from instructor-led formats to primarily online learning formats, what considerations must the instructional design team be aware of to ensure a smooth transition? Does the organization have the infrastructure to support online learning for the entire organization? Is the information technology department equipped with uploading resources and managing any technological challenges that may arise over time? Does the current face to face training provide opportunities for relationship-building that may not seem critical to the learning, but are important to the health and performance of the organization? If so, how can this be accounted for online? These are examples of some questions an instructional designer may ask in order to take a broader view of their instruction besides just whether it achieves learning outcomes.

Performance Analysis

Regardless of context or industry, all instructional design projects fulfill one of three needs within organizations: (1) addressing a problem; (2) embracing quality improvement initiatives; and (3) developing new opportunities for growth (Pershing, 2006). The instructional designer must be able to validate project needs by effectively completing a performance analysis to understand the contextual factors contributing to performance problems. This allows the instructional designer to appropriately identify and design solutions that will address the need in the organization—what is often called the performance gap or opportunity.

The purpose of performance analysis is to assess the desired performance state of an organization and compare it to the actual performance state (Burner, 2010; Rummler, 2006). If any differences exist, it is important for the performance improvement consultant (who may sometimes serve as the instructional designer as well) to identify the necessary interventions to remove the gap between the desired and actual states of performance.

Performance analysis can occur in multiple ways, focusing on the organization as a whole or one specific unit or function. Organizational analysis consists of "an examination of the components that strategic plans are made of. This phase analyzes the organization's vision, mission, values, goals, strategies and critical business issues" (Van Tiem et al., 2012, p. 133). Items that are examined in close detail when conducting an organizational analysis include organizational structure, centrally controlled systems, corporate strategies, key policies, business values, and corporate culture (Tosti & Jackson, 1997). All of these can impact the sustainability of instructional design projects either positively or negatively.

An environmental analysis not only dissects individual performance and organizational performance, it also expands to assess the impact that performance may have outside the system. Rothwell (2005) proposed a tiered environmental analysis that explores performance through four lenses: workers, work, workplace, and world. The worker level dissects the knowledge, skills, and attitudes required of the employee (or performer) to complete the tasks. It assesses the skillsets that an organization's workforce possesses. The work lens examines the workflow and procedures; how the

work moves through the organizational system. The workplace lens takes into account the organizational infrastructure that is in place to support the work and workers. Examples of items taken into consideration at this phase include checking to see if an organization's strategic plan informs the daily work practices, the resources provided to support work functions throughout the organization, and tools that employees are equipped with to complete their work (Van Tiem et al., 2012). World analysis expands even further to consider performance outside of the organization, in the marketplace or society. For example, an organization might consider the societal benefits of their products or services.

While instructional designers do not have to be experts in organizational design and performance analysis, they should be fluent in these practices to understand how various types of performance analyses may influence their work. Whether an analysis is limited to individual performance, organizational performance, or environmental performance, they all seek to understand the degree to which elements within the system are interacting with one another. These analyses vary in terms of scalability and goals. Interactions may involve elements of one subsystem of an organization or multiple subsystems (layers) within an organization. For example, an instructional design program would be considered a subsystem of a department with multiple programs or majors. The department would be another system that would fall under a college, and a university would be comprised of multiple colleges, each representing a subsystem within a larger system.

Cause Analysis

A large part of human performance technology is analyzing organizational systems and work environments to improve performance. While performance analysis helps to identify performance gaps occurring in an organization, it is important to identify the causes that are contributing to those performance gaps. The goal of cause analysis is to identify the root causes of performance gaps and identify appropriate sustainable solutions.

While conducting a cause analysis, a performance technologist will consider the severity of the problems or performance gaps, examine what types of environmental supports are currently in place (i.e. training, resources for employees) and skillsets of employees (Gilbert, 1978). The performance technologist engages in troubleshooting by examining the problem from multiple viewpoints to determine what is contributing to the performance deficiencies (Chevalier, 2003).

Non-instructional Interventions

Once a performance technologist has identified the performance gaps and opportunities, they create interventions to improve performance. "Interventions are deliberate, conscious acts that facilitate change in performance" (Van Tiem, Moseley, & Dessinger, 2012, p. 195). Interventions can be classified as either instructional or non-instructional. Table 2 provides an overview of the various types of interventions common to instructional design practice.

Table 2

Instructional and Non-instructional Interventions

Instructional Interventions	Non-Instructional Interventions
E-learning	Electronic Performance Support System
Classroom Training	Workplace Design
Web-based Tutorials	Knowledge Management
On-the-Job Training	Just-in-Time Support
Games and Simulations	Communities of Practice

Corporate Culture Changes

Process Re-engineering

Job Aids

As mentioned in the discussion of general systems theory, it is imperative that the instructional designer is aware of how they interact with various elements within their system. In order to maintain positive interactions between these organizational elements, non-instructional interventions are often needed to create a supportive infrastructure. Considering politics within an organization and promoting an organizational culture that is valued by all departments and individuals within the system and carried out in processes and services are examples of infrastructural supports needed for an organization (or system) to be successful. While there are a variety of different strategies that may be carried out to promote stability within an organization, the non-instructional strategies most commonly seen by instructional designers include job, analysis, organizational design, communication planning, feedback systems, and knowledge management. Table 3 provides examples of how non-instructional strategies may benefit the instructional design process.

Table 3

Non-instructional strategies

Non-Instructional Strategies	**Benefit to the Instructional Design Process**
Job analysis	Up to date job descriptions with complete task analyses will provide a detailed account for performing tasks conveyed in training.
Organizational design	A plan that outlines the organizational infrastructure of a company. Details are provided to demonstrate how different units interact and function with one another in the organization.
Communication planning	Plans that detail how new initiatives or information is communicated to employees. Examples may include listservs, company newsletters, training announcements, performance reviews, and employee feedback.
Feedback systems	Detailed plans to provide employees feedback on their work performance. This information may be used to identify individual training needs and opportunities for promotion.
Knowledge management	Installation of learning management systems to track learning initiatives throughout the organization. Electronic performance support systems are used to provide just-in-time resources to employees.

Organizational design and job analysis are two non-instructional interventions that instructional designers should be especially familiar with especially, if they are involved with projects that will result in large scale changes within an organization. They should have a solid understanding of the various functions and departments within the organization and the interactions that take place among them. Organizational design involves the process of identifying the necessary organizational structure to support workflow processes and procedures (Burton, Obel, & Hakonsson, 2015). Examples include distinguishing the roles and responsibilities to be carried out by individual departments or work units, determining whether an organization will have multiple levels of management or a more decentralized approach to leadership, and how these departments work together in the larger system.

Job analyses are another area that can affect long term implications of instructional interventions. A job analysis is the process of dissecting the knowledge, skills, and abilities required to carry out job functions listed under a job description (Fine & Getkate, 2014). Oftentimes, a task analysis is conducted to gain a better understanding of the minute details of the job in order to identify what needs to be conveyed through training (Jonassen, Tessmer, & Hannum, 1999). If job analyses are outdated or have never been conducted, there is a very good chance that there will be a misalignment between the instructional materials and performance expectations, thus defeating the purpose of training.

Feedback systems are often put in place by organizations to provide employees with a frame of reference in regards to how they are performing in their respective roles (Shartel, 2012). Feedback, when given properly, can "invoke performance improvement by providing performers the necessary information to modify performance accordingly" (Ross & Stefaniak, 2018, p. 8). Gilbert's (1978) Behavioral Engineering Model is a commonly referenced feedback analysis tool used by practitioners to assess performance and provide feedback as it captures data not only at the performer level but also at the organizational level. This helps managers and supervisors determine the degree of alignment between various elements in the organization impacting performance (Marker, 2007).

The most recognizable non-instructional interventions may be electronic performance support systems (EPSSs) and knowledge management systems. These are structures put in place to support the training and performance functions of an organization. Often times EPSSs are used as a hub to house training and supports for an employee. Examples extend beyond e-learning modules to also include job aids, policies and procedures, informative tools or applications, and other just-in-time supports that an employee may need to complete a task. Knowledge management systems serve as a repository to provide task-structuring support as well as guidance and tracking of learning activities assigned or provided to employees (Van Tiem et al., 2012).

Other examples of supportive systems could also include communities of practice and social forums where employees can seek out resources on an *as needed* basis. Communities of practice are used to bring employees or individuals together who perform similar tasks or have shared common interests (Davies et al., 2017; Wenger, 2000; Wenger, McDermott, & Snyder, 2002). When selecting an intervention, it is important to select something that is going to solve the problem or address a particular need of the organization. Gathering commitment from leadership to implement the intervention and securing buy-in from other members of the organization that the intervention will work is also very important (Rummler & Brache, 2013; Spitzer, 1992; Van Tiem et al., 2012).

Whether the intervention to improve performance is instructional or non-instructional, Spitzer (1992) identified 11 criteria for determining whether an intervention is successful:

1. Design should be based on a comprehensive understanding of the situation. This is where previous performance and cause analyses come together.
2. Interventions should be carefully targeted. Target the right people, in the right setting, and at the right time.
3. An intervention should have a sponsor. A sponsor is someone who will champion the activity.
4. Interventions should be designed with a team approach. The ability to draw upon expertise from all areas of the organization is vital to successful intervention selection.
5. Intervention design should be cost-sensitive.
6. Interventions should be designed on the basis of comprehensive, prioritized requirements, based on what is most important to both the individual and the organization.
7. A variety of intervention options should be investigated because the creation of a new intervention can be costly.
8. Interventions should be sufficiently powerful. Consider long-term versus short-term effectiveness. Use multiple strategies to effect change.
9. Interventions should be sustainable. Thought must be given to institutionalizing the intervention over time. To really be successful, the intervention must become ingrained in the organization's culture.
10. Interventions should be designed with viability of development and implementation in mind. An intervention needs human resources and organizational support.
11. Interventions should be designed using an iterative approach. This occurs during the formative evaluation stage (discussed under the evaluation component of the HPT Model) when multiple revisions will generate interventions to fit the organization.

Forging a Relationship between Human Performance Technology and Instructional Design

While it is not necessary for instructional designers to engage in human performance technology, they may find themselves frequently in their careers working more like performance technologists than they originally supposed they would. In addition, those that use human performance technology thinking may be better positioned to design sustainable solutions in whatever their organization or system. Human performance technology offers a systems view that allows for the instructional designer to consider their design decisions and actions. By recognizing the systemic implications of their actions, they may be more inclined to implement needs assessment and evaluation processes to ensure they are addressing organizational constraints while adding value. With the growing emphasis of *design thinking* in the field of instructional design, we, as a field, are becoming more open to learning about how other design fields can influence our practice (i.e. graphic design, architecture, and engineering), and human performance, as another design field in its own right, is one more discipline that can improve how we do our work as instructional designers.

Professional Resources

There are a variety of resources available for instructional designers who are interested in learning more about how they can utilize concepts of human performance technology in their daily practice. This section provides an overview of professional associations, journals, and important books related to the field.

Professional Associations

"A professional association is an organization devoted to furthering the goals and development of a profession as well as providing professional development and networking opportunities for members of the association" (Surry & Stanfield, 2008). Founded in 1962, the International Society for Performance Improvement (ISPI) is the premiere organization for the field of human performance technology. Members of ISPI represent academia, government, non-profit, industry, and independent consulting sectors around the world. ISPI has a number of local chapters spread out globally. The organization offers a certification for Certified Performance Technologists (CPT) for individuals in the field to emphasize their level of proficiency in the field of human performance technology.

Founded in 1943, The Association for Talent Development [formerly known as the American Society for Training and Development (ASTD)], is the largest professional organization for workplace learning and performance. Similar to ISPI, they also have local chapters in most of the United States. Their members are comprised of instructional designers, performance consultants, talent development managers, and workplace learning professionals (ATD, n.d.), representing more than 120 countries and industries of all sizes. ATD also offers a certification for individuals interested in workplace learning and performance through their Certified Professional in Learning and Performance (CPLP) designation.

The Association of Educational Communications and Technology (AECT) has a division, Organizational Training and Performance, that focuses on performance improvement initiatives experienced by the instructional designer. As credited on their website, the division's mission is to "*bridge the gap* between research and practice, facilitating communication, collaboration and sharing between academics, students and practitioners across multiple disciplines interested in applying current theory and research to training and performance improvement initiatives" (AECT, n.d).

All of the abovementioned organizations host annual conferences that offer workshops, presentations, and discussions on a variety of topics related to workplace performance, performance improvement, and instructional design. More information about each of the professional organizations discussed in this section can be found online at:
Association for Talent Development (ATD) http://atd.org
Association for Educational Communications and Technology (AECT) http://aect.org
International Society for Performance Improvement (ISPI) http://ispi.org

Books

Compared to other disciplines, the field of human performance technology is considered a relatively young field dating back to the early 1960s. The following is a list of books that may be of interest to individuals who are interested in learning more about human performance technology:

- Gilbert, T.F. (1978). *Human competence: Engineering worthy performance.* New York, NY: McGraw-Hill.
- Moseley, J.L., & Dessinger, J.C. (2010). *Handbook of improving performance in the workplace. Volume 3: Measurement and evaluation.* San Francisco, CA: Pfeiffer.
- Pershing, J.A. (2006). *Handbook of human performance technology* (3rd ed.). San Francisco, CA: Pfeiffer.
- Rossett, A. (1999). *First things fast: A handbook for performance analysis*. San Francisco, CA: Pfeiffer.
- Rummler, G. A., & Brache, A. P. (2013). *Improving performance: How to manage the white space on the organization chart* (3rd ed.). San Francisco, CA: Jossey-Bass.
- Silber, K.H., & Foshay, W.R. (2010). *Handbook of improving performance in the workplace. Volume 1: Instructional design and training delivery.* San Francisco, CA: Pfeiffer.
- **Stefaniak, J.** (Ed.). (2015). *Cases on human performance improvement technologies.* Hershey, PA: IGI Global.
- Van Tiem, D., Moseley, J.L., & Dessinger, J.C. (2012). *Fundamentals of performance improvement: A guide to improving people, process, and performance* (3rd ed.). San Francisco, CA: Pfeiffer.
- Watkins, R., & Leigh, D. (2010). *Handbook of improving performance in the workplace. Volume 2: Selecting and implementing performance interventions.* San Francisco, CA: Pfeiffer.

Journals

While a number of instructional design journals will publish articles on trends related to the performance improvement, the following is a list of academic journals focused specifically on the mission of human performance technology:

- *Performance Improvement Journal* is published 10 times a year by the International Society for Performance Improvement and John Wiley & Sons, Inc. (Articles tend to be practitioner and application oriented.)
- *Performance Improvement Quarterly* is a peer-reviewed scholarly journal published by the International Society for Performance Improvement.
- *Human Resource Development Quarterly* is a peer-reviewed scholarly journal published by John Wiley & Sons, Inc.
- *International Journal of Training and Development* is a peer-reviewed scholarly journal published by John Wiley & Sons, Inc.
- *Journal of Workplace Learning* is a peer-reviewed scholarly journal published by Emerald, HR, Learning and Organizational Studies eJournal Collection.
- *TD (Training + Development)* is a monthly magazine published by the Association for Talent Development.

Additional Reading

Another useful chapter on performance technology is available in *The Foundations of Instructional Technology,* available at https://edtechbooks.org/-cx

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Feedback

Please complete this short survey to provide feedback on this chapter: http://bit.ly/HPTTech

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28

Defining and Differentiating the Makerspace

Tonia A. Dousay

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Rise of the Maker Movement

The intersection between constructivism, constructionism, collaborative learning, and problem-based learning comprises the heart of the maker movement. Being a maker means embracing the "do it yourself" or DIY mindset (Morin, 2013), and engaging in making takes different forms. Some call it tinkering, referring to the spirit behind American innovators such as Thomas Edison and Steve Jobs (Lahart, 2009); while others call it hacking, in the essence of the hackerspaces that originally rose in popularity throughout Europe during the 1980s and 1990s (Minsker, 2009). Still others use the terms interchangeably to denote a generic emphasis on creating and exploration. Regardless of which term is used, the hands-on approach to learning from experts and informal structure with particular attention on a truly personal, intrinsic endeavor (Kurti, Kurti, & Fleming, 2014) situates making firmly between constructivism and constructionism. In other words, the social nature of learning defined in constructivism (Vygotsky, 1978) takes shape in a makerspace through interacting with others, learning from those more experienced, proceeding at the learner's own pace, and disconnecting from most formal learning expectations. The relationship to constructionism (Papert & Harel, 1991) arises naturally through the focus on making something and the learning that occurs through that process. The very nature of working with others when making, hacking, or tinkering creates opportunities for collaborative learning through problem and/or project-based means. In the midst of this booming informal learning phenomenon, however, it provides a prime opportunity for PK-12 schools and universities to explore the implications for formal learning.

While the maker movement itself seems broad and general, the physical spaces that host making activities are even more varied. "Makerspaces are informal sites for creative production in art, science, and engineering where people of all ages blend digital and physical technologies to explore ideas, learn technical skills, and create new products" (Sheridan et al., 2014, p. 505). The emphasis on the informal and exploration translates to a wide variety of spaces including public libraries, community centers, PK-12 classrooms, and even university facilities. From the Chicago Public Library's *Maker Lab* to the *Creation Station* at the St. Helena branch of Beaufort County Library in South Carolina (Ginsberg, 2015), public libraries large and small see the potential of and value in making. One of the oldest community spaces,

The Geek Group out of Grand Rapids, MI, began as a collaboration between community members and Grand Valley State University, in the mid 1990s to facilitate innovation, play, and learning. Now a global group with more than 25,000 members, the primary facility provides space for members “to build projects and prototypes, collaborate with other members, take classes in their areas of interest, and teach classes in their areas of expertise” (The Geek Group, n.d., para. 4). Each of these spaces, regardless of host, include diverse approaches to equipment, space, and activities that operate in the spirit of the maker movement.

A Framework for Defining Makerspaces

Characteristics or profiles of spaces take on different dimensions under closer scrutiny. Websites such as Makerspace.com, Hackerspaces.org, and Mobilemakerspace.com maintain user-generated directories and profiles. A review of these directories and an examination of the individual space characteristics generates considerations for location, technology and tools available, personnel, and access. Spaces can be in a permanent facility that houses the space and all related equipment and staff or hosts the space for specific events. For example, some community spaces make arrangements to reserve and use public libraries or other community facilities on a regular basis for meetings and special events. Partnerships like the Center for P-20 Engagement at Northern Illinois University operate as more of a mobile space, coordinating the expertise, equipment, and supplies for special events hosted in various places. The tools and technology in a space are perhaps the most varied aspect. Permanent facilities tend to design spaces around shops or areas focused on specialized tasks and skills. These areas include mechanical repair and electronics, woodworking and fabrication, cooking and crafting, and computer labs with digital technologies (Sheridan et al., 2014). In other words, tools and activities range between industrial arts and digital technologies, including everything in between. With respect to staffing makerspaces, there are three primary approaches; paid personnel, volunteers, and blended. The majority of spaces tend towards the blended approach, making use of operating budgets, when available, to pay coordinators like safety, event, and/or director. Expertise in spaces is almost universally provided on a volunteer basis, but some spaces also call upon volunteers to manage daily operations. Access to spaces also takes on different forms. Some spaces allow open access to a community, accepting donations and/or charging for specific services like 3D printing or use of equipment. Other spaces are open on a membership basis, meaning that an individual or family pays a monthly or yearly fee for open access to all expertise, tools, and materials. Age of the visitors may also be a consideration, ranging from inviting members of all ages to focusing on specific age groups. Still other spaces are completely closed, only allowing access to a specific group of individuals. Spaces in PK-12 schools often fall in this latter classification, only allowing currently enrolled students to access the makerspace. Some spaces focus efforts at specific points along a virtual spectrum while others work at multiple points on the spectrum. Figure 1 illustrates this multidimensional framework for profiling these characteristics.

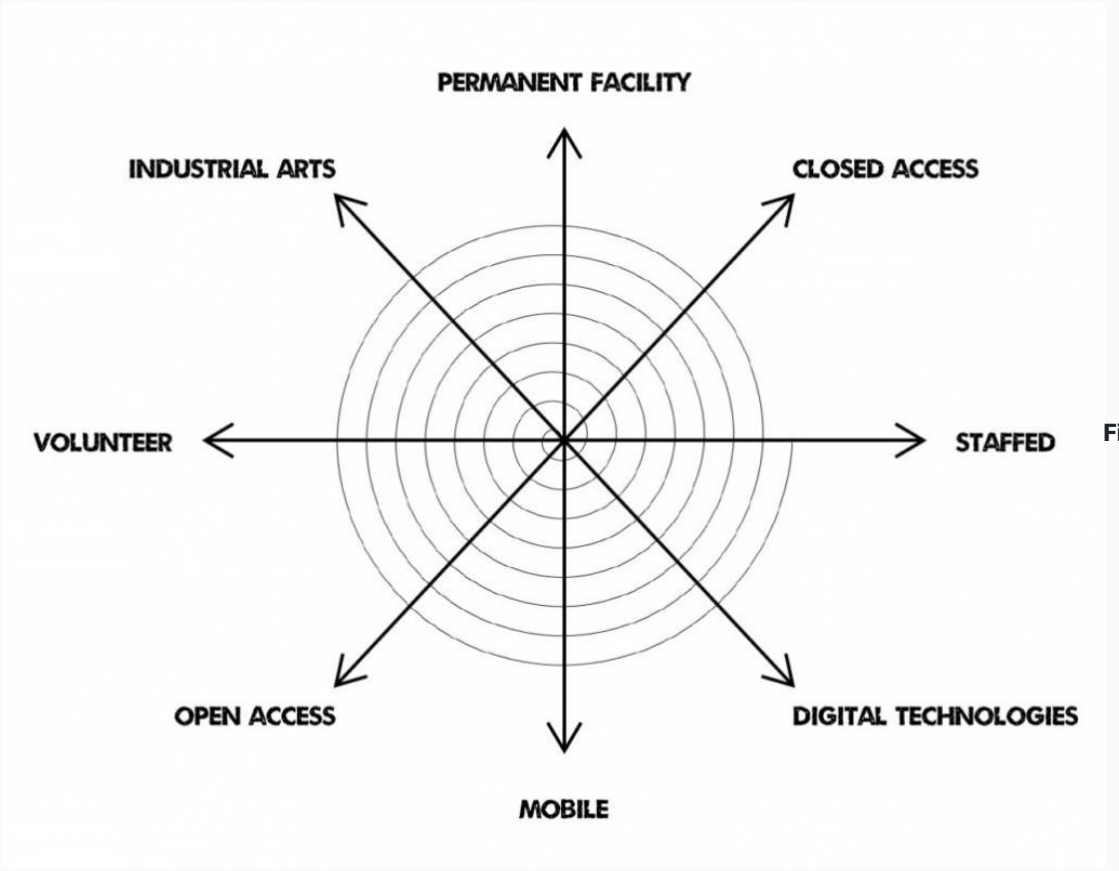

Figure 1. Makerspace framework

Each line represents a spectrum along which a space may operate, either by initial setup and design or through evolving changes. The spiral that swirls around the axis represents a multidimensional nature. For example, the WyoMakers makerspace at the University of Wyoming operates as a permanent facility, housed in a campus building, with primarily digital technologies, staffed by paid student workers and volunteers, with open access to the community. Photographs of WyoMakers are illustrated in Figure 2. Comparatively, only students enrolled in specific courses at Jackson Hole High School (JHHS) can use the campus FabLab, which is housed in a wing of the main school building with a mixture of industrial arts tools and digital technologies. The FabLab is staffed by school faculty. These two makerspace profiles help illustrate how the framework helps describe the features and functions of a space.

Figure 2. WyoMakers makerspace at the University of Wyoming

Using this framework to define a particular makerspace may help stakeholders evaluate immediate and long-term needs and capabilities. Whether a space is in the early conception phase or assessing continued operation, the framework guides decision-making questions that inform budget, infrastructure, personnel, and more. Some of the questions may be easier to answer than others, depending upon particular circumstances. Many PK-12 schools may prefer to operate a closed facility that only serves enrolled students while college and university makerspaces must decide between opening a space for the community or restricting access. Even community spaces must consider their purpose and mission in conjunction with sponsoring agencies to make a similar decision. The access decision informs budgetary concerns when assessing the cost of consumable materials (filament for a 3D printer) and equipment maintenance (blades for silhouette cutters). When considering the funding question, sponsorships must be taken into consideration. Makerspaces that receive funding from a parent organization such as municipal or taxpayer funds may have guidelines on how money can be spent, but still operate in an open fashion. Other examples of sponsorships include competitions such as the CTE Challenge from the U.S. Department of Education (2016) or even corporations like MakerBot. Alternatively, a community space with open access with no primary budget provider would be well served charging a membership fee or offering specific access or services on a fee-for-use basis. Staffing decisions in a space involve questions such as “do individuals need a particular credential to work here?” A closed-access space built into the curriculum of a PK-12 school likely requires staffers to be faculty employed by the school with an endorsement in a particular subject area; whereas an open access university space may allow anyone in the community to work there. Lastly, and likely the most fluid of all decisions, is that of what tools and technology to provide in expertise and/or access. Some makerspaces have found success starting with digital tools more readily available as they draft growth plans and seek the funding or other means to acquire resources to expand. The decision related to the tools and

activities available in a space should also take into consideration the expertise of paid and volunteer staff. Thus, working through each of the primary elements of the framework will inform multiple operating decisions.

Learning in Makerspaces

Regardless of how the space is designed or how it shifts over time, the learning that occurs in a makerspace takes on both formal and informal elements. Just as the spiral in Figure 1 illustrates the multidimensional quality, it also embodies the learning that occurs in the space with the assistance of each spectrum. Guidelines of makerspaces include accepting and learning from failure, encouraging experimentation, supporting unintentional consequences of damage to equipment, and facilitating collaboration (Kurti, Kurti, & Fleming, 2014). Those familiar with the various iterations and implementations with what many refer to as career and technology education (CTE) programs likely see resemblances between some makerspaces and the shop and fabrication spaces often encountered with workshop-based learning environments that specialize in skilled trades and equipment operation (Great Schools Partnership, 2014). The differentiation and perhaps most significant distinction rests in the ability of a makerspace to shift from completely closed access to inviting external expertise as well as the learning from failure entrepreneurial spirit and fluid, evolving nature. Communities and schools that attempt to create a makerspace or rebrand an existing facility under the assumption that a space can only exist in their context if it contains a specific list of equipment aligned directly to scripted curriculum suffer from a narrow view of the maker movement and embodied character.

Blending Formal and Informal Learning

With the rise in attention to and popularity of the maker movement, scholars and practitioners have rushed to capitalize on this momentum under the guise of everything from educational reform to salvaging educational facilities and programs. Economic downturns and renewed interest in the DIY approach and hands-on construction helped introduce and even foster maker movement growth (Lahart, 2009). While leaders have argued about the role of creativity in the classroom and grappled with reconciling educational policies and mandates with curricular strategies and assessment, communities embraced centers of informal learning engagement. Teachers and schools then began to see the makerspace as a means to reinvent curriculum through a constructionist paradigm (Donaldson, 2014) with the ability to promote learning and innovation skills such as the Partnership for 21st Century Learning's (2011) 4Cs — critical thinking, communication, collaboration, and creativity. However, given the movement's deep connection to informal learning, school-based makerspaces must now consider how to blend this approach with formal learning.

Makerspaces inherently hold potential for learning through varied drop-in or scheduled activities and clubs, but the informal emphasis poses challenges to educators. As Kurti, Kurti, and Fleming (2014) noted, "Learning may occur, but it is not the primary objective" (p. 8). An individual's primary objective or purpose in a makerspace varies as widely as the different types of spaces that exist. The driving informal learning factor that occurs rests in a learner-centered approach. In other words, the learner determines what activity he or she wants to undertake, triggering a self-regulated learning phenomenon wherein the the individual serves as the primary driver of all actions based upon intrinsic motivation (Zimmerman, 1986). All knowledge and skill necessary to complete that activity then become the responsibility of the learner, and he or she must seek out the expertise and resources to help complete the activity. This expertise takes the form of volunteered and paid staffers, both in residence and invited. The makerspace also facilitates access to other resources such as online videos or tutorials, consumable materials necessary for the activity, and safety support. Education researchers easily look at this specific learning environment and draw parallels between informal makerspace learning and problem-based learning (PBL). At the very core of a makerspace lies an ill-structured problem, a learner wanting to learn a new skill or create something he or she has never attempted before, with many ways to approach and solve the problem, and this aligns perfectly with Jonassen's (2000) definition of PBL. Even the individual variable of engaging in self-directed learning sits as a cornerstone to PBL design (Scott, 2014). Although many educators and researchers have attempted to encourage and foster PBL curriculum in PK-12 schools (Gallagher, 1997; Hmelo- Silver, 2004; Ward & Lee, 2002), actual implementation has been difficult (Brush & Saye, 2000; Ertmer & Simons, 2006; Frykholm, 2004). Among the issues recognized by teachers as a barrier to adopting PBL, Ertmer, et al. (2009) found that allowing students to take responsibility for their learning and effectively integrating technology tools

arose as a common theme. Perhaps then, the makerspace approach provides a means for clearing this challenge and making PBL easier to adopt while simultaneously bridging the formal and informal.

Returning to the earlier example makerspaces in Wyoming provides examples of how learning transcends individual projects. The WyoMakers space currently operates on a drop-in basis for students, faculty, staff, and community members to take advantage of tools, expertise, and resources. However, formal courses at the University of Wyoming may take advantage of scheduling the space. For example, the Agricultural Education methods course for preservice teachers requested a special informational session in Fall 2015 for the students to learn about the available tools and consider how they might use these facilities as educators. The formal instruction included a brief overview of tools found in WyoMakers as well as tools found in school-based makerspaces around Wyoming in conjunction with demonstrations of the equipment. The preservice teachers worked through basic safety training for the 3D printers before exploring Thingiverse.com for relevant projects that might align with their proposed lesson plans. In particular, multiple students found particular use for an open-source hydroponics lesson (see 3dprintler, 2014). The students experienced using a 3D printer to load and begin printing one of the objects, evaluating the final print for suitable use. The falling semester, these students completed their teaching residencies, where one preservice teacher found herself in a facility that required using 3D printers and design software. Her experience in the WyoMakers makerspace allowed her to be better prepared to design formal learning experiences for her students. From an interdisciplinary standpoint, the JHHS FabLab provides an exemplary example of how multiple courses can take advantage of the maker learning environment. Junior and senior students at JHHS must complete a Greek mythology unit as part of their English/Language Arts curriculum. At the conclusion of the unit, students are challenged to re-create a scene or character from one of the stories in a medium of their choice. A student enrolled at JHHS during the 2015-2016 school year opted to design a figurine of Perseus using the AutoCAD software, working through iterations of prototypes and testing his designs. From meticulously adjusting measurements of scale to ensuring that features of the figurine matched descriptions of Perseus from the stories, the student spent two weeks working informally in the FabLab under the guidance of the space manager to achieve the goals of the assignment. Ultimately, the English teacher worked in conjunction with the makerspace coordinator to assess the student's ability to meet the original assignment requirements. Neither teacher had any obligation to encourage the student to seek a creative solution to the assignment or work with him. However, they seized upon the opportunity to take a risk and allow something non-traditional. Recent legislative changes announced as part of the *Every Student Succeeds Act* (ESSA) might help create a more favorable environment for these types of collaborative, risk-taking assessments in the classroom. For example, reducing duplicative standardized assessments and possibilities related to competency- and/or performance-based assessments (O'Brien, 2016) conceivable opens up the potential for formal assessment informed by informal learning.

Expansion and Evolution

Referring back to the proposed framework in Figure 1 and previous makerspace profiles discussed, consider the relationship between a closed-access space tied to a specific course or set of courses/curriculum. The earlier comparison with CTE facilities takes on an old perspective. Makerspaces in a community thrive due to their fluid and evolving nature that invites interdisciplinary collaboration. CTE facilities, arguably, fell out of favor with formal education through budget cuts and policies or practices that only allowed certain subgroups of students to use the space. Example policies and programs include college-bound or career-ready tracks of courses prescribed for students. In some cases, these practices segregated students, emphasizing post-secondary education over vocational opportunities (Baxter, 2012). If schools adopt a proactive stance of applying open philosophies, collaborative management and use, and integrated project facilitation, they may be able to sustain the maker movement beyond initial hype and implementation. How a PK-12 school approaches these characteristics likely depends largely on breaking down subject-based silos and inviting teachers and staff to experiment with team-teaching or guest teaching in an interdisciplinary PBL approach, which is not uncommon in some post-secondary classrooms. However, adopting such an approach forces school administrations to also shift from a low-risk mindset to one that encourages risk-taking and nontraditional systems thinking. If a school considers creating a makerspace or rejuvenating an existing curricular program, they would be mindful to heed this guidance and incorporate sustainability into each characteristic of the framework in Figure 1 or suffer the hazard of watching their space quickly become obsolete. To truly attain

sustainability and not be considered the next generation of obsolete computer labs or workshops, school-based makerspaces must continuously evaluate and evolve.

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29

User Experience Design

Yvonne Earnshaw, Andrew A. Tawfik, & Matthew Schmidt

Educators and learners are increasingly reliant on digital tools to facilitate learning. However, educators and learners often fail to adopt technology as originally intended (Straub, 2017). For instance, educators may be faced with challenges trying to determine how to assess student learning in their learning management system or they might spend time determining workarounds to administer lesson plans. Learners might experience challenges navigating an interface or finding homework details. When an interface is not easy to use, a user must develop alternative paths to complete a task and thereby accomplish a learning goal. Such challenges are the result of design flaws, which create barriers for effective instruction (Jou, Tennyson, Wang, & Huang, 2016; Rodríguez, Pérez, Cueva, & Torres, 2017).

Understanding how educators and learners interact with learning technologies is key to avoiding and remediating design flaws. An area of research that seeks to understand the interaction between technology and the people who use it is known as human-computer interaction (HCI; Rogers, 2012). HCI considers interaction from many perspectives, two of which are usability and user experience (UX). Usability describes how easily the interfaces are able to be used as intended by the user (Nielsen, 2012). Examples include when an interface is designed in such a way that the user can anticipate errors, support efficiency, and strategically use design cues so that cognitive resources remain focused on learning. UX describes the broader context of usage in terms of "a person's perceptions and responses that result from the use or anticipated use of a product, system, or service" (International Organization for Standardization [ISO], 2010, Terms and Definitions section, para 2.15). Emphasizing HCI corresponds with a more user-centered approach to design. Such user-centered design (UCD) emphasizes understanding users' needs and expectations throughout all phases of design (Norman, 1986).

The principles of HCI and UCD have implications for the design of learning environments. While the LIDT field has historically focused on learning theories to guide design (e.g., scaffolding, sociocultural theory, etc.), less emphasis has been placed on HCI and UCD (OkumuÅŸ, Lewis, Wiebe, & Hollebrands, 2016). This chapter attempts to address this issue. We begin with a discussion of the learning theories that are foundational to HCI. We then discuss the importance of iteration in the design cycles. We conclude with details of UCD-specific methodologies that allow the designer to approach design from both a pedagogical and UCD perspective.

Theoretical Foundations

Usability and HCI are closely related with established learning theories such as cognitive load theory, distributed cognition, and activity theory. In the following sections, we discuss each theory and how it is important for conceptualizing usability and UX from an instructional design perspective.

Cognitive load theory. Cognitive load theory (CLT) contends that meaningful learning is predicated on effective cognitive processing; however, an individual only has a limited number of resources needed to process the information (Mayer & Moreno, 2003; Paas & Ayres, 2014). The three categories of CLT include: (1) intrinsic load, (2) extraneous load, and (3) germane load (Sweller, van Merriënboer, & Paas, 1998). Intrinsic load describes the active processing or holding

of verbal and visual representations within working memory. Extraneous load includes the elements that are not essential for learning, but are still present for learners to process (Korbach, Brünken, & Park, 2017). Germane load describes the relevant load imposed by the effective instructional design of learning materials. Germane cognitive load is relevant to schema construction in long-term memory (Paas, Renkl, & Sweller., 2003; Sweller et al., 1998; van Merriënboer & Ayres, 2005). It is important to note that the elements of CLT are additive, meaning that if learning is to occur, the total load cannot exceed available working memory resources (Paas et al., 2003).

Extraneous load is of particular importance for HCI and usability. Extraneous cognitive load can be directly manipulated by the designer (van Merriënboer & Ayres, 2005). When an interface is not designed with usability in mind, the extraneous cognitive load is increased, which impedes meaningful learning. From an interface design perspective, poor usability might result in extraneous cognitive load in many forms. For instance, a poor navigation structure might require the learner to extend extra effort to click through an interface to find relevant information. Further, when the interface uses unfamiliar terms that do not align with a user's mental models or the interface is not consistently designed, the user must exert additional effort toward understanding the interface. Another example of extraneous cognitive load is when a learner does not know how to proceed, so the learner is taken out of their learning flow. Although there are many other examples, each depicts how poor usability taxes cognitive resources. After extraneous cognitive load is controlled for, then mental resources can be shifted to focus on germane cognitive load for building schemas (Sweller et al., 1998).

Distributed cognition and activity theory. While cognitive load theory helps describe the individual interaction of a user experience, other theories and models focus on broader conceptualizations of HCI. The most prominent ones include distributed cognition and activity theory, which take into account the broader context of learning and introduce the role of collaboration between various individuals. Distributed cognition postulates that knowledge is present both within the mind of an individual and across artifacts (Hollan, Hutchins, & Kirsh, 2000). The theory emphasizes "understanding the coordination among individuals and artifacts, that is, to understand how individual agents align and share within a distributed process" (Nardi, 1996, p. 39). From a learning technology perspective, tools are deemed important because they help facilitate cognition through communication across various entities; that is, technology facilitates the flow of knowledge in pursuit of a goal (Boland, Tenkasi, & Te'eni, 1994; Vasiliou, Ioannou, & Zaphiris, 2014). In doing so, the unit of analysis is focused on the function of the system within the broader context (Michaelian & Sutton, 2013). Therefore, user experience is defined as much broader and more collaborative when compared with cognitive load theory.

Activity theory is a similar framework to distributed cognition, but focuses on the activity and specific roles within an interconnected system. Activity theory describes workgroup behavior in terms of a goal-directed hierarchy: activities, actions, and operations (Jonassen & Rohrer-Murphy, 1999). Activities describe the top-level objectives and fulfillment of motives (Kaptelinin, Nardi, & Macaulay, 1999). Within a learning context, these are often technology implementations that subgroups must embrace. An example is the integration of a new LMS or new training approach. Actions are the more specific goal-directed processes and smaller tasks that must be completed in order to complete the overarching activity. Operations describe the automatic cognitive processes that group members complete (Engeström, 2000). However, they do not maintain their own goals, but are rather the unconscious adjustment of actions to the situation at hand (Kaptelinin et al., 1999). In terms of HCI, an implemented technology will be designed to support learning contexts on any or all of these levels for a given objective.

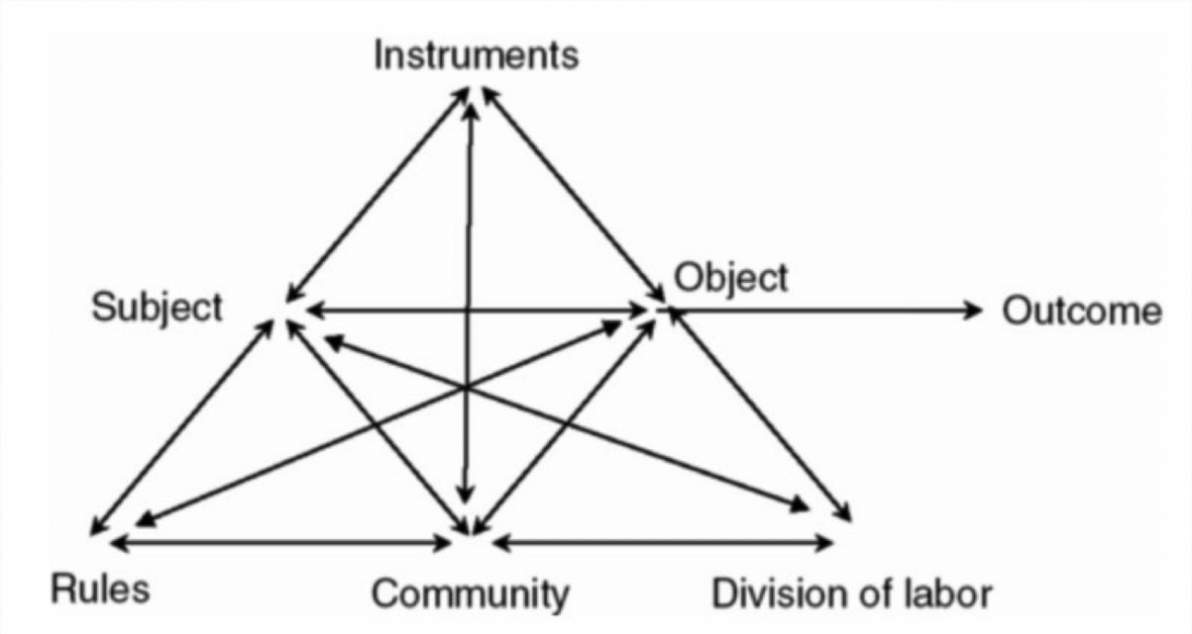

Figure 1. Activity system diagram. Adapted from "Activity Theory as a Framework for Analyzing and Redesigning Work," by Y. Engeström, 2000, Ergonomics, 43(7), p. 962.

Activity theory is especially helpful for design because it provides a framework to understand how objectives are completed throughout a learning context. Nardi (1996) suggested that a key component of activity theory is the role of mediation of the world through tools. These artifacts are created by individuals to control their own behavior and can manifest in the form of instruments, languages, or technology. Each carries a particular culture and history that stretches across time and space (Kaptelinin et al., 1999) and serves to represent ways in which others have solved similar problems. Activity theory applied to education suggests that tools not only mediate the learning experience, but they are often altered to accommodate the new tools (Jonassen & Rohrer-Murphy, 1999). While the availability of learning management systems or educational video games may be beneficial, they need to be seen within the broader context of social activity necessitated by a school or organization (Ackerman, 2000). Moreover, the technological tools instituted in a workgroup should not radically change work processes, but represent solutions given the constraints and history of the workgroup (Barab, Barnett, Yamagata-Lynch, Squire, & Keating, 2002; Yamagata-Lynch, Cowan, & Luetkehans, 2015). As work is increasingly collaborative through technology, activity theory and distributed cognition can provide important insight into the broader aspects of human-computer interaction.

Acronyms

- HCI: Human-computer interaction
- UX: User experience
- ISO: International Organization for Standardization
- UCD: User-centered design
- CLT: Cognitive load theory

User-centered Design

Given the theoretical implications of usability and the design of learning environments, the question arises as to how one designs and develops highly usable learning environments. The field of instructional design (ID) has recently begun to shift its focus to more iterative design and user-driven development models, and a number of existing instructional design methods can be used or adapted to fit iterative approaches. Identifying learning needs has long been the focus of front-end analysis. Ideation and prototyping are frequently used methods from UX design and rapid prototyping. Testing in instructional design has a rich history in the form of formative and summative evaluation. By applying these specific methods within iterative processes, instructional designers can advance their designs in such a way that they can focus not only on intended learning outcomes but also on the usability of their designs. In the following sections, UCD is considered with a specific focus on techniques for incorporating UCD into one's instructional design processes through (1) identifying user needs, (2) requirements gathering, (3) prototyping, and (4) wireframing.

Identifying User Needs

Similarly to the field of instructional design, in which the design process begins with assessing learner needs (Sleezer, Russ-Eft, & Gupta, 2014), UCD processes also begin by identifying user needs. The focus of needs assessment in instructional design often is identification of a gap (the need) between actual performance and optimal performance (Rossett, 1987; Rossett & Sheldon, 2001). Needs and performance can then be further analyzed and instructional interventions designed to address those needs. Assessing user (and learner) needs can yield important information about performance gaps and other problems. However, knowledge of needs alone is insufficient to design highly usable learning environments. Once needs have been identified, the first phase of the UCD process centers around determining the specific context of use for a given artifact. Context is defined by users (who will use the artifact), tasks (what will users do with the artifact), and environment (the local context in which users use the artifact). A variety of methods are used to gain insight into these areas.

Personas. In UCD, a popular approach to understanding learners is to create what is known as personas (Cooper, 2004). Personas provide a detailed description of a fictional user whose characteristics represent a specific user group. They serve as a methodological tool that helps designers approach design based on the perspective of the user rather than (often biased) assumptions. A persona typically includes information about user demographics, goals, needs, typical day, and experiences. In order to create a persona, interviews or observations should take place to gather information from individual users and then place them into specific user categories. Personas should be updated if there are changes to technology, business needs, or other factors. Personas help designers obtain a deep understanding of the types of users for the system. Because personas are developed based on data that have been gathered about users, bias is reduced. An effective way to start creating personas is to use a template; a simple web search will yield many. Table 1 provides an example of a persona that was created by novice designers in an introductory instructional design course using a template.

Table 1. Persona of Website Users

User Goals: What users are trying to achieve by using your site, such as tasks they want to perform
1. Parents seek advice on improving teacher/parent interactions 2. Parents seek to build and foster a positive partnership between teacher and parents to contribute to child's school success 3. Parents wish to find new ways or improve ways of parent-teacher communication
Behavior: Online and offline behavior patterns, helping to identify users' goals

1. Online behavior: “Googling” ways to improve teacher communication with parent or parent communication with teacher; parent searching parent/teacher communication sites for types of technology to improve communication; navigating through site to reach information
2. Offline behavior: Had ineffective or negative parent-teacher communication over multiple occurrences; parents seeking out other parents for advice or teachers asking colleagues for suggestions to improve communication with parents
3. Online/Offline behavior: Taking notes, practicing strategies or tips suggested, discussing with a colleague or friend.

Attitudes: Relevant attitudes that predict how users will behave

1. Looking for answers
2. Reflective
3. Curiosity-driven

Motivations: Why users want to achieve these goals

1. Wishing to avoid past unpleasant experiences of dealing with parent-teacher interaction
2. Looking to improve current or future parent-teacher relationships
3. Looking to avoid negative perceptions of their child by teacher

Design team objectives: What you ideally want users to accomplish in order to ensure your website is successful?

1. Have an interface that is easy to navigate
2. Inclusion of both parent and teacher in the page (no portal/splash page)
3. Grab interest and engage users to continue reading and exploring the site

Derived from: https://edtechbooks.org/-yn

Identifying Requirements

One potential pitfall of design is when developers create systems based on assumptions of what users want. After designers have begun to understand the user, they begin to identify what capabilities or conditions a system must be able to support to meet the identified user needs. These capabilities or conditions are known as “requirements.” The process a designer undertakes to identify these requirements is known as “requirements gathering.” Generally, requirements gathering involves: (1) gathering user data (e.g., user surveys, focus groups, interviews, etc.), (2) data analysis, and (3) interpretation of user needs. Based on interpretation of user needs, a set of requirements is generated to define what system capabilities must be developed to meet those needs. Requirements are not just obtained for one set of users, but for all user-types and personas that might utilize the system.

Requirements gathering from a UCD perspective helps avoid application of a “ready-made” solution in favor of creating design guidelines that meet an array of various users’ needs. Requirements gathering also outlines the scope of the project given the known context and current understanding of personas. Given the iterative nature of UCD, however, requirements might change as a design evolves. Shifts in requirements vary depending design and associated evaluation methods.

Designing and Developing User Interfaces

Similar to requirements gathering, designing and developing a user interface undergoes an iterative process. Based on personas and identified requirements, an initial prototype of the user interface should be created. Prototypes tend to follow a trajectory of development over time from low fidelity to high fidelity (Walker, Takayama, & Landay, 2002). Fidelity refers to the degree of precision, attention to detail, and functionality of a prototype. Examples range from lower fidelity prototypes, which include the proverbial "sketch on a napkin" and paper prototypes, to higher fidelity prototypes, which include non-functional "dummy" graphical mockups of interfaces and interfaces with limited functionality that allow for evaluation. Typically, lower fidelity prototypes do not take much time to develop and higher fidelity prototypes take longer because prototypes become more difficult to change as more details and features are added.

Rapid prototyping. Rapid prototyping is an approach to design that emerged in the 1980s in engineering fields and began to gain traction in ID in the early 1990s (Desrosier, 2011; Tripp & Bichelmeyer, 1990; Wilson, Jonassen, & Cole, 1993). Instead of traditional ID approaches with lengthy design and development phases, rapid prototyping focuses on fast, or "rapid," iterations. This allows instructional designers to quickly gather evaluative feedback on their early designs. Considered a feedback-driven approach to ID, rapid prototyping is seen by many as a powerful tool for the early stages of an ID project. The rapid prototyping approach relies on multiple, rapid cycles in which an artifact is designed, developed, tested, and revised. Actual users of the system participate during the testing phase. This cycle repeats until the artifact is deemed to be acceptable to users. An example of rapid prototyping applied in an instructional design context is the successive approximation model, or SAM (Allen, 2014). The SAM (version 2) process model is provided in Figure 2.

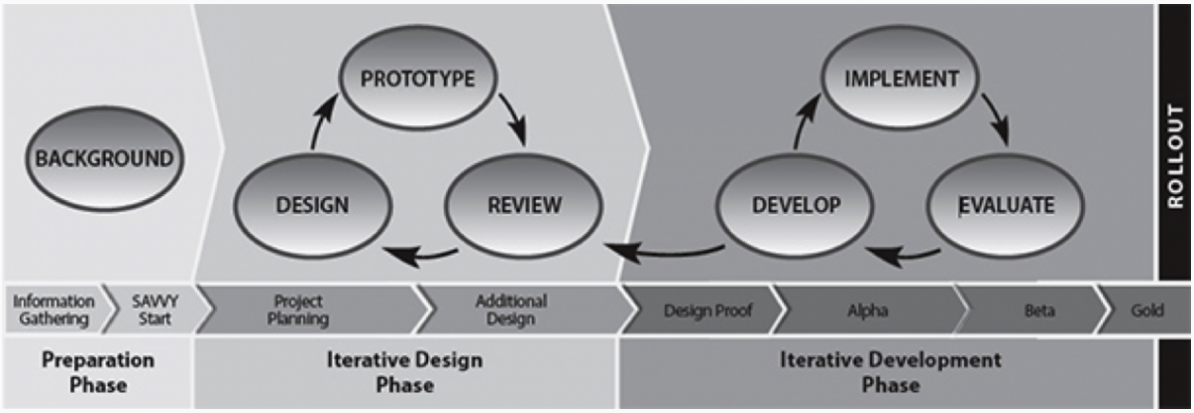

Figure 2. Successive approximation model version 2 (SAM2) process diagram. Adapted from Leaving ADDIE for SAM: An Agile Model for Developing the Best Learning Experience (p. 40), by M. Allen, 2014, Alexandria, VA: American Society for Training and Development. Copyright 2014 by the American Society for Training and Development.

Paper prototyping. A lower fidelity method of prototyping is called paper prototyping. Paper prototyping is used to inform the design and development of many different kinds of interfaces, including web, mobile, and games. The focus of paper prototyping is not on layout or content, but on navigation, workflow, terminology, and functionality. The purpose of creating these prototypes is to communicate designs among the design team, users, and stakeholders, as well as to gather user feedback on designs. A benefit of paper prototyping is that it is rapid and inexpensive – designers put only as much time into developing a design as is absolutely necessary. This makes it a robust tool at the early stages of design. As the name implies, designers use paper to create mockups of an interface. Using pencil and paper is the simplest approach to paper prototyping, but stencils, colored markers, and colored paper can also be used. These paper prototypes can be scanned and further elaborated using digital tools (Figure 3). The simplicity of paper prototyping allows for input from all members of a design team, as well as from users and other stakeholders. The speed of paper

prototyping makes it particularly amenable to a rapid prototyping design approach. The process of creating paper prototypes can be individual, in which the designer puts together sketches on his or her own, or collaborative, in which a team provides input on a sketch while one facilitator draws it out. For further information on paper prototyping, refer to Snyder (2003) and UsabilityNet (2012).

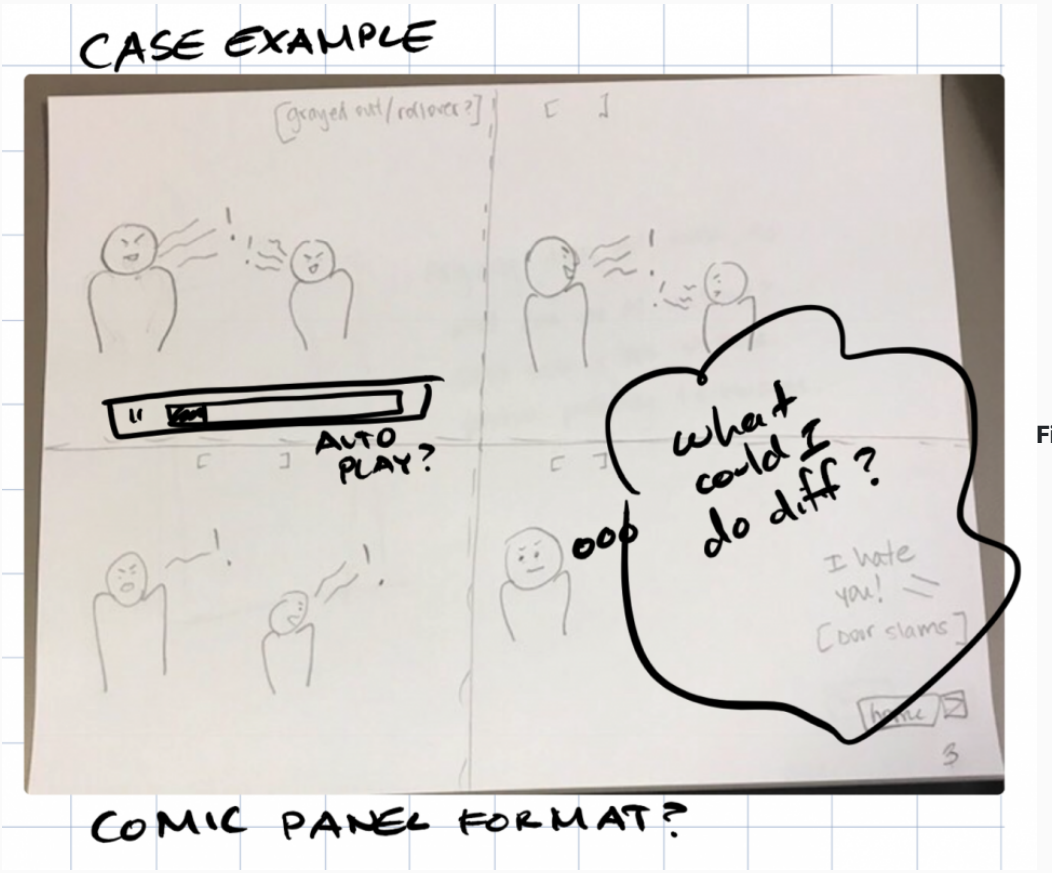

Figure 3.

Example of a paper prototype that has been scanned and annotated using digital tools.

Wireframing. Wireframes are representations of interfaces that visually convey their structure (see Figure 4). Wireframing results in prototypes that are of higher fidelity than paper prototyping, but lack the functionality and visual elements of high fidelity prototypes. Wireframing commonly occurs early in the design process after paper prototyping. It allows designers to focus on things that paper prototyping does not, such as layout of content, before more formal visual design and content creation occurs. Wireframing can be seen as an interim step that allows for fast mockups of an interface to be developed, tested, and refined, the results of which are then used to create higher fidelity, functional prototypes.

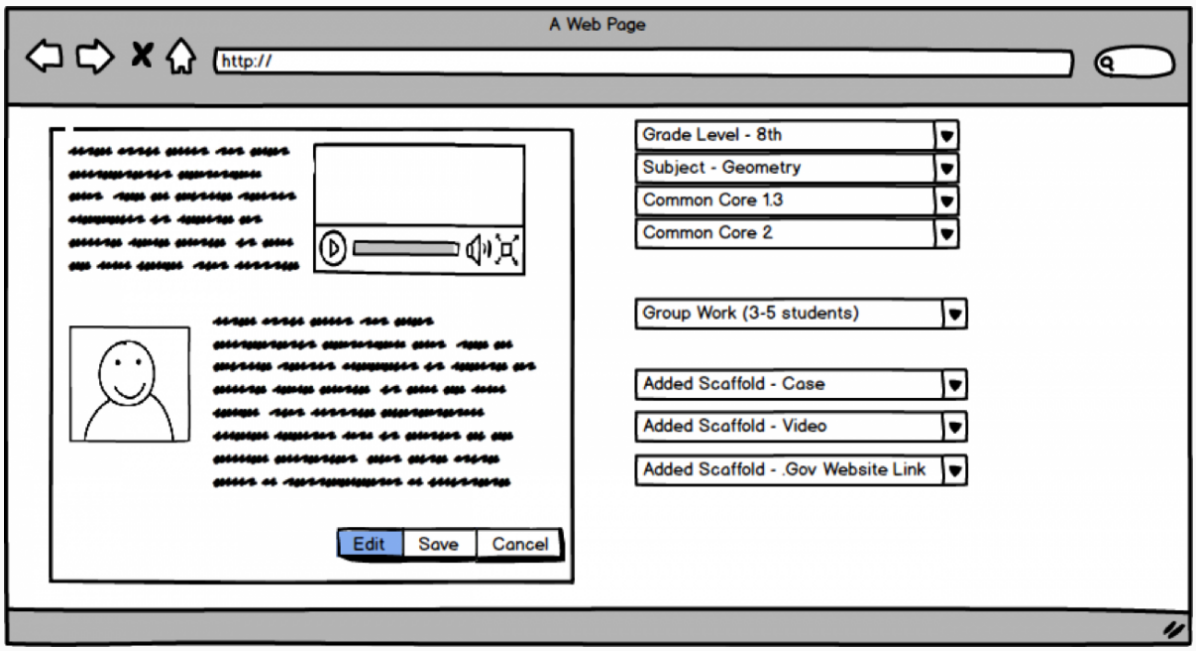

Figure 4. Example of a wireframe.

Wireframes consist of simple representations of an interface, with interface elements displayed as placeholders. Placeholders use a variety of visual conventions to convey their purpose. For example, a box with an "X" or other image might represent a graphic, or a box with horizontal lines might represent textual content. Wireframes can be created using common software such as PowerPoint or Google Drawings or with more specialized software such as OmniGraffle or Balsamiq. Wireframes are particularly amenable to revision, as revisions often consist of simple tweaks, such as moving interface elements, resizing, or removing them. A key benefit of wireframes is that they allow designers to present layouts to stakeholders, generate feedback, and quickly incorporate that feedback into revisions.

Functional prototyping. Functional prototypes are higher-fidelity graphical representations of interfaces that have been visually designed such that they closely resemble the final version of the interface and that incorporate limited functionality. In some cases, content has been added to the prototype. A functional prototype might start out as a wireframe interface with links between screens. A visual design is conceived and added to the wireframe, after which graphical elements and content are added piece-by-piece. Then, simple functionality is added, typically by connecting different sections of the interface using hyperlinks. An advanced functional prototype might look like a real interface but lack full functionality. Functional prototypes can be created using PowerPoint or with more specialized software like InVision and UXPin.

During evaluation, functional prototypes allow for a user to experience a mockup interface in a way that is very similar to the experience of using an actual interface. However, because functionality is limited, development time can be reduced substantially. Functional prototypes provide a powerful way to generate feedback from users in later stages of the design process, allowing for tweaks and refinements to be incorporated before time and effort are expended on development.

To reiterate, the goal of UCD is to approach systems development from the perspective of the end-user. Through tools such as personas and prototypes, the design process becomes iterative and dynamic. Learning designers also use these tools in conjunction with evaluation methods to better align prototype interface designs with users mental models, thereby reducing cognitive load and improving usability.

Evaluation Methodologies for User-centered Design

While UCD is important for creating usable interfaces, a challenge is knowing when and under what conditions to apply the appropriate evaluation methodology. In the following sections, several user evaluation methodologies are described. These can be applied during various phases across the design process (i.e., front-end analysis, low-fidelity to high-fidelity prototyping). While a case can be made to apply any of the approaches outlined below in a given design phase, some evaluation methodologies are more appropriate to overall user experience, while others focus more specifically on usability. Table 2 provides an overview of methods, in which design phase they can be best implemented, and associated data sources.

Table 2. Evaluation Methodologies, Design Phases, and Data Sources

Method	Design phase				Data source
	Front-end analysis	Prototyping			
		Paper	Wireframe	Functional	
Ethnography	•				Single user or users
Focus groups	•	•			Group of users
Card sorting	•	•			Single user, multiple users or group of users
Cognitive walkthrough		•	•	•	Expert
Heuristic evaluation		•	•	•	Experts
A/B testing		•	•	•	Multiple users
Think-aloud				•	Multiple users
EEG/ Eyetracking				•	Multiple users
Analytics				•	Multiple users

Ethnography. A method that is used early in the front-end analysis phase, especially for requirements gathering, is ethnography. Ethnography is a qualitative research method in which a researcher studies people in their native setting (not in a lab or controlled setting). During data collection, the researcher observes the group, gathers artifacts, records notes, and performs interviews. In this phase, the researcher is focused on unobtrusive observations to fully understand the phenomenon in situ. For example, in an ethnographic interview, the researcher might ask open-ended questions but would ensure that the questions were not leading. The researcher would note the difference between what the user is doing versus what the user is saying and take care not introduce his or her own bias. Although this method has its roots in the field of cultural anthropology, ethnography in UX design can support thinking about design from activity theory and distributed cognition perspectives (Nardi, 1996). It is useful in UX evaluations because the researcher can gather information about the users, their work environment, their culture, and how they interact with the device or website in context (Nardi, 1997). This information is particularly valuable when writing user personas. Ethnography is also useful if the researcher cannot conduct user testing on systems or larger equipment due to size or security restrictions.

Focus groups. Focus groups are often used during the front-end analysis phase. Rather than the researcher going into the field to study a larger group as in ethnography, a small group of participants (5-10) are recruited based on shared characteristics. Focus group sessions are led by a skilled moderator who has a semi-structured set of questions or plan. For instance, a moderator might ask what challenges a user faces in a work context (i.e., actuals vs. optimals gap), suggestions for how to resolve it, and feedback on present technologies. The participants are then asked to discuss their thoughts on products or concepts. The moderator may also present a paper prototype and ask for feedback. The role of the researcher in a focus group is to ensure that no single person dominates the conversation in order to hear everyone's opinions, preferences, and reactions. This helps to determine what users want and keeps the conversation on track. It is preferred to have multiple focus group sessions to ensure various perspectives are heard in case a conversation gets side-tracked.

Analyzing data from a focus group can be as simple as providing a short summary with a few illustrative quotes for each session. The length of the sessions (typically 1-2 hours) may include some extraneous information, so it is best to keep the report simple.

Card sorting. Aligning designs with users mental models is important for effective UX design. A method used to achieve this is card sorting. Card sorting is used during front-end analysis and paper prototyping. Card sorting is commonly used in psychology to identify how people organize and categorize information (Hudson, 2012). In the early 1980s, card sorting was applied to organizing menuing systems (Tullis, 1985) and information spaces (Nielsen & Sano, 1995).

Card sorting can be conducted physically using tools like index cards and sticky notes or electronically using tools like Lloyd Rieber's Q Sort (http://lrieber.coe.uga.edu/qsort/index.html). It can involve a single participant or a group of participants. With a single participant, he or she groups content (individual index cards) into categories, allowing the researcher to evaluate the information architecture or navigation structure of a website. For example, a participant might organize "Phone Number" and "Address" cards together. When a set of cards is placed together by multiple participants, this suggests to the designer distinct pages that can be created (e.g., "Contact Us"). When focusing on a group, the same method is employed, but the group negotiates how they will group content into categories. How participants arrange cards provides insight into mental models and how they group content.

In an open card sort, a participant will first group content (menu labels on separate notecards) into piles and then name the category. Participants can also place the notecards in an "I don't know" pile if the menu label is not clear or may not belong to a designated pile of cards. In a closed card sort, the categories will be pre-defined by the researcher. It is recommended to start with an open card sort and then follow-up with a closed card sort (Wood & Wood, 2008). As the arrangement of participants are compared, the designer iterates the early prototypes so the menu information and other features align with how the participants organize the information within their mind. For card sorting best practices, refer to Righi et al (2013) article.

Cognitive walkthroughs. Cognitive walkthroughs (CW) can be used during all prototyping phases. CW is a hands-on inspection method in which an evaluator (not a user) evaluates the interface by walking through a series of realistic tasks (Lewis & Wharton, 1997). CW is not a user test based on data from users, but instead is based on the evaluator's judgments.

During a CW, the evaluator evaluates specific tasks and considers the user's mental processes while completing those tasks. For example, an evaluator might be given the following task: Recently you have been experiencing a technical problem with software on your laptop and you have been unable to find a solution to your problem online. Locate the place where you would go to send a request for assistance to the Customer Service Center. The evaluator identifies the correct paths to complete the task, but does not make a prediction as to what a user will actually do. In order to assist designers, the evaluator also provides reasons for making errors (Wharton, Rieman, Lewis, & Polson, 1994). The feedback received during the course of the CW provides insight into various aspects of the user experience including:

- how easy it is for the user to determine the correct course of action,
- whether the organization of the tools or functions matches the ways that users think of their work,
- how well the application flow matches user expectations,
- whether the terminology used in the application is familiar to users, and
- whether all data needed for a task is present on screen.

For information on how to conduct a CW, view the Interaction Design Foundation's article, available at https://www.interaction-design.org.

Heuristic evaluation. Heuristic evaluation is an inspection method that does not involve directly working with the user. In a heuristic evaluation, usability experts work independently to review the design of an interface against a pre-determined set of usability principles (heuristics) before communicating their findings. Ideally, each usability expert will work through the interface at least twice: once for an overview of the interface and the second time to focus on specific interface elements (Nielsen, 1994). The experts then meet and reconcile their findings. This method can be used during any phase of the prototyping cycle.

Many heuristic lists exist that are commonly used in heuristic testing. The most well-known heuristic checklist was developed over 25 years ago by Jakob Nielsen and Rolf Molich (1990). This list was later simplified and reduced to 10 heuristics which were derived from 249 identified usability problems (Nielsen, 1994). In the field of instructional design, others have embraced and extended Nielsen's 10 heuristics to make them more applicable to the evaluation of eLearning systems (Mehlenbacher et al., 2005; Reeves et al., 2002). Not all heuristics are applicable in all evaluation scenarios, so UX designers tend to pull from existing lists to create customized heuristic lists that are most applicable and appropriate to their local context.

Nielsen's 10 Heuristics

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

An approach that bears similarities with a heuristic review is the expert review. This approach is similar in that an expert usability evaluator reviews a prototype but differs in that the expert does not use a set of heuristics. The review is less formal and the expert typically refers to personas to become informed about the users. Regardless of whether heuristic or expert review is selected as an evaluation method, data from a single expert evaluator is insufficient for making design inferences. Multiple experts should be involved, and data from all experts should be aggregated. Different experts will have different perspectives and will uncover different issues. This helps ensure that problems are not overlooked.

A/B testing. A/B testing or split-testing compares two versions of a user interface and, because of this, all three prototyping phases can employ this method. The different interface versions might vary individual screen elements (such as the color or size of a button), typeface used, placement of a text box, or overall general layout. During A/B testing, it is important that the two versions are tested at the same time by the same user. For instance, Version A can

be a control and Version B should only have one variable that is different (e.g., navigation structure). A randomized assignment, in which some participants receive Version A first and then Version B (versus receiving Version B and then Version A), should be used.

Think-aloud user study. Unlike A/B testing, a think-aloud user study is only used during the functional prototyping phase. According to Jakob Nielsen (1993), "thinking aloud may be the single most valuable usability engineering method" (p. 195). In a think-aloud user study, a single participant is tested at any given time. The participant narrates what he or she is doing, feeling, and thinking while looking at a prototype (or fully functional system) or completing a task. This method can seem unnatural for participants, so it is important for the researcher to encourage the participant to continue verbalizing throughout a study session. To view an example of a think-aloud user study, please watch Steve Krug's "Rocket Surgery Made Easy" video.

A great deal of valuable data can come from a think-aloud user study (Krug, 2010). Sometimes participants will mention things they liked or disliked about a user interface. This is important to capture because it may not be discovered in other methods. However, the researcher needs to also be cautious about changing an interface based on a single comment.

Users do not necessarily have to think aloud while they are using the system. The retrospective think aloud is an alternative approach that allows a participant to review the recorded testing session and talk to the researcher about what he or she was thinking during the process. This approach can provide additional helpful information, although it may be difficult for some participants to remember what they were thinking after some time. Hence, it is important to conduct retrospective think aloud user testing as soon after a recorded testing session as possible.

EEG/Eye-tracking. Similar to the think-aloud user study, electroencephalography (EEG) and eye tracking are evaluation methods that involve the user during the functional prototype phase. EEG and eye-tracking are physiological methods used to measure a participant's physical responses. Instead of relying on self-reported information from a user, these types of methods look at direct, objective measurements in the form of electrical activity in the brain and gaze behavior. EEG measures a participant's brain activity. An EEG records changes in the brain's electrical signals in real-time. A participant wears a skull cap with tiny electrodes attached to it. While viewing a prototype, EEG data can show when a participant is frustrated or confused with the user interface (Romano Bergstrom, Duda, Hawkins & McGill, 2014). Eye-tracking measures saccades, eye movements from one point to another, and fixations, areas where the participant stops to gaze at something. These saccades and fixations can be used to create heat maps and gaze plots, as shown in Figures 5-7, or for more sophisticated statistical analysis.

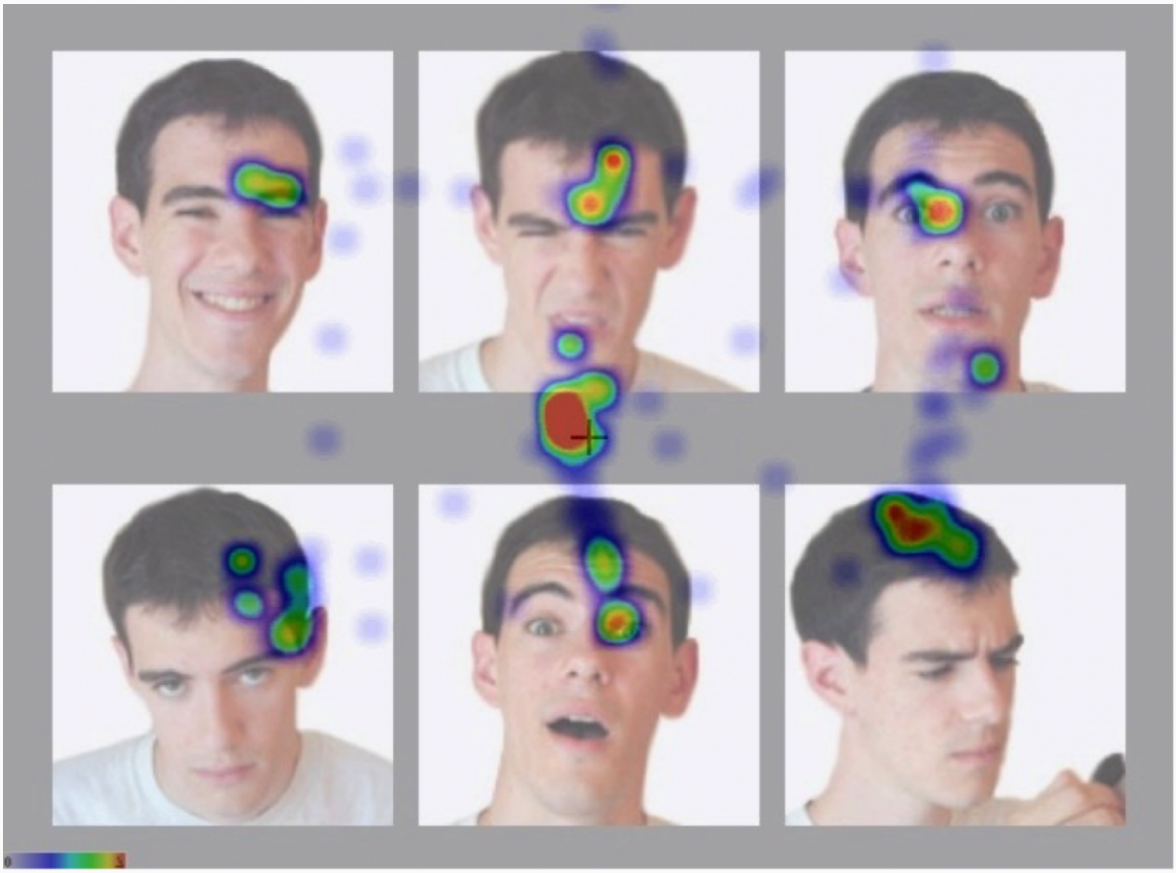

Figure 5. Heat map of an interface in which users with autism must identify facial expressions; here, eye fixations are shown with red indicating longer dwell time and blue indicating shorter dwell time. Adapted from "3D Virtual Worlds: Assessing the Experience and Informing Design," by S. Goggins, M. Schmidt, J. Guajardo, and J. Moore, 2011, International Journal of Social and Organizational Dynamics in Information Technology, 1(1), p. 41. Reprinted with permission.

Figure 6. Heat map of a three-dimensional interface showing eye fixations and saccades in real-time, with yellow indicating longer dwell time and red indicating shorter dwell time. Adapted from "The Best Way to Predict the Future is to Create It: Introducing the Holodeck Mixed-Reality Teaching and Learning Environment," by M. Schmidt, J., Kevan, P. McKimmy, and S. Fabel, 2013, Proceedings of the 2013 International Convention of the Association for Educational Communications and Technology, Anaheim, CA. Reprinted with permission.

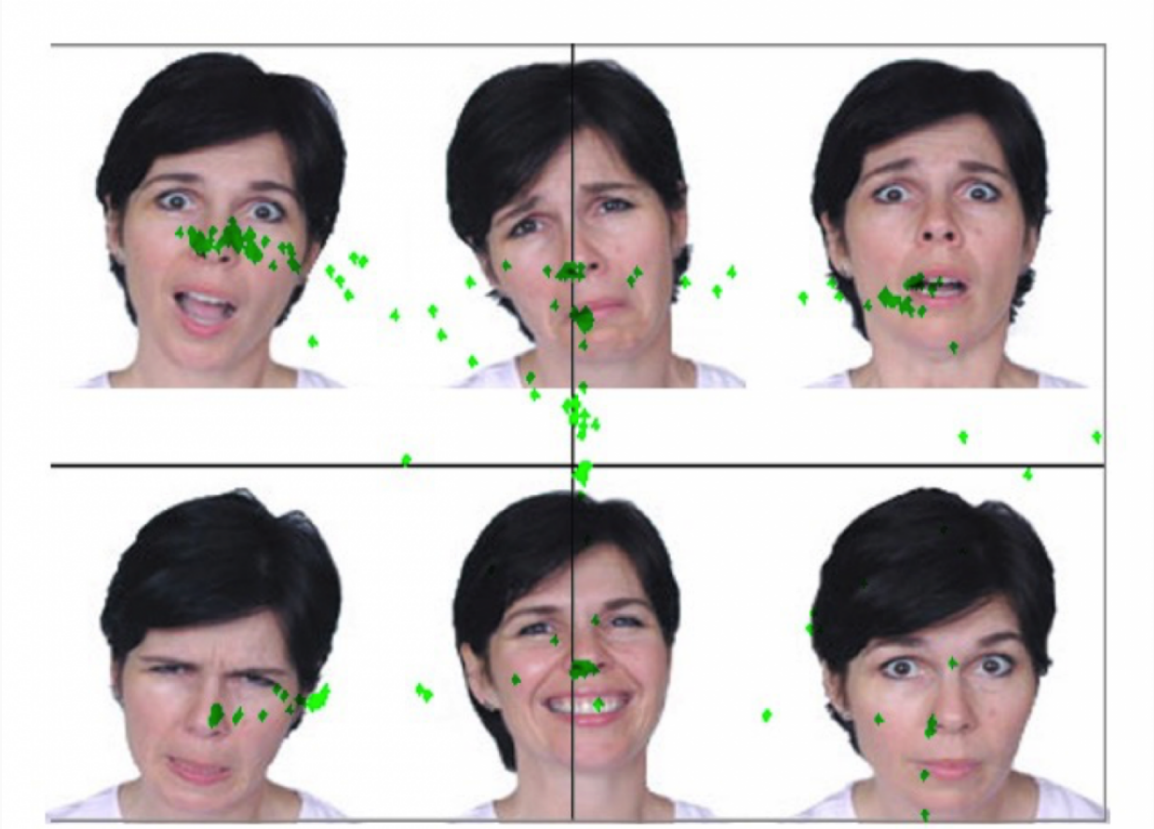

Figure 7. Gaze plot of an interface in which users with autism must identify facial expressions; here, markers plot gaze location every 5 milliseconds. Adapted from "3D Virtual Worlds: Assessing the Experience and Informing Design," by S. Goggins, M. Schmidt, J. Guajardo, and J. Moore, 2011, International Journal of Social and Organizational Dynamics in Information Technology, 1(1), p. 39. Reprinted with permission.

This type of user testing serves as a way to understand when users find something important or distracting, thereby informing designers of extraneous cognitive load. A disadvantage of this type of data is that it might not be clear why a user was fixated on a particular element on the screen. This is a situation in which a retrospective think-aloud can be beneficial. After the eye-tracking data have been collected, the researcher can sit down with the user and review the eye-tracking data while asking about eye movements and particular focus areas.

Analytics. Another type of evaluation method that focuses on participants' behavior is analytics, which are typically collected automatically in the background while a user is interfacing with a system and without the participant always being aware of the data collection. An example is a clickstream analysis in which the participants' clicks are captured while browsing the web or using a software application (see Figure 8). This information can be beneficial because it can show the researcher the path the participant was taking while navigating a system. Typically, these data need to be triangulated with other data sources to paint a broader picture.

Figure 8. An example of a clickstream, showing users' paths through a system. Adapted from "Transforming a Problem-Based Case Library Through Learning Analytics and Gaming Principles: An Educational Design Research Project," by M. Schmidt and A. Tawfik, in press, Interdisciplinary Journal of Problem-Based Learning. Reprinted with permission.

Conclusion

As digital tools have gained in popularity, there is a rich body of literature that has focused on interface design. Indeed, a variety of principles and theories (e.g. cognitive load theory, distributed cognition, activity theory, etc.) have provided valuable insight about the design process. While the design of learning technologies is not new, issues of how users interact with the technology can sometimes become secondary to pedagogical concerns. In this chapter, we have illustrated how the field of HCI intersects with the field of instructional design and explored how to approach interface design from the perspectives of usability, UX, and UCD. Moreover, we have provided examples of iterative design techniques and evaluation methodologies that can be employed to advance usable designs. The concepts of HCI, UX, and UCD provide insight into how learning technologies are used by educators and learners. A design approach approach that balances these principles and learning theories helps ensure that digital tools are designed in a way that best supports learning.

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IV. Technology and Media

Technology and media has always been central to the field of LIDT. While many in the field have argued that technology can represent any tool, even conceptual ones, this section will discuss the more popular digital technologies. You will read about current research trends in technology integration, and frameworks for understanding what effective technology integration is. There is also a summary of the essential topic of distance education, and an older, but classic, cautionary article about how much of the research into distance education (and any new educational technology) falls into the classic "media comparison" trap that has plagued our field since the classic Clark versus Kozma debates in *Educational Technology Research and Development* and *Review of Educational Research* in the 1980s and 1990s (see this summary). A few of the many current trends are also represented in this section, with articles on open educational resources, gamified learning, data mining, learning analytics, and open badges. While reading these articles, I refer you back to Andrew Gibbons' article in the design section, where he defines the various "centrisms" he has observed in our field. While it is common for many students to begin their careers media-centric, as you develop wisdom and expertise, you should come to see technology and media as a means, instead of an end, to your instructional design goals.

United States National Educational Technology Plan
Technology Integration in Schools
K-12 Technology Frameworks
What Is Technological Pedagogical Content Knowledge?
The Learner-Centered Paradigm of Education
Distance Learning
Old Concerns with New Distance Education Research
Open Educational Resources
The Value of Serious Play
Video Games and the Future of Learning
Educational Data Mining and Learning Analytics
Opportunities and Challenges with Digital Open Badges

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30

United States National Educational Technology Plan

U.S. Office of Educational Technology

Editor's Note

The following are sections 1 and 2 from the National Educational Technology Plan, published by the Office of Educational Technology in the United States Department of Education. The full document is available at https://tech.ed.gov/netp/

The references follow each section, as they do in the original OET report.

Section 1: Engaging and Empowering Learning Through Technology

Goal: All learners will have engaging and empowering learning experiences in both formal and informal settings that prepare them to be active, creative, knowledgeable, and ethical participants in our globally connected society.

To be successful in our daily lives and in a global workforce, Americans need pathways to acquire expertise and form meaningful connections to peers and mentors. This journey begins with a base of knowledge and abilities that can be augmented and enhanced throughout our lives. Fortunately, advances in learning sciences have provided new insights into how people learn.1 Technology can be a powerful tool to reimagine learning experiences on the basis of those insights.

Historically, a learner's educational opportunities have been limited by the resources found within the walls of a school. Technology-enabled learning allows learners to tap resources and expertise anywhere in the world, starting with their own communities. For example:

- With high-speed Internet access, a student interested in learning computer science can take the course online in a school that lacks the budget or a faculty member with the appropriate skills to teach the course.
- Learners struggling with planning for college and careers can access high-quality online mentoring and advising programs where resources or geography present challenges to obtaining sufficient face-to-face mentoring.
- With mobile data collection tools and online collaboration platforms, students in a remote geographic area studying local phenomena can collaborate with peers doing similar work anywhere in the world.
- A school with connectivity but without robust science facilities can offer its students virtual chemistry, biology, anatomy, and physics labs—offering students learning experiences that approach those of peers with better resources.
- Students engaged in creative writing, music, or media production can publish their work to a broad global audience regardless of where they go to school.
- Technology-enabled learning environments allow less experienced learners to access and participate in specialized communities of practice, graduating to more complex activities and deeper participation as they gain the experience needed to become expert members of the community.2

These opportunities expand growth possibilities for all students while affording historically disadvantaged students greater equity of access to high-quality learning materials, expertise, personalized learning, and tools for planning for future education.3, 4 Such opportunities also can support increased capacity for educators to create blended learning opportunities for their students, rethinking when, where, and how students complete different components of a learning experience.

Personalized Learning

Personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) all may vary based on learner needs. In addition, learning activities are meaningful and relevant to learners, driven by their interests, and often self-initiated.

Blended Learning

In a blended learning environment, learning occurs online and in person, augmenting and supporting teacher practice. This approach often allows students to have some control over time, place, path, or pace of learning. In many blended learning models, students spend some of their face-to-face time with the teacher in a large group, some face-to-face time with a teacher or tutor in a small group, and some time learning with and from peers. Blended learning often benefits from a reconfiguration of the physical learning space to facilitate learning activities, providing a variety of technology-enabled learning zones optimized for collaboration, informal learning, and individual-focused study.

Agency in Learning

Learners with agency can “intentionally make things happen by [their] actions,” and “agency enables people to play a part in their self-development, adaptation, and self-renewal with changing times.”6 To build this capacity, learners should have the opportunity to make meaningful choices about their learning, and they need practice at doing so effectively. Learners who successfully develop this ability lay the foundation for lifelong, self-directed learning.

What People Need to Learn

To remain globally competitive and develop engaged citizens, our schools should weave 21st century competencies and expertise throughout the learning experience. These include the development of critical thinking, complex problem solving, collaboration, and adding multimedia communication into the teaching of traditional academic subjects.5 In addition, learners should have the opportunity to develop a sense of agency in their learning and the belief that they are capable of succeeding in school.

Beyond these essential core academic competencies, there is a growing body of research on the importance of non-cognitive competencies as they relate to academic success.7, 8, 9 Non-cognitive competencies include successful navigation through tasks such as forming relationships and solving everyday problems. They also include development of self-awareness, control of impulsivity, executive function, working cooperatively, and caring about oneself and others.

Building Non-cognitive Competencies: Providing Opportunities for Practice

Interacting with peers, handling conflicts, resolving disputes, or persisting through a challenging problem are all experiences that are important to academic success.

Digital games can allow students to try out varied responses and roles and gauge the outcomes without fear of negative consequences.28 Accumulating evidence suggests that virtual environments and games can help increase empathy, self-awareness, emotional regulation, social awareness, cooperation, and problem solving while decreasing the number of behavior referrals and in-school suspensions.29

Games such as Ripple Effects and The Social Express use virtual environments, storytelling, and interactive experiences to assess a student's social skill competencies and provide opportunities to practice. Other apps help bridge the gap between the virtual environment and the real world by providing just-in-time supports for emotional regulation and conflict resolution. A number of apps are available to help students name and identify how they are feeling, express their emotions, and receive targeted suggestions or strategies for self-regulation. Examples include Breathe, Think, Do with Sesame; Smiling Mind; Stop, Breathe & Think; Touch and Learn—Emotions; and Digital Problem Solver.

Fostering Growth Mindset: Technology-based Program to Fuel Student Achievement

A key part of non-cognitive development is fostering a growth mindset about learning. Growth mindset is the understanding that abilities can be developed through effort and practice and leads to increased motivation and achievement. The U.S. Department of Education has funded several growth mindset–related projects, including a grant to develop and evaluate SchoolKit, a suite of resources developed to teach growth mindset quickly and efficiently in schools.

Jill Balzer, a middle school principal in Killeen, Texas, has seen success from using SchoolKit in her school. Balzer spoke with an eighth grader who achieved academic distinction for the first time in five years after using the using the program. "When I asked him what the difference was," recalled Balzer, "he said that now he understood that even though learning was not always going to come easy to him it didn't mean he was stupid, it just meant he needed to work harder on that subject."

District of Columbia Public Schools also have made the SchoolKit available to all middle schools. Principal Dawn Clemens of Stuart-Hobson Middle School saw increases in reading scores for their seventh-grade students after using the program. "With middle-schoolers, there are always excuses," Clemens said. "But this shifts the language to be about payoff from effort, rather than 'the test was too hard' or 'the teacher doesn't like me.'"

Increased connectivity also increases the importance of teaching learners how to become responsible digital citizens. We need to guide the development of competencies to use technology in ways that are meaningful, productive, respectful, and safe. For example, helping students learn to use proper online etiquette, recognize how their personal information may be collected and used online, and leverage access to a global community to improve the world around them can help prepare them for successfully navigating life in a connected world. Mastering these skills requires a basic understanding of the technology tools and the ability to make increasingly sound judgments about the use of them in learning and daily life. For the development of digital citizenship, educators can turn to resources such as Common Sense Education's digital citizenship curriculum or the student technology standardsfrom the International Society for Technology in Education (ISTE).

Technology-enabled Learning in Action

Learning principles transcend specific technologies. However, when carefully designed and thoughtfully applied, technology has the potential to accelerate, amplify, and expand the impact of powerful principles of learning. Because the process of learning is not directly observable, the study of learning often produces models and conclusions that evolve across time. The recommendations in this plan are based on current assumptions and theories of how people learn even while education researchers, learning scientists, and educators continue to work toward a deeper understanding.

The NETP focuses on how technology can help learners unlock the power of some of the most potent learning principles discovered to date. For example, we know that technology can help learners think about an idea in more than one way and in more than one context, reflect on what is learned, and adjust understanding accordingly. Technology also can help capture learners' attention by tapping into their interests and passions. It can help us align *how* we learn with *what* we learn.

Following are five ways technology can improve and enhance learning, both in formal learning and in informal settings. Each is accompanied by examples of transformational learning in action.

1. **Technology can enable personalized learning or experiences that are more engaging and relevant.**Mindful of the learning objectives, educators might design learning experiences that allow students in a class to choose from a menu of learning experiences—writing essays, producing media, building websites, collaborating with experts across the globe in data collection—assessed via a common rubric to demonstrate their learning. Such technology-enabled learning experiences can be more engaging and relevant to learners.

Scaling Up Personalized Learning: Massachusetts' Innovation Schools Create Multiple Pathways to Learning

As part of Massachusetts' Achievement Gap Act of 2010, funding was set aside to give schools the opportunity to implement innovative strategies to improve learning. Through this legislation, educators can create Innovation Schools that can operate with increased flexibility in key areas such as schedule, curriculum, instruction, and professional development.

As of 2015, there were 54 approved Innovation Schools and Academies in 26 school districts across Massachusetts. Some schools implemented a science, technology, engineering, and mathematics (STEM) or STEM-plus-arts model, and others implemented a combination of one or more of the following educational models: multiple pathways, early college, dual-language immersion, or expanded learning time.

Students in a Safety and Public Service Academy combine rigorous college-style coursework available in a variety of formats (in class, online, blended learning, off-site for internships and job shadows) in areas such as forensics, computer science, criminal law, crisis management, psychology, and video production. Students at the Arts Academy may combine their coursework with off-site learning opportunities at local universities, combining high-tech design skills and knowledge of the creative arts to prepare them for post-secondary education and a career in the arts.

Pentucket Regional School District's program has scaled their innovation approach to every elementary school in the district. Their approach is centered on student choice and the use of opportunities for learning that extend beyond the classroom walls. Through the redesign of the school day and year, students engage in hands-on experiential learning with in-class lessons; online and blended coursework; and off-campus academic opportunities, internships, and apprenticeships.

2. **Technology can help organize learning around real-world challenges and project-based learning—using a wide variety of digital learning devices and resources to show competency with complex concepts and content.** Rather than writing a research report to be read only by her biology teacher and a small group of classmates, a student might publish her findings online where she receives feedback from researchers and other members of communities of practice around the country. In an attempt to understand the construction of persuasive arguments, another student might draft, produce, and share a public service announcement via online video streaming sites, asking his audience for constructive feedback every step of the way.

Project-based Learning

Project-based learning takes place in the context of authentic problems, continues across time, and brings in knowledge from many subjects. Project-based learning, if properly implemented and supported, helps students develop 21st century skills, including creativity, collaboration, and leadership, and engages them in complex, real-world challenges that help them meet expectations for critical thinking.

Engaged Creation: Exploratorium Creates a Massive Open Online Course (mooc) for Exploring Circuits and Electricity

In the summer of 2015, the Exploratorium in San Francisco launched its first MOOC, working with Coursera, called Tinkering Fundamentals to inspire STEM-rich tinkering; introduce a set of high-quality activities that could be replicated easily in the classroom; and foster robust discussions of the learning.

The six-week course included a blend of hands-on activities, short videos of five to eight minutes each, an active discussion forum, live Web chats, social media, and other resources. Each week the videos highlighted an introduction to a new tinkering activity, the learning goals, and tips for facilitation; step-by-step instructions for how to build and support others to build the tinkering contraption; classroom video and interviews with teachers about classroom implementation and student learning; profiles of artists; and comments by learning experts. Reflective prompts generated extensive conversation in the discussion forums.

To facilitate these online activities, the Exploratorium integrated multiple platforms, including Coursera and live video streaming tools. Instructors used these online platforms and spaces to reflect on the week's activities and forum posts and to provide real-time feedback to participants. In videoconferences, the instructors positioned themselves as questioners rather than as experts, enhancing a strong sense of camaraderie and collaborative exploration.

The Exploratorium used a social media aggregator to showcase photos and videos of participants' tinkering creations, underscoring the hands-on and material nature of the work of the MOOC. The course attracted more than 7,000 participants from 150 countries, of whom approximately 4,400 were active participants, resulting in more than 66,000 video views and 6,700 forum posts. For more information, visit the Exploratorium and Coursera on the Web.

Building Projects for Real Audiences: National Parks Service Deepens Engagement Through Technology

Journey Through Hallowed Ground is a partnership project of the National Park Service that encourages students to create rich connections to history through project-based learning, specifically making videos about their visits to historical sites. The students take the roles of writers, actors, directors, producers, costume designers, music directors, editors, and filmmakers with the support of professional video editors. The videos allow the students to speak about history in their own words as well as share their knowledge with their peers. In addition to learning about history, participating in the projects also teaches students to refine their skills of leadership and teamwork. All videos become official material of the National Park Service and are licensed openly for use by other students and teachers around the world.

3. **Technology can help learning move beyond the classroom and take advantage of learning opportunities available in museums, libraries, and other out-of-school settings.**Coordinated events such as the Global Read Aloudallow classrooms from all over the world to come together through literacy. One book is chosen, and participating classrooms have six weeks in which teachers read the book aloud to students and then connect their classrooms to other participants across the world. Although the book is the same for each student, the interpretation, thoughts, and connections are different. This setting helps support learners through the shared experience of reading and builds a perception of learners as existing within a world of readers. The shared experience of connecting globally to read can lead to deeper understanding of not only the literature but also of their peers with whom students are learning.

Upskilling Adult Learners: at Peer-to-peer University (p2pu), Everyone is a Teacher and a Learner

P2PU and the Chicago Public Library (CPL) have partnered to pilot Learning Circles—lightly facilitated study groups for adult learners taking online courses together at their local library. In spring 2015, the partnership ran a pilot program in two CPL branches, facilitating in-person study groups around a number of free, online courses. The pilot program has expanded to 10 CPL branches in fall 2015, with the ultimate goal of developing an open-source, off-the-shelf solution that can be deployed by other public libraries, allowing all libraries and their communities to harness the potential of blended learning for little to no expertise or cost.

Meeting once a week in two-hour sessions, a non-content expert librarian helps facilitate a peer-learning environment, with the goal that after six weeks the Learning Circles become self-sustainable. P2PU has designed a number of software tools and guidelines to help onboard learners and facilitators, easing administrative burdens and integrating deeper learning principles into existing online learning content. Initial results suggest that students in Learning Circles have far higher retention than do students in most online courses, participants acquire non-cognitive skills often absent from pure online learning environments, and a diverse audience is participating. By working with libraries and building in additional learning support, P2PU also is able to reach first-time online learners, many of whom do not have a post-secondary degree.

P2PU measures success in terms of both the progress of individual learners and the viability of the model. In addition to the number of branches involved, cost per user, and number of learners, attributes such as retention, returning to additional Learning Circles, advancing from the role of learner to that of facilitator, and transitioning from Learning Circles into other fields (formal education, new job) are all other factors that contribute to success. Furthermore, P2PU designs for and measures academic mindsets (community, self-efficacy, growth mindsets, relevance) as a proxy for learner success.

Helping Parents Navigate a Technological World: a Resource for Making Informed Technology Decisions

Family Time With Apps: A Guide to Using Apps With Your Kids is an interactive resource for parents seeking to select and use apps in the most effective ways with their children.33 The guide informs parents of the variety of ways that apps can support children's healthy development and family learning, communication, and connection with eight strategies. These strategies are playing games together, reading together every day, creating media projects, preparing for new experiences, connecting with distant family, exploring the outside world, making travel more fun, and creating a predictable routine. Tips on how to find the best apps to meet a child's particular needs and an explanation of how and why to use apps together also are included.

The guide references specific apps, which connect parents with the resources to select appropriate apps for their children. This online community is connected with various app stores and gives parents a menu for app selection on the basis of learning topic, age, connectivity, and device capability. Information also is included that describes exactly what other elements are attached to each app—for example, privacy settings, information collection, advertisements allowed, related apps, and so on.

The Joan Ganz Cooney Center at Sesame Workshop also recommends the Parents' Choice Award Winners as a tool for selecting child-appropriate apps. These apps, reviewed by the Parents' Choice Awards Committee within the Parents' Choice Foundation, have gone through a rigorous, multi-tiered evaluation process. The committee looks for apps that help children grow socially, intellectually, emotionally, and ethically while inspiring creativity and imagination and connecting parents and children.

4. **Technology can help learners pursue passions and personal interests.**A student who learns Spanish to read the works of Gabriel García Márquez in the original language and a student who collects data and creates visualizations of wind patterns in the San Francisco Bay in anticipation of a sailing trip are learning skills that are of unique interest to them. This ability to learn topics of personal interest teaches students to practice exploration and research that can help instill a mindset of lifelong learning.

Leveraging the Power of Networks: Cultivating Connections Between Schools and Community Institutions

Cities of LRNG helps close the opportunity gap by connecting young people with a wide range of learning opportunities throughout their cities. The program makes learning activities from hundreds of community organizations easily discoverable to youth and their families on a single online platform.

Each LRNG city has a website where partner organizations can make their offerings visible. Young people receive recommended activities on the basis of their personal passions. For example, in Chicago through the local Chicago Cities of Learning initiative, more than 120 organizations have provided a collective 4,500 engaging learning opportunities for tens of thousands of young people in all areas of the city through the platform.

As students participate in learning activities, they earn digital badges that showcase their skills and achievements. These digital badges signify mastery of a skill—for example, coding, games, design, or fashion—giving out-of-school learning greater currency by documenting and archiving learning wherever it occurs. Each time a young person earns a badge, he or she is recommended additional learning experiences and invited to broaden or deepen skills to propel him or her along academic, civic, or career trajectories. Because digital badges contain in-depth information about each individual's learning experiences, schools and potential employers can gain a comprehensive view of each person's interests and competencies.

Hive Learning Networks, a project of the Mozilla Foundation, organize and support city-based, peer-to-peer professional development networks and champion connected learning, digital skills, and Web literacy in youth-serving organizations in urban centers around the world. Using a laboratory approach and catalytic funding model, Hive re-imagines learning as interest based and empowers learners through collaboration with peer educators, youth, technology experts, and entrepreneurs.

Similar to Cities of LRNG, Hive networks are made up of community-based organizations, including libraries; museums; schools; after-school programs; and individuals, such as educators, designers, and artists. Hive participants work together to create learning opportunities for youth within and beyond the confines of traditional classroom experiences, design innovative practices and tools that leverage digital literacy skills for greater impact, and advance their own professional development.

The Hive model supports three levels of engagement:

1. **Events.**Organizations with shared learning goals unite to provide fun, engaging events, such as maker parties, as a first step toward exploring longer term collaborations.
2. **Learning Communities.**Community organizers with an interest in Hive's core principles come together in regular meet-ups and events to explore how to apply connected learning tools and practices. Learning communities are in seven cities in the United States, Canada, and India.
3. **Learning Networks.**With an operational budget and staff, Hive Learning Networks commit to promoting innovative, open-source learning models in partnership with a community's civic and cultural organizations, businesses, entrepreneurs, educators, and learners. Learning Networks are in New York, Chicago, and Pittsburgh.

For more information about Hive Learning Networks, visit Hive on the Web.

5. **Technology access when equitable can help close the digital divide and make transformative learning opportunities available to all learners.**An adult learner with limited physical access to continuing education can upskill by taking advantage of online programs to earn new certifications and can accomplish these goals regardless of location.

Building Equal Experiences: Black Girls Code (bgc) Informs and Inspires

Introducing girls of color to technology at an early age is one key to unlocking opportunities that mostly have eluded this underserved group. BGC, founded in 2001 by Kimberly Bryant, an electrical engineer, aims to "increase the number of women of color in the digital space by empowering girls of color to become innovators in STEM subjects, leaders in their communities, and builders of their own futures through exposure to computer science and technology."

Through a combination of workshops and field trips, BGC gives girls of color a chance to learn computer programming and connects them to role models in the technology space. BGC also hosts events and workshops across the country designed to help girls develop a wide range of other skills such as ideation, teamwork, and presenting while exploring social justice issues and engaging in creating solutions to those issues through technology. One example of such an event occurred at DeVry University where 100 girls between the ages of 7 and 17 learned how to build a webpage in a day. Tech industry volunteers led sessions in how to code using HTML, change the look and formatting of webpages using CCS, and design a basic Web structure. The girls developed webpages that integrated text, images, videos, and music, according to their interests and creativity. Toward the end of the day, participants presented their websites to cheering parents, volunteers, and other attendees. Between 10 and 12 similar events by BGC are held in Oakland each year.

BGC is headquartered in San Francisco, and BGC chapters are located in Chicago; Detroit; Memphis; New York; Oakland; Raleigh; and Washington, D.C., with more in development.

Creating for Accessibility: Hello Navi for the Visually Impaired

When Maggie Bolado, a teacher at Resaca Middle School in Los Fresnos, Texas, was approached about the unique challenge of helping a visually impaired student navigate the school's campus, she had not imagined the innovation that was about to happen. Bolado helped guide a group of seventh- and eighth-grade students to develop an app to navigate the school grounds called Hello Navi. Working mostly during extracurricular time, the students learned bracket coding via online tutorials that enabled them to develop the app. As they learned to program, they also were developing problem-solving skills and becoming more detail oriented.

When the app was made available for download, requests came in to tailor the app to the needs of other particular users, including one parent who wanted to know how to make it work for her two-year-old child. The students participated in a developers' forum to go through requests and questions on the app and problem-solve challenges and issues together. The students also interpreted various data sets, tracking the number of times the app was downloaded and monitoring the number of total potential users, making possible an improved next iteration of the app.

The Future of Learning Technologies

Although these examples help provide understanding of the current state of educational technologies, it is also important to note the research being done on early stage educational technology and how this research might be applied more widely in the future to learning.

As part of their work in cyberlearning, the National Science Foundation (NSF) is researching opportunities offered by integrating emerging technologies with advances in the learning sciences. Following are examples of the projects being funded by the NSF as part of this effort:

Increased use of games and simulations to give students the experience of working together on a project without leaving their classrooms. Students are involved actively in a situation that feels urgent and must decide what to measure and how to analyze data in order to solve a challenging problem. Examples include RoomQuake, in which an entire classroom becomes a scaled-down simulation of an earthquake. As speakers play the sounds of an earthquake, the students can take readings on simulated seismographs at different locations in the room, inspect an emerging fault line, and stretch twine to identify the epicenter. Another example is Robot-Assisted Language Learning in Education (RALL-E), in which students learning Mandarin converse with a robot that exhibits a range of facial expressions and gestures, coupled with language dialogue software. Such robots will allow students to engage in a social role-playing experience with a new language without the usual anxieties of speaking a new language. The RALL-E also encourages cultural awareness while encouraging good use of language skills and building student confidence through practice.

New ways to connect physical and virtual interaction with learning technologies that bridge the tangible and the abstract. For example, the In Touch With Molecules project has students manipulate a physical ball-and-stick model of a molecule such as hemoglobin, while a camera senses the model and visualizes it with related scientific phenomena, such as the energy field around the molecule. Students' tangible engagement with a physical model is connected to more abstract, conceptual models, supporting students' growth of understanding. Toward a similar goal, elementary school students sketch pictures of mathematical situations by using a pen on a tablet surface with representational tools and freehand sketching, much as they would on paper. Unlike with paper, they easily copy, move, group, and transform their pictures and representations in ways that help them to express what they are learning about mathematics. These can be shared with the teacher, and, via artificial intelligence, the computer can help the teacher see patterns in the sketches and support the teacher's using student expression as a powerful instructional resource.

Interactive three-dimensional imaging software, such as zSpace, is creating potentially transformational learning experiences. With three-dimensional glasses and a stylus, students are able to work with a wide range of images from the layers of the earth to the human heart. The zSpace program's noble failure feature allows students constructing a motor or building a battery to make mistakes and retry, learning throughout the process. Although the content and curriculum are supplied, teachers can customize and tailor lesson plans to fit the needs of their classes. This type of versatile technology allows students to work with objects schools typically would not be able to afford, providing a richer, more engaging learning experience.

Augmented reality (AR) as a new way of investigating our context and history In the Cyberlearning: Transforming Education EXP project, researchers are addressing how and for what purposes AR technologies can be used to support the learning of critical inquiry strategies and processes. The question is being explored in the context of history education and the Summarizing, Contextualizing, Inferring, Monitoring, and Corroborating (SCIM-C) framework developed for historical inquiry education. A combined hardware and software platform is being built to support SCIM-C pedagogy. Students use a mobile device with AR to augment their "field" experience at a local historical site. In addition to experiencing the site as it exists, AR technology allows students to view and experience the site from several social perspectives and to view its structure and uses across several time periods. Research focuses on the potential of AR technology in inquiry-based fieldwork for disciplines in which analysis of change across time is important to promote understanding of how very small changes across long periods of time may add up to very large changes.

E-rate: Source of Funding for Connectivity

The Schools and Libraries Universal Service Support Program, commonly known as E-rate, is a source of federal funding for Internet connectivity for U.S. schools and libraries. Created by Congress in 1996, E-rate provides schools and libraries with discounted Internet service based on need. The program was modernized in 2014 to allow schools to prioritize funding high-speed wireless connectivity in schools. For more information about E-rate, visit the website of the Federal Communications Commission (FCC).

Across these examples, we see that learning is not contained within screens or classrooms and that technology can enrich how students engage in the world around them.

To see additional examples of cyberlearning, visit The Center for Innovative Research in CyberLearning.

Bringing Equity to Learning Through Technology

Closing the Digital Use Divide

Traditionally, the digital divide in education referred to schools and communities in which access to devices and Internet connectivity were either unavailable or unaffordable. Although there is still much work to be done, great progress has been made providing connectivity and device access. The modernization of the federal E-rate program has made billions of dollars available to provide high-speed wireless access in schools across the country.

However, we have to be cognizant of a new digital divide—the disparity between students who use technology to create, design, build, explore, and collaborate and those who simply use technology to consume media passively.

On its own, access to connectivity and devices does not guarantee access to engaging educational experiences or a quality education. Without thoughtful intervention and attention to the way technology is used for learning, the digital use divide could grow even as access to technology in schools increases.

Providing Technology Accessibility for All Learners

Learning experiences enabled by technology should be accessible for all learners, including those with special needs. Supports to make learning accessible should be built into learning software and hardware by default. The approach of including accessibility features from the beginning of the development process, also known as *universal design*, is a concept well established in the field of architecture. Modern public buildings include features such as ramps, automatic doors, or braille on signs to make them accessible by everyone. In the same way, features such as text-to-speech, speech-to-text, enlarged font sizes, color contrast, dictionaries, and glossaries should be built into educational hardware and software to make learning accessible to everyone.

Three main principles drive application of universal design for learning (UDL):

1. **Provide multiple means of representation so that students can approach information in more than one way.** Examples include digital books, specialized software and websites, and screen readers that include features such as text-to-speech, changeable color contrast, alterable text size, or selection of different reading levels.
2. **Provide multiple means of expression so that all students can demonstrate and express what they know.** Examples include providing options in how they express their learning, where appropriate, which can include options such as writing, online concept mapping, or speech-to-text programs.
3. **Provide multiple means of engagement to stimulate interest in and motivation for learning.** Examples include providing options among several different learning activities or content for a particular competency or skill and providing opportunities for increased collaboration or scaffolding.

Digital learning tools can offer more flexibility and learning supports than can traditional formats. Using mobile devices, laptops, and networked systems, educators are better able to personalize and customize learning experiences to align with the needs of each student. They also can expand communication with mentors, peers, and colleagues through social media tools. Digital tools also can make it possible to modify content, such as raising or lowering the complexity level of a text or changing the presentation rate.

At a higher level of engagement, digital tools such as games, websites, and digital books can be designed to meet the needs of a range of learners, from novices to experts. Learners with little understanding might approach the experience first as a novice and then move up to an intermediate level as they gain more knowledge and skills. One example is McGill University's The Brain from Top to Bottom. The site includes options to engage with the content as a beginner, intermediate, or advanced learner and adjusts the learning activities accordingly.

To help in the selection of appropriate universally designed products and tools, the National Center on Universal Design for Learning has developed a resource linking each guideline to information about digital supports that can help a teacher put UDL into practice.

Reaching All Learners: Tools for Udl

Developed with support from the U.S. Department of Education, the tools listed here were designed to help educators implement UDL principles into classroom practice and make learning activities more accessible:

- Nimble Assessment Systems developed Nimble Tools, to deliver standard versions of assessment instruments that are tailored with embedded accommodation tools to meet the specific needs of students with disabilities. Some examples of the accommodation tools include a keyboard with custom keyboard overlays, the capacity of the system to read text aloud for students, an on-screen avatar presenting questions in American Sign Language (ASL) or Signed English, and the magnification of text and images for students with visual impairments.
- The Information Research Corporation developed eTouchSciences, an integrated software and hardware assistive technology platform to support STEM learning among middle school students with (or without) visual impairments. The product includes a haptic sensing controller device to provide real-time tactile, visual, and audio feedback. See video.
- Filament Games developed the Game-enhanced Interactive Life Sciencesuite of learning games to introduce middle school students to key scientific concepts and practices in the life sciences. These games, aligned to UDL, provide students with multiple means of representation, expression, and engagement and provide assistive features such as in-game glossaries and optional voice-over for all in-game text. See video.
- Institute for Disabilities Research and Training developed the myASL Quizmakerto provide Web-based assessments for deaf or hard of hearing students who use ASL. This product provides automatic ASL graphic and video translations for students; enables teachers to create customized tests, exams, and quizzes that are scored automatically; and provides teacher reports with grades and corrected quizzes. See video.

Design in Practice: Indiana School District Adopts Udl for All Instruction for All Students

Bartholomew Consolidated School Corporation is a public school district in Columbus, Indiana, serving approximately 12,000 students. The student population consists of 13 percent in special education, 50 percent receive free or reduced-price lunch, and more than 54 languages are spoken. UDL has been helpful as a decision-making tool in the deployment of technologies such as computers and other networked devices. The UDL guidelines help educators determine what strategies, accessible technologies, and teaching methods will enable all students to achieve lesson goals.

In one instance, a social studies teacher held an online discussion during a presidential debate. Realizing that some students were not taking part in class discussions, the teacher used technology to provide multiple means of representation, expression, and engagement. Some students who were reluctant to speak up in a face-to-face setting felt safe to do so online, becoming engaged participants in the class discussion.

Since they adopted a universal design approach, graduation rates increased by 8 percent for general education students and 22 percent for special education students. Also, the number of students taking and passing Advanced Placement tests has increased.

Physical Spaces and Technology-enabled Learning

Blended learning and other models of learning enabled by technology require educators to rethink how they organize physical spaces to facilitate best collaborative learning using digital tools. Considerations include the following:

- Are the design and layout of the physical space dynamic and flexible enough to facilitate the technology-enabled learning models and practices selected? Can a space in which an educator delivers whole-class instruction also be shifted to facilitate individual online practice and research?
- Do the physical spaces align in their ability to facilitate individual and collaborative work? When practices such as project-based learning require students to be working together with multiple devices for research and presentation building, is the space as useful as when individual learners need time and space to connect with information and experts online for personalized learning?
- Can the physical spaces and tools be shaped to provide multiple contexts and learning experiences such as Wi-Fi access for outdoor classrooms? Are library spaces able to become laboratories? Can a space used as a history lecture hall for one class become a maker space for engineering the next period?

For more information and tools for aligning physical spaces, visit the Centre for Effective Learning Environments and the Clayton Christensen Institute's Blended Learning Universe.

Innovation From the Ground Up: Denver School for Science and Technology (dsst) Uses Space to Promote Student Achievement

The DSST is an innovative high school located in Stapleton, Colorado, a redeveloped neighborhood near downtown Denver. Behind the bright colors and unique geometry of spaces at DSST lies a relationship to the way academic subjects are taught and community is formed at the high school. The school is designed to be flexible and aims to support student achievement through the design of its physical spaces.

The school features a series of gathering spaces that can be used for various academic and social purposes throughout the day. The largest of the gathering areas, near the school's entrance, is where the school's daily morning meeting for both students and faculty is held. Student and faculty announcements, skits, and other community functions are all encouraged in this communal setting.

Each of the three academic pods also includes informal spaces for gathering, studying, and socializing. These academic clusters are linked by a galleria, or large open hallway, that is lined with skylights and also serves as a gathering place for students and faculty members.

DSST has demonstrated results in the academic achievement of its students and in its attendance record. In 2005, the school's founding Grade 9 class was the highest scoring Grade 9 class in Denver in mathematics and the second highest scoring class in reading and writing. DSST was also the only Denver high school to earn a significant growth rating on the Colorado Student Assessment Program test scores from one year to the next. Student attendance at the school is typically about 96 percent.

Recommendations

States, districts, and post-secondary institutions should develop and implement learning resources that embody the flexibility and power of technology to create equitable and accessible learning ecosystems that make learning possible everywhere and all the time for all students. Whether creating learning resources internally, drawing on

collaborative networks, or using traditional procurement procedures, institutions should insist on the use of resources and the design of learning experiences that use UD practices to ensure accessibility and increased equity of learning opportunities.

States, districts, and post-secondary institutions should develop and implement learning resources that use technology to embody design principles from the learning sciences. Educational systems have access to cutting-edge learning sciences research. To make better use of the existing body of research literature, however, educators and researchers will need to work together to determine the most useful dissemination methods for easy incorporation and synthesis of research findings into teachers' instructional practices.

States, districts, and post-secondary institutions should take inventory of and align all learning technology resources to intended educational outcomes. Using this inventory, they should document all possible learner pathways to expertise, such as combinations of formal and informal learning, blended learning, and distance learning. Without thoughtful accounting of the available tools and resources within formal and informal learning spaces within a community, matching learners to high-quality pathways to expertise is left to chance. Such an undertaking will require increased capacity within organizations that have never considered such a mapping of educational pathways. To aid in these efforts, networks such as LRNG, the Hive Learning Networks, and education innovation clusters can serve as models for cross-stakeholder collaboration in the interest of best using existing resources to present learners with pathways to learning and expertise.

Education stakeholders should develop a born accessible standard of learning resource design to help educators select and evaluate learning resources for accessibility and equity of learning experience. Born accessible is a play on the term born digital and is used to convey the idea that materials that are born digital also can and should be born accessible. If producers adopt current industry standards for producing educational materials, materials will be accessible out of the box. Using the principles and research-base of UD and UDL, this standard would serve as a commonly accepted framework and language around design for accessibility and offer guidance to vendors and third-party technology developers in interactions with states, districts, and institutions of higher education.

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Section 2: Teaching With Technology

Goal: Educators will be supported by technology that connects them to people, data, content, resources, expertise, and learning experiences that can empower and inspire them to provide more effective teaching for all learners.

Technology offers the opportunity for teachers to become more collaborative and extend learning beyond the classroom. Educators can create learning communities composed of students; fellow educators in schools, museums, libraries, and after-school programs; experts in various disciplines around the world; members of community organizations; and families. This enhanced collaboration, enabled by technology offers access to instructional materials as well as the resources and tools to create, manage, and assess their quality and usefulness.

To enact this vision, schools need to support teachers in accessing needed technology and in learning how to use it effectively. Although research indicates that teachers have the biggest impact on student learning out of all other school-level factors, we cannot expect individual educators to assume full responsibility for bringing technology-based learning experiences into schools. They need continuous, just-in-time support that includes professional development, mentors, and informal collaborations. In fact, more than two thirds of teachers say they would like more technology in their classrooms, and roughly half say that lack of training is one of the biggest barriers to incorporating technology into their teaching.

Institutions responsible for pre-service and in-service professional development for educators should focus explicitly on ensuring all educators are capable of selecting, evaluating, and using appropriate technologies and resources to create experiences that advance student engagement and learning. They also should pay special care to make certain that educators understand the privacy and security concerns associated with technology. This goal cannot be achieved without incorporating technology-based learning into the programs themselves.

For many teacher preparation institutions, state offices of education, and school districts, the transition to technology-enabled preparation and professional development will entail rethinking instructional approaches and techniques, tools, and the skills and expertise of educators who teach in these programs. This rethinking should be based on a deep understanding of the roles and practices of educators in environments in which learning is supported by technology.

Roles and Practices of Educators in Technology-supported Learning

Technology can empower educators to become co-learners with their students by building new experiences for deeper exploration of content. This enhanced learning experience embodies John Dewey's notion of creating "more mature learners." Side-by-side, students and teachers can become engineers of collaboration, designers of learning experiences, leaders, guides, and catalysts of change. Following are some descriptions of these educator roles and examples of how technology can play an integral part.

Authentic Learning

Authentic learning experiences are those that place learners in the context of real-world experiences and challenges.

Educators can collaborate far beyond the walls of their schools. Through technology, educators are no longer restricted to collaborating only with other educators in their schools. They now can connect with other educators and experts across their communities or around the world to expand their perspectives and create opportunities for student learning. They can connect with community organizations specializing in real-world concerns to design learning experiences that allow students to explore local needs and priorities. All of these elements make classroom learning more relevant and authentic.

In addition, by using tools such as videoconferencing, online chats, and social media sites, educators, from large urban to small rural districts, can connect and collaborate with experts and peers from around the world to form online professional learning communities.

Building Communities for Educators: International Education and Resource Network (iearn) Fosters Global Collaborative Teaching and Learning

Through technology, educators can create global communities of practice that enable their students to collaborate with students around the world. Technology enables collaborative teaching regardless of geographic location, as demonstrated by the global nature of the Solar Cooking Project organized by earth and environmental science teacher Kathy Bosiak.

Bosiak teaches at Lincolnton High School in Lincolnton, North Carolina, and is a contributing educator for iEARN, a nonprofit organization made up of more than 30,000 schools and youth organizations in more than 140 countries. iEARN offers technology-enabled resources that enable teachers and students around the world to collaborate on educational projects, all designed and facilitated by teachers and students to fit their curriculum, classroom needs, and schedules.

In addition to its student programs, iEARN offers professional face-to-face workshops for teachers that combine technology and continued engagement through virtual networks and online professional learning opportunities. The workshops focus on the skills needed to engage in Internet-based collaborative learning projects, including peer review, team building, joining regional and international learning communities, and developing project-based curricula that integrate national education standards.

Educators can design highly engaging and relevant learning experiences through technology. Educators have nearly limitless opportunities to select and apply technology in ways that connect with the interests of their students and achieve their learning goals. For example, a classroom teacher beginning a new unit on fractions might choose to have his students play a learning game such as Factor Samurai, Wuzzit Trouble, or Sushi Monster as a way to introduce the concept. Later, the teacher might direct students to practice the concept by using manipulatives so they can start to develop some grounded ideas about equivalence.

To create an engaging and relevant lesson that requires students to use content knowledge and critical thinking skills, an educator might ask students to solve a community problem by using technology. Students may create an online community forum, public presentation, or call to action related to their proposed solution. They can use social networking platforms to gather information and suggestions of resources from their contacts. Students can draft and present their work by using animated presentation software or through multimedia formats such as videos and blogs. This work can be shared in virtual discussions with content experts and stored in online learning portfolios.

A school without access to science labs or equipment can use virtual simulations to offer learners those experiences that are currently unavailable because of limited resources. In addition, these simulations are safe places for students to learn and practice effective processes before they conduct research in the field. Just as technology can enhance science learning for schools lacking equipment, it can enable deep learning once students are in the field as well. Students can collect data for their own use via mobile devices and probes and sync their findings with those of collaborators and researchers anywhere in the world to create large, authentic data sets for study.

Educators can lead the evaluation and implementations of new technologies for learning. Lower price points for learning technologies make it easier for educators to pilot new technologies and approaches before attempting a school-wide adoption. These educators also can lead and model practices around evaluating new tools for privacy and security risks, as well as compliance with federal privacy regulations. (For more on these regulations, see Section 5: Infrastructure). Teacher-leaders with a broad understanding of their own educational technology needs, as well as those of students and colleagues, can design short pilot studies that impact a small number of students to ensure the chosen technology and the implementation approach have the desired outcomes. This allows schools to gain experience with and confidence in these technologies before committing entire schools or districts to purchases and use.

Teacher-leaders and those with experience supporting learning with technology can work with administrators to determine how to share their learning with other teachers. They also can provide support to their peers by answering questions and modeling practical uses of technology to support learning.

Evaluating Technology Through Rapid-cycle Technology Evaluations

As schools continue to invest heavily in education technology, there is a pressing need to generate evidence about the effectiveness of these investments and also to develop evaluation tools that developers and practitioners can use to conduct their own evaluations that take less time and incur lower costs than do traditional evaluations. The U.S. Department of Education is funding a rapid cycle technology evaluation project that will design research approaches for evaluating apps, platforms, and tools; conduct pilots and disseminate the resulting short reports; and create an interactive guide and implementation support tools for conducting rapid cycle technology evaluations to be used by schools, districts, developers, and researchers.

Rapid cycle technology evaluations will help provide results in a timely manner so that evidence of effectiveness is available to school and district leaders when they need to make purchasing decisions.

Teach to Lead: Developing Teachers as Leaders

Teach to Lead, a joint program of the National Board for Professional Teaching Standards, ASCD, and the U.S. Department of Education, aims to advance student outcomes by expanding opportunities for teacher leadership, particularly opportunities that allow teachers to stay in the classroom. With the help of supporting organizations, Teach to Lead provides a platform for teacher-leaders and allies across the country (and around the world) to create and expand on their ideas.

Teach to Lead participants are invested personally in the development of their teacher leadership action plans because the ideas are their own. Participants identify a current problem within their school, district, or community and develop a theory of action to solve that problem. Since its inception in March 2014, Teach to Lead has engaged more than 3,000 educators, in person and virtually through its online platform, with more than 850 teacher leadership ideas spanning 38 states. Teach to Lead regional Teacher Leadership Summits brought together teams of teacher-leaders and supporting

organizations to strengthen their teacher leadership ideas, share resources, and develop the skills necessary to make their projects a reality.

Marcia Hudson and Serena Stock, teacher-leaders at Avondale Elementary School in Michigan, identified a need for teacher-led professional development at their school and created a module for teachers to collect and analyze student outcome data to drive new professional development opportunities. The teachers now are holding engagement meetings with teacher-leaders to develop and fund professional development and data collection further.

Chris Todd teaches at Windsor High School in Connecticut and is a Teacher-Leader-in-Residence for the Connecticut State Department of Education. Chris's team is developing the Connecticut Educator Network, a database of teacher-leaders who are readily available to advise on policy development. The group intends to provide training and policy briefings to continue to hone the teachers' leadership skills.

Educators can be guides, facilitators, and motivators of learners. The information available to educators through high-speed Internet means teachers do not have to be content experts across all possible subjects. By understanding how to help students access online information, engage in simulations of real-world events, and use technology to document their world, educators can help their students examine problems and think deeply about their learning. Using digital tools, they can help students create spaces to experiment, iterate, and take intellectual risks with all of the information they need at their fingertips. Teachers also can take advantage of these spaces for themselves as they navigate new understandings of teaching that move beyond a focus on what they teach to a much broader menu of how students can learn and show what they know.

Educators can help students make connections across subject areas and decide on the best tools for collecting and showcasing learning through activities such as contributing to online forums, producing webinars, or publishing their findings to relevant websites. These teachers can advise students on how to build an online learning portfolio to demonstrate their learning progression. Within these portfolios, students can catalog resources that they can review and share as they move into deeper and more complex thinking about a particular issue. With such portfolios, learners will be able to transition through their education careers with robust examples of their learning histories as well as evidence of what they know and are able to do. These become compelling records of achievement as they apply for entrance into career and technical education institutions, community colleges, and four-year colleges and universities or for employment.

Deepening Student Understanding: Using Interactive Video to Improve Learning

Reflective teachers can search for new ways for their students to engage with technology effectively, especially when students are not optimizing their learning experiences. Every year at Crocker Middle School, Ryan Carroll would ask his sixth-grade world history students to watch a variety of online videos for homework. He found that no matter how entertaining or interesting the videos were, his students were not retaining much of the information being presented, and often they were confused about key concepts. After learning about Zaption, a teaching tool funded by the U.S. Department of Education, Carroll realized his students could get more out of the videos he assigned. Using Zaption's interactive video platform, he added images, text, drawings, and questions to clarify tricky concepts and check for understanding as students watched the video.

Zaption's analytics allow educators to review individual student responses and class-wide engagement data quickly, giving greater insight on how students are mastering key concepts as they watch and enabling teachers to address misconceptions quickly.

Educators can be co-learners with students and peers. The availability of technology-based learning tools gives educators a chance be co-learners alongside their students and peers. Although educators should not be expected to know everything there is to know in their disciplines, they should be expected to model how to leverage available tools

to engage content with curiosity and a mindset bent on problem solving and how to be co-creators of knowledge. In short, teachers should be the students they hope to inspire in their classrooms.

Co-learning in the Classroom: Teacher User Groups Provide Peer Learning for Adult Education Educators

Recognizing the power of virtual peer learning, the U.S. Department of Education's Office of Career, Technical, and Adult Education has funded projects that have established teacher user groups to explore the introduction of openly licensed educational resources into adult education. This model of professional development recognizes that virtual peer learning can support teachers to change their practice and provide leadership and growth opportunities. The small groups of far-flung teachers work with a group moderator to identify, use, and review openly licensed resources in mathematics, science, and English language arts.

Reviews referenced the embedded evaluation criteria in OER Commons, a repository of open educational resources (OER) that can be used or reused freely at no cost and that align to the College- and Career-Readiness mathematics and language arts and Next Generation Science Standards. They also included practice tips for teaching the content to adult learners. The reviews are posted on OER Commons and tagged as *Adult Basic Education* or *Adult English for Speakers of Other Languages* to facilitate the discovery by other teachers of these high-quality, standards-aligned teaching and learning materials.

Learning Out Loud Online: Jennie Magiera, District Chief Technology Officer and Classroom Teacher

Planning a lesson on how elevation and other environmental influences affect the boiling point of water, Jennie Magiera realized that many of the students in her fourth-grade class in Cook County, Illinois, had never seen a mountain. So Magiera reached out to her network of fellow educators through social media to find a teacher in a mountainous area of the country interested in working with her on the lesson.

Soon, Magiera and a teacher in Denver were collaborating on a lesson plan. Using tablets and online videoconferencing, the students in Denver showed Magiera's students the mountains that they could see outside of their classrooms every day. After a discussion of elevation, the two teachers engaged their students in a competition to see which class could boil water faster. By interacting with students in the other class, Magiera's students became engaged more deeply in the project, which led them to develop a richer understanding of ecosystems and environments than they might have otherwise.

Educators can become catalysts to serve the underserved. Technology provides a new opportunity for traditionally underserved populations to have equitable access to high-quality educational experiences. When connectivity and access are uneven, the digital divide in education is widened, undermining the positive aspects of learning with technology.

All students deserve equal access to (1) the Internet, high-quality content, and devices when they need them and (2) educators skilled at teaching in a technology-enabled learning environment. When this occurs, it increases the likelihood that learners have personalized learning experiences, choice in tools and activities, and access to adaptive assessments that identify their individual abilities, needs, and interests.

Connected Educators: Exemplars

Technology can transform learning when used by teachers who know how to create engaging and effective learning experiences for their students. In 2014, a group of educators collaborated on a report entitled, Teaching in the Connected Learning Classroom. Not a how-to guide or a set of discrete tools, it draws together narratives from a group of educators within the National Writing Project who are working to implement and refine practices around technology-

enabled learning. The goal was to rethink, iterate on, and assess how education can be made more relevant to today's youth.

Producing Student Films With Online Audiences: Katie Mckay: Lights, Camera, Social Action!

In Katie McKay's diverse, fourth-grade transitional bilingual class, encouraging her students to work together on a project helped them build literacy skills while simultaneously giving them the opportunity to pursue culturally relevant questions related to equity.

McKay recognized that her students were searching for the language to talk about complicated issues of race, gender, power, and equity. To address the competing priorities of preparing her students for the state test and providing them with authentic opportunities to develop as readers and writers, McKay started a project-based unit on the history of discrimination in the United States.

Students worked in heterogeneously mixed groups to develop comic strips that eventually were turned into two videos, one showing micro-aggressions students commonly see today and one about the history of discrimination in the United States. The movie on micro-aggressions portrayed current scenarios that included characters who acted as agents of change, bravely and respectfully defending the rights of others.

According to McKay, students who previously were disengaged found themselves drawn into the classroom community in meaningful and engaging ways. While reflecting on this unit, McKay wrote:

> *We were not only working to promote tolerance and appreciation for diversity in our community. We also were resisting an oppressive educational context. In the midst of the pressure to perform on tests that were isolating and divisive, we united in collaborative work that required critical thinking and troubleshooting. In a climate that valued silence, antiquated skills, and high-stakes testing, we engaged in peer-connected learning that highlighted 21st century skills and made an impact on our community.*

Just-in-time Learning: Janelle Bence: How Do I Teach What I Do Not Know?

Texas teacher Janelle Bence was looking for new ways to engage and challenge her students, the majority of whom are English language learners from low-income families. After observing her students' motivation to persist through game challenges, she wondered if games held a key to getting them similarly engaged in classwork. After attending a session on gaming at a National Writing Project Annual Meeting, Bence was inspired to incorporate gaming into her classroom. She did not know anything about gaming and so, as is the case for many teachers seeking to bridge the gap between students' social interests and academic subjects, she had to figure out how to teach what she did not know.

Bence started by reading a book about using video games to teach literacy. As she read, she shared her ideas and questions on her blog and talked to other educators, game designers, and systems thinkers. Through these collaborations, she decided that by creating games, her students would be required to become informed experts in the content of the game as well as to become powerful storytellers.

As she explored games as a way to make academic tasks more engaging and accessible for her students, Bence found it was important to take advantage of professional learning and peer networks, take risks by moving from a passive consumer of knowledge to actually trying the tasks that she planned to use with students, and put herself in her students' shoes.

Bence shared that "finding a way to connect to students and their passions—by investigating what makes them tick and bridging [those passions] to academic tasks—educators are modeling risks that encourage the same behavior in their learners."

Building Student Agency: Jason Sellers: Text-based Video Games

Aware of the popularity of video games among his students, and as a longtime fan of video games himself, teacher Jason Sellers decided to use gaming to develop his 10th-grade students' ability to use descriptive imagery in their writing. Specifically, Sellers introduced his students to text-based video games. Unlike graphics-based games in which users can view graphics and maneuver through the game by using controller buttons, text-based games require players to read descriptions and maneuver by typing commands such as go north or unlock the door with a key. Sellers decided his students could practice using descriptive imagery by developing their own text-based games.

Using tutorials and other resources found on Playfic, an interactive fiction online community, Sellers created lessons that allowed students to play and eventually create interactive fiction games. Prior to the creation of the games, Sellers's class analyzed several essays that skillfully used descriptive imagery, such as David Foster Wallace's *A Ticket to the Fair*, and composed short pieces of descriptive writing about their favorite locations in San Francisco.

Students then transferred their newly honed descriptive storytelling skills to the development of an entertaining text-based game. Because Sellers's students wanted to develop games their peers would want to play, they focused on ways to make their games more appealing, including, as Sellers described, "using familiar settings (local or popular culture), familiar characters (fellow students or popular culture), and tricky puzzles."

According to Sellers, this project allowed students to work through problems collaboratively with peers from their classroom and the Playfic online community and motivated them to move beyond basic requirements to create projects worthy of entering competitions.

Rethinking Teacher Preparation

Teachers need to leave their teacher preparation programs with a solid understanding of how to use technology to support learning. Effective use of technology is not an optional add-on or a skill that we simply can expect teachers to pick up once they get into the classroom. Teachers need to know how to use technology to realize each state's learning standards from day one. Most states have adopted and are implementing college- and career-ready standards to ensure that their students graduate high school with the knowledge and skills necessary to succeed.

For states that have voluntarily adopted the Common Core State Standards, there are more than 100 direct mentions of technology expectations, and similar expectations exist in states adopting other college- and career-ready standards. Many federal, state, and district leaders have made significant investments in providing infrastructure and devices to schools. Without a well-prepared and empowered teaching force, our country will not experience the full benefits of those investments for transformative learning.

Schools should be able to rely on teacher preparation programs to ensure that new teachers come to them prepared to use technology in meaningful ways. No new teacher exiting a preparation program should require remediation by his or her hiring school or district. Instead, every new teacher should be prepared to model how to select and use the most appropriate apps and tools to support learning and evaluate these tools against basic privacy and security standards. It is inaccurate to assume that because pre-service teachers are tech savvy in their personal lives they will understand how to use technology effectively to support learning without specific training and practice. This expertise does not come through the completion of one educational technology course separate from other methods courses but through the inclusion of experiences with educational technology in all courses modeled by the faculty in teacher preparation programs.

Aligning Education With Technology Standards: University of Michigan

Pre-service teachers at the University of Michigan School of Education are experiencing the kind of learning with technology their students will one day know. The curriculum addresses each of the five ISTE Standards for Teachers21 and aligns with skills from the Partnership for 21st Century Skills. Each standard also has related course projects

designed for teacher candidates to use technology actively to demonstrate their understanding of the material through practice and feedback. For example, teacher candidates are asked to design and teach a 20-minute webinar for fourth graders that is based on Next Generation Science Standards and to design and teach a lesson that uses technology and meets the needs of their learners as part of their student teaching placement.

Preparing to Teach in Technology-enabled Environments: Saint Leo University

A 2006 survey of Saint Leo University teacher preparation program alumni showed satisfaction with their preparation with one notable exception—technology in the classroom. As a result, the education department established a long-term goal of making technology innovation a keystone of its program. Saint Leo faculty redesigned their program on the basis of the Technological Pedagogical and Content Knowledge model, in which pre-service teachers learned to blend content, pedagogical, and technological knowledge in their PK–12 instruction.

Faculty developed their expertise with different technologies so that every course models the use of technology to support teaching and learning. The school built an education technology lab where teacher candidates can practice using devices, apps, and other digital learning resources. Students regularly reflect on their experience using technology to increase effectiveness and efficiency as well as its value in the learning process.

Perhaps most notably, Saint Leo ensures all pre-service teachers have basic technologies available at their student teaching placements. Each pre-service teacher is given a digital backpack with a tablet, portable projector, speakers, and a portable interactive whiteboard. A student response system is also available for pre-service teachers to use in their field placements.

Advancing Knowledge and Practice of Assistive Technologies for New Teachers: Illinois State University

Illinois State University's Department of Special Education is one of the largest special education training programs in the nation. Recognizing the value of assistive technology in meeting the needs of each student, the special education teacher preparation program at the University includes an extensive emphasis on selection and use of assistive technologies.

Classroom learning is brought to life through ongoing clinical and field-based experiences in schools and at the university's Special Education Assistive Technology Center. The center provides hands-on experiences to pre-service teachers enrolled in the special education programs at Illinois as well as opportunities for teachers, school administrators, family members, and businesses to learn about assistive technologies. Furthermore, faculty work in partnership with a variety of public, private, and residential schools to enhance student field experiences and provide opportunities for students to work with learners with a range of disabilities and in a variety of settings, including rural, urban, and suburban areas.

Building Digital Literacy in Teaching: University of Rhode Island (uri)

A critical aspect of ensuring that young Americans learn appropriate digital literacy skills is equipping educators at all levels with the same skills. To that end, URI offers a graduate certificate in digital literacy for graduate students, classroom teachers, librarians, and college faculty. By targeting a broad audience to participate in the program, URI is expanding the number of educators with the professional capacity to help students to learn, access, analyze, create, reflect, and take action using digital tools, texts, and technologies in all aspects of their lives.

During the program, students are introduced to key theories of digital literacy in inquiry-driven learning and given time to experiment with and explore a wide range of digital texts, tools, and technologies. In collaboration with a partner, they create a project-based instructional unit that enables them to demonstrate their digital skills in the context of an authentic learning situation. Throughout the program, students participate in hands-on, minds-on learning experiences;

participants build a deeper understanding of digital literacy while developing practical skills and have time to reflect on the implications of the digital shift in education, leisure, citizenship, and society.

In its evaluation of the program, URI has found that participants experienced a dramatic increase in digital skills associated with implementing project-based learning with digital media and technology. Their understanding of digital literacy also shifted to focus more on inquiry, collaboration, and creativity.

Fostering Ongoing Professional Learning

The same imperatives for teacher preparation apply to ongoing professional learning. Professional learning and development programs should transition to support and develop educators' identities as fluent users of technology; creative and collaborative problem solvers; and adaptive, socially aware experts throughout their careers. Programs also should address challenges when it comes to using technology learning: ongoing professional development should be job embedded and available just in time.

Increasing Online Professional Learning: Connected Educator Month Builds Collaboration Across the Country

Connected Educator Month, part of the U.S. Department of Education's Connected Educators project, began with a monthlong online conference that included a centralized guiding structure, kickoff and closing events, engagement resources, and an open calendar to which organizations of all types could submit professional learning events and activities. Educators used these resources and the calendar to create their own professional development plan for the month. Available activities included webinars, Twitter chats, forum discussions, and actively moderated blog discussions based on personal learning needs and interests.

In the first year, more than 170 organizations provided more than 450 events and activities, with educators completing an estimated 90,000 hours of professional learning across the month. More than 4 million people followed the #ce12 hashtag on Twitter, generating 1.4 million impressions per day.

Now led by partner organizations from the original Connected Educators project—American Institutes for Research (AIR), Grunwald Associates LLC, and Powerful Learning Practice—Connected Educator Month features more than 800 organizations and has provided more than 1,000 events and activities. Australia, New Zealand, and Norway hosted their own iterations of Connected Educator Month, and educators in more than 125 countries participated in some way.

Putting Learning in Teachers' Hands: Denver Public Schools Personalizes Professional Development

In 2014, 80 teachers from 45 schools engaged in the pilot year of Project Cam Opener, an initiative of the Personalized Professional Learning team in Denver Public Schools. Now in its second year with 425 teachers and leaders, Project Cam Opener allows educators to record their teaching with customized video toolkits and share those videos for self-reflection and feedback within an online community of practice.

In the program's pilot year, the first 80 teachers recorded hundreds of videos using tools such as Swivls, iPads, high-definition webcams, and microphones. The videos were uploaded to private YouTube channels and shared via a Google+ community for feedback. For many of these teachers, it was the first time that they had seen the teaching practices of other teachers in their district. The videos sparked daily conversations and sharing of ideas.

Three measures are used to determine the effectiveness of Project Cam Opener: engagement, retention, and observation. In the first end-of-year survey, 90 percent of respondents said that taking part in Project Cam Opener made them more engaged in their own professional learning and growth. In addition, not a single teacher from the pilot group left Denver Public Schools after their year with Project Cam Opener (the overall district rate of turnover is 20 percent). Although teacher observation scores are harder to attribute to this project specifically, the growth of this cohort of

teachers outpaced that of their non–Project Cam Opener counterparts, according to the district's Framework for Effective Teaching.

Micro-credentialing Teacher Learning: Kettle Moraine Introduces Teacher-led Professional Learning

Kettle Moraine School District in Wisconsin is creating a professional learning environment in which practicing teachers can be the masters and architects of their own learning. Using the Digital Promise educator micro-credentialing framework as a guide (for more information on Digital Promise's micro-credentialing work, see Section 4: Leadership), teachers in the district take a technology proficiency self-assessment, which they use as a baseline for their personal professional growth. The teachers then work by themselves and in collaborative teams to develop specific professional learning goals aligned to district strategic goals, which they submit to district leadership for approval.

Once these goals are approved, the teachers establish measurable benchmarks against which they can assess their progress. Both the goals and benchmarks are mapped to specific competencies, which, in turn, are tied to micro-credentials that can be earned once teachers have demonstrated mastery. Demonstrations of mastery include specific samples of their work, personal reflections, classroom artifacts, and student work and reflections, which are submitted via Google Forms to a committee of 7 to 10 teachers who review them and award micro-credentials.

Currently, 49 staff members are working to earn a micro-credential for personalized learning, which requires them to conduct their own background research and engage in regularly scheduled Twitter chats as well as blogging, networking, and other forms of self-guided learning using technology. Many also have begun to engage with teachers across the country, allowing them to give and receive ideas, resources, and support.

Embracing the Unconference: Going to Edcamp

An educator attending an Edcamp event engages in a professional learning experience vastly different from traditional professional development. Sessions are built on the interests and needs of the people who attend and are created on the day by using a cloud-based collaborative application that is open to all (including those unable to participate in person). Each teacher chooses which sessions to attend on the basis of individual interests or needs.

Because using technology in learning effectively is one of the challenges facing teachers, sessions frequently are organized around sharing practices and overcoming common challenges when improving practices around the use of technology. Teachers collaborate to overcome challenges together, often making connections that lead beyond the single session or day, as partnerships are formed to engage their students with each other. The shared documents created at these events become an archive and resource for whoever attended, in person or virtually.

The first Edcamp was organized in Philadelphia by a group of local educators interested in new unconference (self-organizing) approaches to a conference for professional learning. The model took off, and five years later there have been more than 750 Edcamps all organized by local educators. The enormous popularity of the format has led to the formation of the Edcamp Foundation, a nonprofit organization that will formalize much of the ad hoc support that has been provided to Edcamp organizers until now.

Recommendations

Provide pre-service and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling learning activities that improve learning and teaching, assessment, and instructional practices. To make this goal a reality, teacher preparation programs, school systems, state and local policymakers, and educators should come together in the interest of designing pre- and in-service professional learning opportunities that are aligned specifically with technology expectations outlined within state standards and that are reflective of the increased connectivity of and access to devices in schools. Technology

should not be separate from content area learning but used to transform and expand pre- and in-service learning as an integral part of teacher learning.

Use technology to provide all learners with online access to effective teaching and better learning opportunities with options in places where they are not otherwise available. This goal will require leveraging partner organizations and building institutional and teacher capacity to take advantage of free and openly licensed educational content such as that indexed on LearningRegistry.org. Adequate connectivity will increase equitable access to resources, instruction, expertise, and learning pathways regardless of learners' geography, socio-economic status, or other factors that historically may have put them at an educational disadvantage.

Develop a teaching force skilled in online and blended instruction. Our education system continues to see a marked increase in online learning opportunities and blended learning models in traditional schools. To meet the need this represents better, institutions of higher education, school districts, classroom educators, and researchers need to come together to ensure practitioners have access to current information regarding research-supported practices and an understanding of the best use of emerging online technologies to support learning in online and blended spaces.

Develop a common set of technology competency expectations for university professors and candidates exiting teacher preparation programs for teaching in technologically enabled schools and post-secondary education institutions. There should be no uncertainty of whether a learner entering a PK–12 classroom or college lecture hall will encounter a teacher or instructor fully capable of taking advantage of technology to transform learning. Accrediting institutions, advocacy organizations, state policymakers, administrators, and educators have to collaborate on a set of clear and common expectations and credentialing regarding educators' abilities to design and implement technology-enabled learning environments effectively.

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31

Technology Integration in Schools

Randall S. Davies & Richard E. West

Editor's Note

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Abstract

It is commonly believed that learning is enhanced through the use of technology and that students need to develop technology skills in order to be productive members of society. For this reason, providing a high-quality education includes the expectation that teachers use educational technologies effectively in their classroom and that they teach their students to use technology. In this chapter, we have organized our review of technology integration research around a framework based on three areas of focus: (1) increasing access to educational technologies, (2) increasing the use of technology for instructional purposes, and (3) improving the effectiveness of technology use to facilitate learning. Within these categories, we describe findings related to one-to-one computing initiatives, integration of open educational resources, various methods of teacher professional development, ethical issues affecting technology use, emerging approaches to technology integration that emphasize pedagogical perspectives and personalized instruction, technology-enabled assessment practices, and the need for systemic educational change to fully realize technology's potential for improving learning. From our analysis of the scholarship in this area, we conclude that the primary benefit of current technology use in education has been to increase information access and communication. Students primarily use technology to gather, organize, analyze, and report information, but this has not dramatically improved student performance on standardized tests. These findings lead to the conclusion that future efforts should focus on providing students and teachers with increased access to technology along with training in pedagogically sound best practices, including more advanced approaches for technology-based assessment and adaptive instruction.

Introduction

The Elementary and Secondary Education Act of 2001 mandated an emphasis on technology integration in all areas of K–12 education, from reading and mathematics to science and special education (U.S. Department of Education, 2002).

This mandate was reinforced in the U.S. Department of Education's (2010) National Education Technology Plan. Under current legislation, education leaders at the state and local levels are expected to develop plans to effectively utilize educational technologies in the classroom. The primary goal of federal education legislation is to improve student academic achievement, measured primarily by student performance on state standardized tests. Secondary goals include the expectation that every student become technologically literate, that research-based technology-enhanced instructional methods and best practices be established, and that teachers be encouraged and trained to effectively integrate technology into the instruction they provide. The directive to integrate instructional technology into the teaching and learning equation results from the following fundamental beliefs: (1) that learning can be enhanced through the use of technology and (2) that students need to develop technology skills in order to become productive members of society in a competitive global economy (McMillan-Culp, Honey, & Mandinach, 2005; U.S. Department of Education, 2010).

By most measures, the quality and availability of educational technology in schools, along with the technological literacy of teachers and students, have increased significantly in the past decade (Center for Digital Education, 2008; Gray, Thomas, & Lewis, 2010; McMillan-Culp, Honey, & Mandinach, 2005; Nagel, 2010; Russell, Bebell, O'Dwyer, & O'Connor, 2003). In addition, educators are generally committed to technology use. Most educational practitioners value technology to some degree, yet many researchers and policy analysts have suggested that technology is not being used to its full advantage (Bauer & Kenton, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Overbaugh & Lu, 2008; Woolfe, 2010). Even at technology-rich schools, effective integration of technology into the instructional process is rare (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). To fully understand this criticism requires in-depth consideration of the goals and criteria used for evaluating technology integration.

Most efforts to integrate technology into schools have the stated goal of appropriate and effective use of technology (Center for Digital Education, 2008; International Society for Technology in Education [ISTE], 2008; Niederhauser & Lindstrom, 2006; Richey, Silber, & Ely, 2008); however, many current efforts have focused predominantly on gaining access to and increasing the extent of technology use. For example, in 1995 Moersch provided an extremely useful framework describing levels of technology integration—a tool which is still being used (see http://loticonnection.com). Like other indicators, the Levels of Teaching Innovation (LoTi) Framework tends to rely on access to and pervasive innovative use of instructional technology as an indicator of the highest level of technology integration and literacy. To some degree frameworks of this type assume that using technology will in itself be beneficial and effective. Clearly, effective and appropriate use of technology does not happen if students do not have access to learning technologies and do not use them for educational purposes; however, pervasive technology use does not always mean that technology is being used effectively or appropriately, nor does pervasive use of technology necessarily lead to increased learning. The field of adaptive technologies is one area where educational technology holds much promise. It is widely believed that intelligent tutoring systems could be used to enhance a teacher's ability to teach and test students, but advances in this area have failed to produce the same kinds of formative and diagnostic feedback that teachers provide (Woolfe, 2010). As a result, recent efforts to identify appropriate and effective uses for technology have focused more on the pedagogically sound use of technology to accomplish specific learning objectives (see for example, Koehler & Mishra, 2008).

To better orient our understanding and evaluation of technology integration efforts at both classroom and individual levels, integration might best be viewed as progressive steps toward effective use of technology for the purposes of improving instruction and enhancing learning. The current status of technology integration efforts could then be evaluated by the degree to which teachers and students (1) have access to educational technologies, (2) use technology for instructional purposes, and (3) implement technology effectively to facilitate learning (Davies, 2011). After first defining technology and technology integration, this chapter uses this framework for understanding and evaluating current technology integration efforts in schools, along with the challenges associated with technology integration.

Defining Technology and Technology Integration

Efforts to describe and critique current use of technology must recognize that not everyone shares a common understanding of what technology is and what technology integration means. For many, *technology* is synonymous with computer equipment, software, and other electronic devices (U.S. Department of Education, 2010; Woolfe, 2010), while *technology integration* means having and using this equipment in the classroom. However, these definitions are rather narrow. Interpreting technology integration to mean simply having access to computers, computer software, and the Internet has led critics to identify the mandate to integrate technology into schools as a simplistic solution to a complicated endeavor (Bahrampour, 2006; Cuban, 2006a; Warschauer & Ames, 2010). Similarly, defining technology simply as electronic devices tends to place an unwarranted emphasis on using digital technologies in schools regardless of the merits for doing so (Davies, Sprague, & New, 2008). However, most technology integration efforts do intentionally focus on attempting to establish innovative and creative best practices as they progress in gaining access to new and developing digital technologies (ISTE, 2008; Woolfe, 2010).

For this analysis we define *technology integration* as the effective implementation of educational technology to accomplish intended learning outcomes. We consider *educational technology* to be any tool, piece of equipment, or device—electronic or mechanical—that can be used to help students accomplish specified learning goals (Davies, Sprague, & New, 2008). Educational technology includes both instructional technologies, which focus on technologies teachers employ to provide instruction, and learning technologies, which focus on technologies learners use to accomplish specific learning objectives.

Increasing Access to Educational Technology

Teachers find it particularly challenging, if not impossible, to integrate technology when the technologies they would like to use are either not available or not easily accessible to them or their students (Ely, 1999). Fortunately, by most measures the availability of technology in schools has increased significantly in the past decade (Bausell, 2008). In 2009 Gray, Thomas, and Lewis (2010) conducted a nationally representative survey of 2,005 public schools across 50 states. A total of 4133 surveys were administered with a response rate 65%. From these results they estimated that 97% of teachers in the U.S. had access to one or more computers in their classroom every day (a ratio of approximately five students per computer on average). In addition, these authors reported that 93% of schools had access to the Internet.

However, 60% of teachers providing data for this report also indicated that they and their students did not often use computers in the classroom during instructional time. In fact, 29% of the teacher respondents reporting daily access to one or more computers also reported that they rarely or never used computers for instructional purposes. A study conducted by Shapley, Sheehan, Maloney, & Caranikas-Walker (2010) suggested that teachers most frequently use the computer technology they had for administrative purposes (e.g., record keeping), personal productivity (e.g., locating and creating resources), and communicating with staff and parents. Students' use of technology most often for information gathering (i.e., internet searches) or for completing tasks more efficiently by using a specific technology (e.g., word processing, cloud-based computing) (Bebell & Kay, 2010; Davies, Sprague, & New, 2008; Stucker, 2005).

Thus while the availability of technology in schools may have increased in recent years, measures of access likely provide an overoptimistic indicator of technology integration. In fact, some feel that for a variety of reasons the current level of technology access in schools is far too uneven and generally inadequate to make much of an impact (Bebell & Kay, 2010; Toch & Tyre, 2010). While some question the wisdom and value of doing so (Cuban, 2006b; Warschauer & Ames, 2010), many believe we must strengthen our commitment to improving access to technology by making it an educational funding priority (O'Hanlon, 2009; Livingston, 2008).

One-to-one Computing Initiatives

The primary purpose of one-to-one computing initiatives is to increase access to technology in schools. Essentially this means providing each teacher and student in a school with individual access to an internet-enabled computer or to a

laptop (tablet PC or mobile computing device) for use both in the classroom and at home (Center for Digital Education, 2005). Such access implies that schools would also provide and maintain the infrastructure needed to support these technologies (i.e., networking and internet access). While the number of these programs has increased worldwide, growth has been slow, largely due to the cost of implementation and maintenance (Bebell & Kay, 2010; Greaves & Hayes, 2008; Livingston, 2008). In practice, major one-to-one computing programs in the U.S. require large federal or state grants, which are often directed at Title I schools in areas characterized by high academic risk (Bebell & Kay, 2010; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). Often these programs partner with equipment providers to alleviate implementation costs (including training and support) as well as maintaining and upgrading equipment. These partnerships have resulted in several pockets of technology-rich schools around the nation, some of which have demonstrated excellence in integrating technology effectively. More often one-to-one computing programs have provided equipment to schools, but students' access to it could not be considered ubiquitous, nor has having access to more computer equipment dramatically changed the instruction in most classrooms (Penuel, 2006; Ross, Morrison, & Lowther, 2010; Warschauer & Matuchniak, 2010).

Evidence of academic impact that can be attributed to one-to-one computing initiatives has been mixed. A few studies have provided evidence that infusing technology into the classroom has closed the achievement gap and increased academic performance (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010; Zucker & Light, 2009); however, Cuban (2006b) reported that most studies have shown little academic benefit in these areas, and Vigdor and Ladd (2010) suggested that providing ubiquitous computer access to all students may actually widen the achievement gap.

Other studies have suggested that additional benefits derived from technology integration might include increased access to information, increased motivation of students to complete their studies, and better communication between teachers and students (Bebell & Kay, 2010; Zucker; 2005). However, such studies often referred to the "potential" technology has for increasing learning, acknowledging that any scholastic benefit technology might produce depends on factors other than simply having access to technology (Center for Digital Education, 2008; McMillan-Culp, Honey, & Mandinach, 2005; Woolfe, 2010).

Open Educational Resources

An important factor associated with access is the issue of educational resource availability: i.e., having access to technological tools without access to the educational resources needed to utilize those tools effectively. Much of the current work in this area has focused on developing research-based instructional resources such as online courses and instructional materials that can be used in the classroom to improve student achievement. This can be costly and time consuming. Facing budget cuts and restrictions in funding, many schools need freer access to educational resources.

The Open Educational Resource (OER) movement is a worldwide initiative providing free educational resources intended to facilitate teaching and learning processes (Atkins, Brown, & Hammond, 2007). A few examples of OER initiatives include the OpenCourseWare Consortium (www.ocwconsortium.org), the Open Educational Resources Commons (www.oercommons.org), and the Open Learning Initiative (oli.web.cmu.edu/openlearning), along with Creative Commons (creativecommons.org), which provides the legal mechanism for sharing resources. Since one of the largest impediments to technology integration has been cost (Greaves & Hayes, 2008), some policy analysts have identified the need to provide free educational resources as essential to the success of any technology integration mandate; but this idea has been controversial because it means individuals must be willing to create and provide quality educational resources without compensation. Wiley (2007) has pointed out that as the OER movement is currently an altruistic endeavor with no proven cost recovery mechanism, the real costs associated with producing, storing, and distributing resources in a format that operates equally well across various hardware and operating system platforms constitute a sustainability challenge for the OER movement. The topic of open education is discussed more completely in another chapter of this handbook.

Increasing Instructional Technology Use

Even when schools have adequate access to educational technologies, teachers and students do not always use them for instructional purposes. Efforts to improve technology use in schools have typically focused on professional development for teachers. In addition, both social and moral ethical issues have been raised.

Professional Development as a Method for Increasing Technology Use

Much of the research on increasing technology use in schools has focused on training those preparing to become teachers, although discussions regarding professional development for current classroom teachers are becoming more common. Harris, Mishra, and Koehler (2009) suggested that most professional development in technology for teachers uses one of five models: (a) software-focused initiatives, (b) demonstrations of sample resources, lessons, and projects, (c) technology-based educational reform efforts, (d) structured/standardized professional development workshops or courses, or (e) technology-focused teacher education courses. According to these authors, there is, as yet, very little conclusive evidence that any of these models has been successful in substantially increasing the effective use of technology as measured by increased learning outcomes. Research on technology integration training for teachers has typically focused on either (a) the effectiveness of the professional development training methods or (b) the desired objectives of the professional development.

Technology Integration Professional Development Methods

Many methods have been utilized to provide professional development to teachers on technology integration issues. We highlight three methods on which the research evidence seems strongest: (a) developing technological skills, (b) increasing support through collaborative environments; and (c) providing increased mentoring.

Skill Development Using Technology

Some scholars have focused on using technology to mediate professional development. Technology integration practices are modeled by using blogs and other forms of internet communication (Chuang, 2010; Cook-Sather, 2007; Gibson & Kelland, 2009); video-based self-assessment (Calandra, Brantley-Dias, Lee, & Fox, 2009; West et al., 2009); electronic portfolios (Derham & DiPerna, 2007); and individual response systems (Cheesman, Winograd, & Wehr, 2010). These approaches are intended to help teachers gain experience and confidence with technology, as well as provide them with models for how it might be used effectively.

Collaborative Environments

Other scholars have found that increasing collaboration among teachers learning to integrate technology can improve professional development outcomes. In an article on technology integration, MacDonald (2008) wrote that “to effect lasting educational change” collaboration for teachers needs to be facilitated in “authentic teacher contexts” (p. 431). Hur and Brush (2009) added that professional development needs to emphasize the ability of teachers to share their emotions as well as knowledge. Most collaborative environments typically only emphasize knowledge sharing when emotion sharing may be linked to effective professional development.

An increasingly popular medium for enabling this collaboration and development of emotional safety is online discussions and social networking. While this trend needs more research, positive effects have been indicated. For example, Vavasseur and MacGregor (2008) found that online communities provided better opportunities for teacher sharing and reflection, improving curriculum-based knowledge and technology integration self-efficacy. Also, Borup, West, and Graham (2012) found that using video technologies to mediate class discussions helped students feel more connected to their instructor and peers.

Mentoring

Similar to research on teacher collaboration, some scholars have discussed the important role of mentoring in helping teachers gain technology integration skills. Kopcha (2010) described a systems approach to professional development

emphasizing communities of practice and shifting mentoring responsibilities throughout various stages of the technology integration adoption process. Kopcha's model was designed to reduce some of the costs associated with teacher mentoring—a common criticism of the method. In addition, Gentry, Denton, and Kurtz (2008) found in their review of the literature on technology-based mentoring that while these approaches were not highly used, technology can support mentoring and improve teachers' technology integration attitudes and practices. The authors noted however that many of these effects were self-reported, and not substantiated through direct observation, nor was there any evidence of subsequent effect on student learning outcomes.

Goals of Technology Integration Professional Development

In addition to a variety of methods and approaches to providing professional development on technology integration issues, researchers have found that the goals and objectives of the professional development have also varied. Perhaps the most common objective has been to change teachers' attitudes towards technology integration in an effort to get them to use technology more often (e.g., Annetta et al., 2008; Lambert, Gong, & Cuper, 2008; McCaughtry & Dillon, 2008; Rickard, McAvinia, & Quirke-Bolt, 2009). This has included efforts to change teachers' ability to use specific technologies (through skill development) and thereby to improve their technology integration self-efficacy (e.g., Ertmer & Ottenbreit-Leftwich, 2010; Overbaugh & Lu, 2008). It also included changing teachers' attitudes regarding the pedagogical value of using technology in the classroom (Bai & Ertmer, 2008; Ma, Lu, Turner, and Wan, 2007). In many of these studies, increasing positive teacher attitudes was seen not only as a way to increase technology use but as an important and necessary step towards increasing effective technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Palak & Walls, 2009).

Ethical Issues Affecting Increased Technology Use

Because education is a human, and thus a moral, endeavor (Osguthorpe, Osguthorpe, Jacob, & Davies, 2003), ethical issues frequently surface. Technology integration has caused major shifts in administrative and pedagogical strategies, thus creating a need for new definitions and ideas about ethical teaching and learning (Turner, 2005). Although some have cautioned that ethical issues should be considered before implementing technology-based assignments (Oliver, 2007), the pressure to increase access to and ubiquitous use of technology has often outpaced the necessary development of policies and procedures for its ethical use (Baum, 2005), creating challenges for administrators and teachers who are integrating it in schools. In many cases unintended negative consequences and ethical dilemmas have resulted from inappropriate use of technology, and addressing these issues has required that restrictions be applied. Scholars have specifically mentioned the issues related to technology-based academic dishonesty, the challenges of technology accessibility for all students, and the necessity for developing standards for ethical technology use.

Technology-based Academic Dishonesty

According to Akbulut et al. (2008), the most common examples of academic dishonesty include fraudulence, plagiarism, falsification, delinquency, and unauthorized help. Lin (2007) adds copyright infringement and learner privacy issues to the list of unethical behaviors. Many researchers have discussed the potential for technology to increase these kinds of academic dishonesty and unethical behaviors. Of concern to many teachers is that technology provides easy access to information, giving students more opportunities to cheat (Akbulut, et al., 2008; Chiesl, 2007). King, Guyette, and Piotrowski (2009) found that the vast majority of undergraduate business students in their study considered it easier to cheat online than in a traditional classroom setting. Scholars also believed that the increasingly social and collaborative nature of the Web creates a greater acceptance of cheating by students (Ma, Lu, Turner, & Wan, 2007). Baum (2005) reported, "Many computer-savvy kids as well as educators, administrators and parents are unclear about what is and what is not ethical when dealing with the World Wide Web" (p. 54). Greater opportunities and relaxed attitudes about cheating have led to issues of plagiarism, among other challenges (de Jagar & Brown, 2010; Samuels & Blast, 2006). However, other research has contradicted these conclusions, arguing that online learning does not necessarily facilitate greater dishonesty. For example, Stuber-McEwen, Wiseley, and Hoggatt (2009) surveyed 225

students and found that students enrolled in online classes were less likely to cheat than those in regular classes, leaving the question of whether the online medium facilitates greater cheating still unanswered.

Accessibility

Accessibility of educational technologies has been recognized as one of the most prominent ethical concerns facing schools (Lin, 2007). In support of this notion, Garland (2010) suggested that one of the school principal's most important roles is ensuring ethical technology use and guarding against inequities in technology access between groups of students. However scholars are not consistent on how accessibility might be a problem. Traxler (2010), for example, has suggested that unequal access to technology creates a digital divide that can impede the social progress of some student groups, contributing to a potential nightmare for institutions. In contrast, Vigdor & Ladd (2010) pointed out that providing all students with ubiquitous access to educational technology would increase not decrease the achievement gap. In addition to enabling all student groups to have access to the same educational technologies, institutions must also increase access to assistive technologies for students with disabilities (Dyal, Carpenter, & Wright, 2009).

Developing Ethical Use Behaviors

A quick search of the internet using the keywords *"appropriate technology use policy"* reveals a plethora of documents from schools stipulating the expectation that students use technology for appropriate educational purposes only. Although technology has the potential to benefit students in their educational pursuits, making technology ubiquitously available to students and teachers has the obvious risk that technology will be used inappropriately on occasion. Thus most K-12 schools find it necessary, as a moral imperative, to monitor Internet use and restrict student access to this technology and the information the technology may provide.

Researchers have suggested several possible methods for developing students' ability to use technologies more ethically. Bennett (2005) suggested using the National Education Technology Standards (NETS•S) as a guide (see ISTE 2008b); however, while instructive, these standards are not specific enough to inform direct strategies. Including ethical training in teacher professional development has also been explored (Ben-Jacob, 2005; Duncan & Barnett, 2010). Some academics feel it is the teacher's responsibility to create a safe and ethical learning environment with and without technology (Bennet, 2005; Milson, 2002). Several researchers have suggested classroom strategies for teachers. For example, Kruger (2003) recommended teaching by example and working cyber ethics into assignments and discussions. Baum (2005) echoed these ideas, adding that teachers should create acceptable use policies with students and involve them in making pledges concerning their ethical behavior. Ma, Lu, Turner, and Wan (2007) added that effectively designed activities that are engaging and relevant to students' interests encourage more ethical technology use. Still other scholars have suggested using technology to combat technological-based dishonesty through anti-plagiarism software (Jocoy & DiBiase, 2006) or the use of webcams to verify that online students who complete the work are the same students enrolled in the courses (Saunders, Wenzel, & Stivason, 2008). In addition, instructors can make it a personal goal to stay abreast of technological developments and their potential ethical implications (Howell, Sorensen, & Tippets, 2009). Finally, some researchers have suggested building a supportive social community characterized by a culture of academic honesty (Ma, Lu, Turner, & Wan, 2007; Wang, 2008) because "students who feel disconnected from others may be prone to engage in deceptive behaviors such as academic dishonesty" (Stuber-McEwen et al., 2009, p. 1).

Despite the concern expressed and implied in these suggestions, it is apparent that as a society we have been slow in developing the ethics, norms, and cultural practices needed to keep pace with technological advances (Traxler, 2010), leaving many teachers unaware of proper "technoethics" (Pascual, 2005, p. 73). As we continue to increase access to and use of technologies, it will become paramount to address these and other ethical considerations if we are to succeed in promoting effective and sustainable technology integration.

Increasing Effective Use of Technology

Researchers have reported that even when teachers and students have sufficient access to educational technologies, adequate training in technology use, and confidence in their abilities to apply it, not all of them actually use technology in the classroom, and those who do may not always use it effectively (Choy, Wong, & Gao, 2009; Bauer & Kenton, 2005; Overbaugh & Lu, 2008; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010; Van Dam, Becker & Simpson, 2007; Woolfe, 2010; Zhao, 2007). For example Choy, Wong, and Gao (2009) found that student teachers who had received technology integration training indicated they were more likely to use technology in their classrooms; but in practice they used technology in teacher-centered functions rather than in more effective student-centered pedagogies.

The complex and dynamic nature of the teaching and learning process contributes to the difficulty of effective technology integration. For example, experts and stakeholders do not always agree on what to teach and how to teach it (Woolfe, 2010). Also given the complexity of most educational tasks, the certainty of accomplishing specific learning goals with or without technology is often low (Patton, 2011). Thus establishing research-based technology-enhanced instructional methods and best practices is challenging. However, emerging research into the effective use of technology has identified some best practices by considering issues such as (1) the need to focus on pedagogically-sound technology use, (2) ways to use technology to personalize instruction, and (3) benefits of technology-enabled assessment. An additional area of concern is the need for systemic changes at the organizational level.

Need for Pedagogically Sound Technology Integration Practices

A major criticism of current teacher professional development efforts is that many of them have emphasized improving teachers' attitudes toward technology integration and increasing their self-efficacy without a strong enough emphasis on pedagogically sound practice. Some scholars have indicated that professional development goals must shift to emphasize understanding and utilizing pedagogically sound technology practices (Inan & Lowther, 2010). For example, Palak, and Walls (2009) explained that "future technology professional development efforts need to focus on integration of technology into curriculum via student-centered pedagogy while attending to multiple contextual conditions under which teacher practice takes place" (p. 417). Similarly, Ertmer, and Ottenbreit-Leftwich (2010) argued that "we need to help teachers understand how to use technology to facilitate meaningful learning, defined as that which enables students to construct deep and connected knowledge, which can be applied to real situations" (p. 257). According to Cennamo, Ross, and Ertmer (2010), to achieve technology integration that targets student learning, teachers need to identify which technologies support specific curricular goals. Doing so would require understanding the technological tools themselves, as well as the specific affordances of each tool that would enable students to learn difficult concepts more readily, hopefully resulting in greater and more meaningful student outcomes (Ertmer & Ottenbreit-Leftwich, 2010).

An emerging framework for professional development technology integration that attempts to help teachers focus more on learning is Technological Pedagogical Content Knowledge (TPACK). This framework is discussed elsewhere in this handbook, but it is worth mentioning here in that it has been proposed as a guiding framework for training teachers and evaluating effective technology integration efforts (Harris, Mishra, & Koehler, 2009). Mishra and Koehler (2009; see also Koehler, Mishra, & Yahya, 2007) developed the concept of TPACK as a specific type of knowledge necessary for successful teaching with technology. TPACK is the intersection of three knowledge areas that individual educators might possess: content knowledge, pedagogical knowledge, and technological knowledge. Teachers are expected to be knowledgeable in pedagogical issues related to teaching and learning (PK). They are also required to have in-depth content knowledge of the subjects they are to teach (CK). In addition, they are expected to have technological knowledge in general (TK), along with an understanding of how specific technologies might facilitate student learning of specific content in a pedagogically sound way (TPCK). TPACK proponents argue that teachers must understand the connections between these knowledge areas so that instructional decisions regarding technology integration are pedagogically sound and content driven.

Since TPACK emerged as a theoretical framework, researchers have explored its potential professional development applications (Cavin, 2008), as well as ways to assess teachers' abilities and skills in this area (Kang, Wu, Ni, & Li, 2010;

Schmidt et al., 2009). However, work in this area is still ongoing, and methods and principles for creating effective TPACK-related professional development and measurement should continue to develop as an area of research.

Need for Technology-enabled Personalized Instruction

Most educators hope to personalize instruction for their students, which generally includes identifying the needs and capabilities of individual learners; providing flexibility in scheduling, assignments, and pacing; and making instruction relevant and meaningful for the individual student (Keefe, 2007). The goal of personalizing instruction usually means rejecting the “one size fits all” model of education and replacing it with customized instruction. The idea of personalized or differentiated instruction is not new (Keefe & Jenkins, 2002; Tomlinson, 2003); however the potential for technology to facilitate differentiation is appealing to many educators (Woolfe, 2010).

Many factors are required for technology-enabled personalized instruction to become a reality. Access to the mobile devices needed for ubiquitous individualized instruction would need to be more prevalent (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008; Inan & Lowther, 2010; Nagel, 2010). And few of the many existing educational software programs are designed to provide differentiated instruction, monitor student progress, and assess student achievement on a comprehensive set of learning objectives (Fletcher & Lu, 2009; Ross & Lowther, 2009).

Critics of educational initiatives that use technology as a primary means of instruction contend that computers do not teach as well as human beings (Kose, 2009; Owusua, Monneyb, Appiaha, & Wilmota, 2010). We do not have the type of artificial intelligence needed to replicate all that teachers do when providing instruction (Woolfe, 2010). However, hybrid courses (blended learning) are now utilizing technology (like intelligent tutoring systems) but maintaining face-to-face aspects of the traditional classroom (Jones & Graham, 2010; Yang, 2010).

Much of the educational software currently being used in schools focuses on content delivery (with some pacing flexibility and assessment) or on knowledge management systems using information communication technology, but not necessarily customization that tailors instruction to the individual needs of the learner. Computer software used in K-12 education has primarily involved drill and practice for developing reading and mathematics skills (i.e., computer-based instructional products). Improving basic word processing skills (i.e., typing) is also a prevalent technology-facilitated instructional activity taking place in schools (Ross, Morrison, & Lowther, 2010). These educational software programs are intended to supplement the work of teachers rather than replacing them and are typically not integrated directly into classroom instruction.

Some intelligent tutoring systems (also called intelligent computer-assisted instruction or integrated learning systems) have been studied and made available to schools (Conati, 2009; Lowther & Ross, 2012; Vandewaetere, Desmet, & Clarebout, 2011; Yang, 2010). These systems have been designed to customize instruction for individual students, but many challenges are involved with their use (Conati, 2009; Yang, 2010). They are not widely implemented in schools, as many are in a developmental stage, are limited in scope, and are quite expensive (Conati, 2009; Cooper, 2010; Lowther & Ross, 2012; Yang, 2010). In most cases they attempt to differentiate instruction but fail to rise to the level of adaptive intelligent tutors. The current efforts to personalize instruction with technology have focused on managing learning (e.g., providing instruction, practice, and summative testing) because programming intelligent formative and diagnostic assessment and feedback into these systems has proven to be a daunting challenge (Woolfe, 2010).

Need for Technology-enabled Assessment

Assessment is an important aspect of differentiated instruction that can be strengthened by technology. The primary focus of summative standardized testing in schools has been accountability (U.S. Government Accountability Office, 2009); but the true power of assessment is obtaining diagnostic and formative information about individuals that can be used to customize instruction and remediation (Cizek, 2010a; Keefe, 2007; Marzano, 2009). For this critical purpose, technology has the potential to be extremely valuable.

Summative Assessment and Accountability Efforts

Since 2002 the cost of testing in schools has increased significantly (U.S. Government Accountability Office, 2009). Testing costs result primarily from accountability mandates that emphasize increased achievement on state standardized tests. With the current imperative to adopt common core standards and establish national online standardized testing in the U.S., the need for technology-enabled assessment will only increase (Toch & Tyre, 2010), including the use of computer-adaptive testing techniques and technologies. The major concern with these initiatives is that schools are not now, nor in the immediate future will they be, equipped to handle the requirements of large scale online testing in terms of access to computers and the internet, as well as the networking infrastructure needed (Deubel, 2010; Toch & Tyre, 2010).

Formative and Diagnostic Assessment Efforts

One of the greatest benefits of online testing is the potential for teachers and individual students to get immediate results (Deubel, 2010; Toch & Tyre, 2010). State standardized testing in its current form does little to improve learning for individual students, as the lag time between taking a test and receiving the results prevents the information from being useful. In addition, most standardized assessments are not designed to help individual students (Marzano, 2009). Embedding assessment into the learning activities for both formative and diagnostic purposes can be facilitated by using technology, but the ability to do this is at the emergent stage. Critics of technology-enabled assessment have pointed out that the tools required to accomplish this type of testing are far from adequate.

The desire to benefit from having computerized assessment systems in schools may be compromised by a lack of quality. For example, while assessment vendors claim high correlations between the results of computer-scored and human-scored writing tests (Elliot, 2003), critics have described serious flaws in the process (McCurry, 2010; Miller, 2009). Writing software using computer scoring can be programmed to identify language patterns, basic writing conventions, and usage issues; the software cannot, however, read for meaning, creativity, or logical argument (McCurry, 2010), which are more important aspects of literacy development. Thus the accuracy and validity of computer-scored writing assessments are suspect. At this time, schools using these technologies are forced into a tradeoff between quality assessment and practicality (Miller, 2009). However, computer-scored writing assessment is an area of great interest in schools.

Another criticism of current assessment trends relates to how tests are developed and used. Diagnostic formative assessments should be narrower in focus, more specific in content coverage, and more frequent than the summative standardized testing currently being mandated for accountability purposes (Cizek, 2010b; Marzano, 2009). For this type of testing to become a reality, students would need better access to personal computers or mobile devices, school networks, and the internet (Toch & Tyre, 2010). In addition, instructional software would have to be aligned with approved learning objectives (Cizek, 2010b). Assessment would need to be integrated into the learning process more thoroughly, with instructional software designed to monitor and test the progress of students and then provide prompt feedback to each individual learner (Marzano, 2009). We expect teachers to provide formative assessment and feedback to their students, but teachers are often overwhelmed by the task. Technology has the potential to facilitate learning by enabling this process, but greater advancements in this area are needed to make this a workable reality (Woolfe, 2010).

Need for Change at Systemic Level

While TPACK and other pedagogically driven technology integration efforts are an improvement in the drive towards more effective use of educational technologies, to focus on pedagogically sound technology use alone would be insufficient for lasting change. Many teachers and educational technologists have learned that even when teachers adopt technologies and learn how to use them in pedagogically appropriate ways, they are hampered in their integration efforts by the educational system. Thus as Sangra and Gonzalez-Sanmamed (2010) argued, true technology integration is possible only when systemic changes are made in the way we teach and provide education (see also Gunn, 2010). Teacher-level implementation of technology is not always the most significant predictor of student achievement. For example, Li (2010) found through observations and focus group interviews of students, teachers, and school

stakeholders in a school in Hong Kong that changing teachers' conceptions did not necessarily impact outcomes without an accompanying increase in "social trust, access to expertise, and social pressure" (p. 292) in a way that empowered the teachers to take risks and supported their pedagogical changes, suggesting a great need for social support for whatever educational initiative is being implemented. And Shapley et al. (2010) suggested that students' use of laptops outside of school to complete learning tasks may be the strongest predictor of academic success. Thus, possibly the most important indicator of whether an educational initiative will be effective is the individual students' desire and effort to learn (Davies, 2003).

The importance of social and organizational structures is further confirmed as many teachers and educational technologists have encountered barriers to effective implementation at the administrative, collegial, parental, or community level. As Marshall (2010) reported, based on evidence from higher education institutions in the United Kingdom, Australia, and New Zealand, "university culture and existing capability constrain such innovation and to a large extent determine the nature and extent of organizational change" (p. 179). Marshall also argued that without strong and supportive leadership, rather than being a catalyst for more effective instruction, educational technologies reinforced the status quo of existing beliefs and practices (see also, Ely, 1999). Similarly in their study of faculty adoption of course management technologies, West, Waddoups, and Graham (2007) found that the attitudes of peers, administrators, and even teaching assistants were often more influential than the perceived quality of the tool and the availability of technical support on campus.

Much discussion of systemic change is occurring in the field of educational communications technology. It appears that these efforts will become more critical as "educational performance based on the learning outcomes of formal schooling in a future knowledge society could be significantly different from that of today" (Kang, Heo, Jo, Shin, & Seo, 2010-2011, p. 157), requiring new and evolving uses of technologies, curriculum, and systems to facilitate these changes (Facer & Sandford, 2010).

We find it surprising that scholars appear to be lagging in this effort to understand systemic influences on technology integration. As Tondeur, van Keer, van Braak, and Valcke (2008) reported, research on technology in schools is focused mostly on classroom rather than organizational variables. Additionally, there seems to be a major gap in the literature regarding the development of a technology integration framework that, like TPACK, is pedagogically driven but sensitive to systemic variables. We are unsure what an "organizational TPACK" model would look like, but we believe this to be a potentially fruitful research endeavor for the next decade.

Conclusions

Legislative mandates for schools to utilize educational technologies in classrooms are based on the belief that technology can improve instruction and facilitate learning. Another widely held belief is that students need to develop technology literacy and skills in order to become productive members of society in a competitive global economy. This chapter explored school technology integration efforts as progressive steps: increasing access to educational technologies, increasing ubiquitous technology use, and improving effective technology implementation.

Over the past decade, one-to-one computing programs have been the most prominent initiatives used to increase access to technology in schools. These initiatives are designed to increase the availability of primarily digital technologies and related software for teachers and students. The biggest access obstacle has been the cost of obtaining and maintaining technology resources. The Open Educational Resource (OER) movement is attempting to alleviate some of the cost associated with providing quality educational resources, but OER programs struggle with sustainability issues. The cost of providing and maintaining technology as well as the way federal programs fund technology initiatives have often resulted in uneven levels of access, creating pockets of technology-rich schools.

While technology availability in schools has increased significantly over the past decade, measures of access likely provide an overenthusiastic impression of progress in effective technology integration and use. Having greater access to and improved use of technology (i.e., computer and internet availability) has not always led to substantial increases

in learning. Typically, studies refer to technology's potential for increasing learning but acknowledge that any scholastic benefit depends on factors other than simply having technology access.

Once schools have access to educational technologies, the focus of technology integration often turns to increasing technology use. Researchers have reported that even when teachers and students have sufficient access, they do not always use technology for instructional purposes. Issues that hinder technology use in schools include social and moral ethics, like the question of inequitable access to technology for all students, which causes some teachers to avoid requiring students to use technologies to do assignments at home. Many schools also find it necessary to restrict the use of various technologies due to potential negative consequences and ethical dilemmas, considering it a moral imperative to monitor internet use and limit student access to this technology.

In an effort to increase technology use in classrooms, most schools encourage teachers to participate in professional development activities. The most common goal for teacher development has been to change teachers' attitudes towards technology integration and to strengthen their abilities to use specific technologies. A major criticism of these efforts is that they do not provide a strong emphasis on practice that is contextually based and pedagogically sound. TPACK proponents argue that teachers must understand the connections between the specific affordances of various technologies and the ways each tool might best be used to facilitate specific content learning.

However, efforts to establish research-based technology-enhanced instructional methods and best practices encounter many challenges. Given the contextual complexity and extraneous factors that affect most educational endeavors, our ability to accomplish specific learning goals with or without technology can be difficult. But researchers warn that pedagogically sound practice must be implemented before substantial increases can be made in the effectiveness of technology use in schools. Specific areas where technology has the potential for improving instruction and learning include personalizing instruction and improving assessment. But by most accounts, given the current state of technology, our ability to customize instruction and assessment effectively with technology would require better technology access, tools, and methods.

In conclusion, future efforts to improve instruction and learning using educational technologies will still need to focus on providing students and teachers with ubiquitous access to new technologies and educational resources. However, pedagogically sound best practices will need to be established, and professional development will need to focus more on using technology to improve learning—not just on changing teachers' attitudes and abilities in general. Substantial systemic changes will likely need to be made in educational systems, administration, and resources in order to support teachers in making these types of transformations. The development of adaptive intelligent tutors is an area of great potential. Technology-enabled assessment will be an especially important area of research and development in this regard. In addition to these efforts we would need more discussion on pedagogically oriented systemic changes that can support frameworks such as TPACK at the organizational level.

Key Takeaways

Technology integration: the effective implementation of educational technologies to accomplish intended learning outcomes.

Educational technology: any tool, equipment, or device—electronic or mechanical—that can help students accomplish specified learning goals. Educational technology includes both instructional and learning technologies.

Instructional technology: educational technologies teachers employ to provide instruction.

Learning technology: educational technologies learners use to accomplish specific learning objectives and tasks.

TPACK: technological pedagogical content knowledge, the knowledge teachers need to effectively and successfully teach their specific content area with content-specific technologies.

Educational policy: mandates for schools to utilize educational technologies in classrooms based on the beliefs that (1) technology can improve instruction and facilitate learning and (2) students need to develop technology literacy and skills in order to become productive members of society in a competitive global economy.

Technology-enabled assessment: assessment that utilizes technology to facilitate and improve a teacher's ability to measure student learning outcomes.

Personalized instruction: adaptive technologies that use information obtained about individual students (including formative and diagnostic assessment data) to modify the way instruction is provided.

Application Exercises

- After reading the chapter, what do you believe to be the number one barrier to having technology used in the classroom? Share how you would overcome this?
- Think about how you currently use technology in your formal education settings. How is it being used effectively? How could it be integrated more effectively?
- If you were to hold a professional development for teachers to help increase skills and self-efficacy in their use of technology in the classroom, what would that training look like? Use research from the article to support your plan.

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32

K-12 Technology Frameworks

Royce Kimmons

Editor's Note

The following is excerpted and adapted from Dr. Royce Kimmon's open textbook, K-12 Technology Integration*. It is licensed CC BY-SA 3.0.*

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Technology Integration Models

Technology integration models are theoretical models that are designed to help teachers, researchers, and others in the education field to think about technology integration in meaningful ways. There are many, many technology integration models that are used by different groups. Some models are very popular, while some are used by only very small groups of people, and some are very similar to one another, while others are very unique. Rather than provide an exhausting description of each technology integration model, we will provide a brief overview of a few that we believe to be most widely used or valuable to help you begin thinking about technology integration in your classroom. The models we will explore will include the following: TPACK, RAT, SAMR, and PIC-RAT.

TPACK

TPACK is the most commonly used technology integration model amongst educational researchers. The goal of TPACK is to provide educators with a framework that is useful for understanding technology's role in the educational process. At its heart, TPACK holds that educators deal with three types of core knowledge on a daily basis: content knowledge, pedagogical knowledge, and technological knowledge. Content knowledge is knowledge of one's content area, such as science, math, or social studies. Pedagogical knowledge is knowledge of how to teach. And technological knowledge is knowledge of how to use technology tools.

These core knowledge domains, however, interact with and build on each other in important and complicated ways. For instance, if you are going to teach kindergarten mathematics, you must understand both mathematics (i.e., content knowledge) and how to teach (i.e., pedagogical knowledge), but you must also understand the relationship between pedagogy and the content area. That is, you must understand how to teach mathematics, which is very different from teaching other subject areas, because the pedagogical strategies you use to teach mathematics will be specific to that content domain. When we merge content knowledge and pedagogical knowledge together, a hybrid domain emerges called pedagogical content knowledge. Pedagogical content knowledge includes knowledge about content and pedagogy, but it also includes the specific knowledge necessary to teach the specified content in a meaningful way.

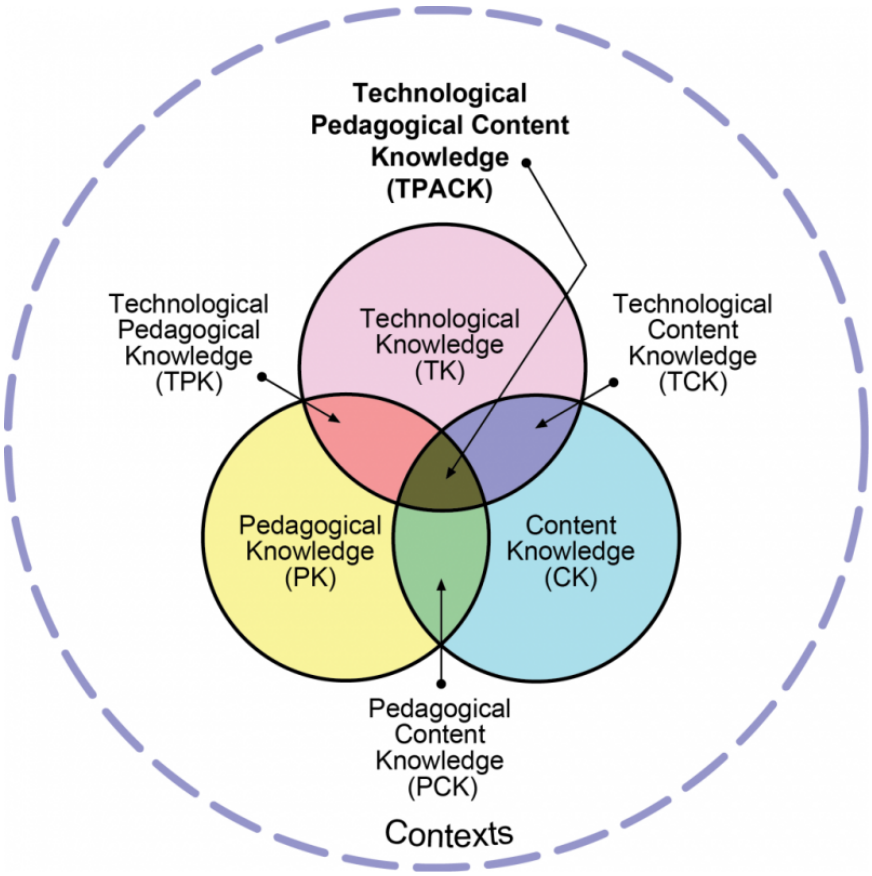

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Figure 1. Technological Pedagogical Content Knowledge (TPACK).

TPACK goes on to explain that when we try to integrate technology into a classroom setting, we are not merely using technological knowledge, but rather, we are merging technological knowledge with pedagogical content knowledge to produce something new. TPACK or technological pedagogical content knowledge is the domain of knowledge wherein technology, pedagogy, and content meet to create a meaningful learning experience. From this, educators need to recognize that merely using technology in a classroom is not sufficient to produce truly meaningful technology integration. Rather, teachers must understand how technology, pedagogy, and content knowledge interact with one another to produce a learning experience that is meaningful for students in specific situations.

RAT and SAMR

RAT and SAMR are very similar technology integration models, though RAT has been used more often by researchers and SAMR has been used more often by teachers. Both of these models assume that the introduction of technology into a learning experience will have some effect on what is happening, and they try to help us understand what this effect is and how we should be using technology in meaningful ways.

RAT is an acronym for replace, amplify, and transform, and the model holds that when technology is used in a teaching setting, technology is used either to replace a traditional approach to teaching (without any discernible difference on student outcomes), to amplify the learning that was occurring, or to transform learning in ways that were not possible without the technology (Hughes, Thomas, & Scharber, 2006). Similarly, SAMR is an acronym for substitution, augmentation, modification, and redefinition (Puentedura, 2003). To compare it to RAT, substitution and replacement both deal with technology use that merely substitutes or replaces previous use with no functional improvement on efficiency. Redefinition and transformation both deal with technology use that empowers teachers and students to learn in new, previously impossible ways.

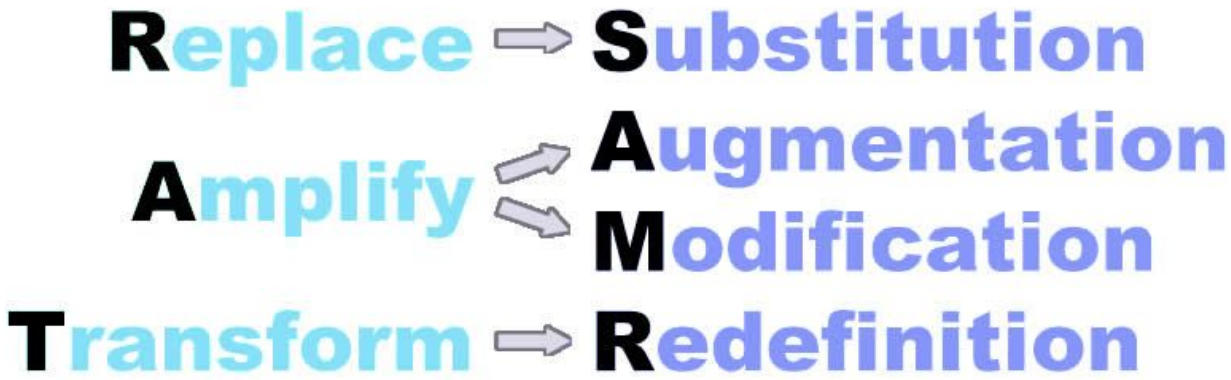

Figure 2. RAT & SAMR

The difference between these two models rests in the center letters, wherein RAT's amplification is separated into two levels as SAMR's augmentation and modification. All of these levels deal with technology use that functionally improves what is happening in the classroom, but in the SAMR model, augmentation represents a small improvement, and modification represents a large improvement.

Both of these models are helpful for leading educators to consider the question: What effect is using the technology having on my practice? If the technology is merely replacing or substituting previous practice, then it is a less meaningful use of technology, whereas technology use that transforms or redefines classroom practice is considered to be more valuable.

PICRAT

Building off of the ideas presented in the models above, we will now provide one final model that may serve as a helpful starting point for teachers to begin thinking about technology integration. PIC-RAT assumes that there are two foundational questions that teachers must ask about any technology use in their classrooms:

1. What is the students' relationship to the technology? (PIC: Passive, Interactive, Creative)
2. How is the teacher's use of technology influencing traditional practice? (RAT: Replace, Amplify, Transform; cf. Hughes, Thomas, & Scharber, 2006)

The provided illustration maps these two questions on a two-dimensional grid, and by answering these two questions, teachers can get a sense for where any particular practice falls.

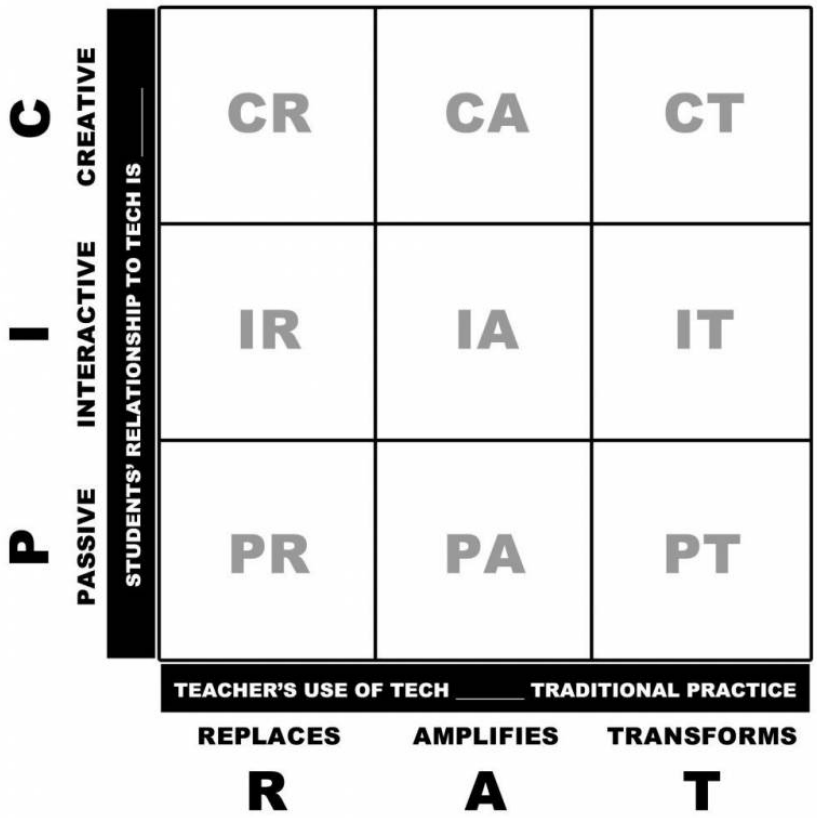

Figure 3. PIC-RAT

For instance, if a history teacher shifts from writing class notes on a chalkboard to providing these notes in a PowerPoint presentation, this would likely be categorized in the bottom-left (PR) section of the grid, because the teacher is using the technology to merely replace a traditional practice, and the students are passively taking notes on what they see. In contrast, if an English teacher guides students in developing a creative writing blog, which they use to elicit feedback from peers, parents, and the online community on their short stories, this would likely be categorized in the top-right (CT) section, because the teacher is using the technology to transform the practice to do something that would have been impossible without the technology, and the students are using the technology as a tool for creation.

Experience has shown that as teachers begin using technologies in their classrooms, they will typically begin doing so in a manner that falls closer to the bottom-left of the grid. However, many of the most exciting and valuable uses of technology for teaching rest firmly in the top-most and right-most sections of this grid. For this reason, teachers need to be encouraged to evolve their practice to continually move from the bottom-left (PR) to the top-right (CT) of the grid.

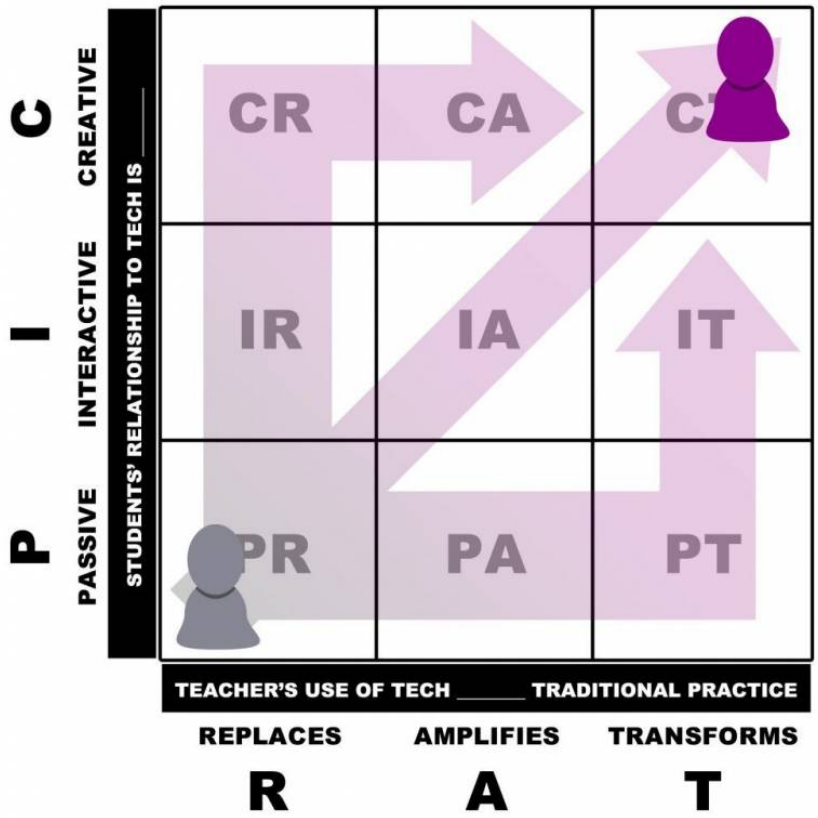

Figure 4. The use of PIC-RAT.

Further Resource

For more information on the PIC-RAT model, please view this video, scripted by Dr. Kimmons and Dr. Richard E. West of Brigham Young University.

Watch on YouTube

Please complete this short survey to provide feedback on this chapter:
http://bit.ly/TechnologyFrameworks

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33

What Is Technological Pedagogical Content Knowledge?

Matthew J. Koehler & Punya Mishra

Editor's Note

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As educators know, teaching is a complicated practice that requires an interweaving of many kinds of specialized knowledge. In this way, teaching is an example of an ill-structured discipline, requiring teachers to apply complex knowledge structures across different cases and contexts (Mishra, Spiro, & Feltovich, 1996; Spiro & Jehng, 1990). Teachers practice their craft in highly complex, dynamic classroom contexts (Leinhardt & Greeno, 1986) that require them constantly to shift and evolve their understanding. Thus, effective teaching depends on flexible access to rich, well-organized and integrated knowledge from different domains (Glaser, 1984; Putnam & Borko, 2000; Shulman, 1986, 1987), including knowledge of student thinking and learning, knowledge of subject matter, and increasingly, knowledge of technology.

The Challenges of Teaching With Technology

Teaching with technology is complicated further considering the challenges newer technologies present to teachers. In our work, the word technology applies equally to analog and digital, as well as new and old, technologies. As a matter of practical significance, however, most of the technologies under consideration in current literature are newer and digital and have some inherent properties that make applying them in straightforward ways difficult.

Most traditional pedagogical technologies are characterized by specificity (a pencil is for writing, while a microscope is for viewing small objects); stability (pencils, pendulums, and chalkboards have not changed a great deal over time); and transparency of function (the inner workings of the pencil or the pendulum are simple and directly related to their function) (Simon, 1969). Over time, these technologies achieve a transparency of perception (Bruce & Hogan, 1998); they become commonplace and, in most cases, are not even considered to be technologies. Digital technologies—such as computers, handheld devices, and software applications—by contrast, are protean (usable in many different ways;

Papert, 1980); unstable (rapidly changing); and opaque (the inner workings are hidden from users; Turkle, 1995). On an academic level, it is easy to argue that a pencil and a software simulation are both technologies. The latter, however, is qualitatively different in that its functioning is more opaque to teachers and offers fundamentally less stability than more traditional technologies. By their very nature, newer digital technologies, which are protean, unstable, and opaque, present new challenges to teachers who are struggling to use more technology in their teaching.

Also complicating teaching with technology is an understanding that technologies are neither neutral nor unbiased. Rather, particular technologies have their own propensities, potentials, affordances, and constraints that make them more suitable for certain tasks than others (Bromley, 1998; Bruce, 1993; Koehler & Mishra, 2008). Using email to communicate, for example, affords (makes possible and supports) asynchronous communication and easy storage of exchanges. Email does not afford synchronous communication in the way that a phone call, a face-to-face conversation, or instant messaging does. Nor does email afford the conveyance of subtleties of tone, intent, or mood possible with face-to-face communication. Understanding how these affordances and constraints of specific technologies influence what teachers do in their classrooms is not straightforward and may require rethinking teacher education and teacher professional development.

Social and contextual factors also complicate the relationships between teaching and technology. Social and institutional contexts are often unsupportive of teachers' efforts to integrate technology use into their work. Teachers often have inadequate (or inappropriate) experience with using digital technologies for teaching and learning. Many teachers earned degrees at a time when educational technology was at a very different stage of development than it is today. It is, thus, not surprising that they do not consider themselves sufficiently prepared to use technology in the classroom and often do not appreciate its value or relevance to teaching and learning. Acquiring a new knowledge base and skill set can be challenging, particularly if it is a time-intensive activity that must fit into a busy schedule. Moreover, this knowledge is unlikely to be used unless teachers can conceive of technology uses that are consistent with their existing pedagogical beliefs (Ertmer, 2005). Furthermore, teachers have often been provided with inadequate training for this task. Many approaches to teachers' professional development offer a one-size-fits-all approach to technology integration when, in fact, teachers operate in diverse contexts of teaching and learning.

An Approach to Thinking about Technology Integration

Faced with these challenges, how can teachers integrate technology into their teaching? An approach is needed that treats teaching as an interaction between what teachers know and how they apply what they know in the unique circumstances or contexts within their classrooms. There is no "one best way" to integrate technology into curriculum. Rather, *integration efforts should be creatively designed or structured for particular subject matter ideas in specific classroom contexts*. Honoring the idea that teaching with technology is a complex, ill-structured task, we propose that understanding approaches to successful technology integration requires educators to develop new ways of comprehending and accommodating this complexity.

At the heart of good teaching with technology are three core components: content, pedagogy, and technology, plus the relationships among and between them. The interactions between and among the three components, playing out differently across diverse contexts, account for the wide variations seen in the extent and quality of educational technology integration. These three knowledge bases (content, pedagogy, and technology) form the core of the technology, pedagogy, and content knowledge (TPACK) framework. An overview of the framework is provided in the following section, though more detailed descriptions may be found elsewhere (e.g., Koehler & 2008; Mishra & Koehler, 2006). This perspective is consistent with that of other researchers and approaches that have attempted to extend Shulman's idea of pedagogical content knowledge (PCK) to include educational technology. (A comprehensive list of such approaches can be found at http://www.tpck.org/.)

The Tpack Framework

The TPACK framework builds on Shulman's (1987, 1986) descriptions of PCK to describe how teachers' understanding of educational technologies and PCK interact with one another to produce effective teaching with technology. Other authors have discussed similar ideas, though often using different labeling schemes. The conception of TPACK described here has developed over time and through a series of publications, with the most complete descriptions of the framework found in Mishra and Koehler (2006) and Koehler and Mishra (2008).

In this model (see Figure 1), there are three main components of teachers' knowledge: content, pedagogy, and technology. Equally important to the model are the interactions between and among these bodies of knowledge, represented as PCK, TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPACK.

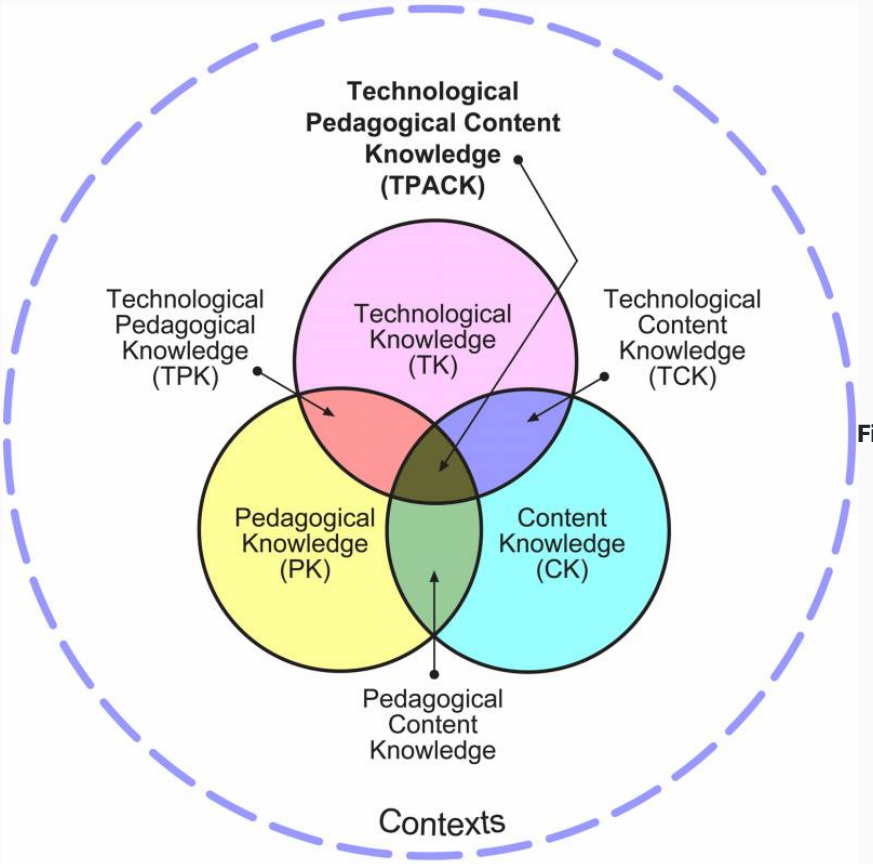

Figure 1. The TPACK framework and its knowledge components.

Content Knowledge

Content knowledge (CK) is teachers' knowledge about the subject matter to be learned or taught. The content to be covered in middle school science or history is different from the content to be covered in an undergraduate course on art appreciation or a graduate seminar on astrophysics. Knowledge of content is of critical importance for teachers. As Shulman (1986) noted, this knowledge would include knowledge of concepts, theories, ideas, organizational frameworks, knowledge of evidence and proof, as well as established practices and approaches toward developing such knowledge. Knowledge and the nature of inquiry differ greatly between fields, and teachers should understand the deeper knowledge fundamentals of the disciplines in which they teach. In the case of science, for example, this would include knowledge of scientific facts and theories, the scientific method, and evidence-based reasoning. In the case of

art appreciation, such knowledge would include knowledge of art history, famous paintings, sculptures, artists and their historical contexts, as well as knowledge of aesthetic and psychological theories for evaluating art.

The cost of not having a comprehensive base of content knowledge can be prohibitive; for example, students can receive incorrect information and develop misconceptions about the content area (National Research Council, 2000; Pfundt, & Duit, 2000). Yet content knowledge, in and of itself, is an ill-structured domain, and as the culture wars (Zimmerman, 2002), the Great Books controversies (Bloom, 1987; Casement, 1997; Levine, 1996), and court battles over the teaching of evolution (Pennock, 2001) demonstrate, issues relating to curriculum content can be areas of significant contention and disagreement.

Pedagogical Knowledge

Pedagogical knowledge (PK) is teachers' deep knowledge about the processes and practices or methods of teaching and learning. They encompass, among other things, overall educational purposes, values, and aims. This generic form of knowledge applies to understanding how students learn, general classroom management skills, lesson planning, and student assessment. It includes knowledge about techniques or methods used in the classroom; the nature of the target audience; and strategies for evaluating student understanding. A teacher with deep pedagogical knowledge understands how students construct knowledge and acquire skills and how they develop habits of mind and positive dispositions toward learning. As such, pedagogical knowledge requires an understanding of cognitive, social, and developmental theories of learning and how they apply to students in the classroom.

Pedagogical Content Knowledge

PCK is consistent with and similar to Shulman's idea of knowledge of pedagogy that is applicable to the teaching of specific content. Central to Shulman's conceptualization of PCK is the notion of the transformation of the subject matter for teaching. Specifically, according to Shulman (1986), this transformation occurs as the teacher interprets the subject matter, finds multiple ways to represent it, and adapts and tailors the instructional materials to alternative conceptions and students' prior knowledge. PCK covers the core business of teaching, learning, curriculum, assessment and reporting, such as the conditions that promote learning and the links among curriculum, assessment, and pedagogy. An awareness of common misconceptions and ways of looking at them, the importance of forging connections among different content-based ideas, students' prior knowledge, alternative teaching strategies, and the flexibility that comes from exploring alternative ways of looking at the same idea or problem are all essential for effective teaching.

Technology Knowledge

Technology knowledge (TK) is always in a state of flux—more so than the other two core knowledge domains in the TPACK framework (pedagogy and content). Thus, defining it is notoriously difficult. Any definition of technology knowledge is in danger of becoming outdated by the time this text has been published. That said, certain ways of thinking about and working with technology can apply to all technology tools and resources.

The definition of TK used in the TPACK framework is close to that of Fluency of Information Technology (FITness), as proposed by the Committee of Information Technology Literacy of the National Research Council (NRC, 1999). They argue that FITness goes beyond traditional notions of computer literacy to require that persons understand information technology broadly enough to apply it productively at work and in their everyday lives, to recognize when information technology can assist or impede the achievement of a goal, and to continually adapt to changes in information technology. FITness, therefore, requires a deeper, more essential understanding and mastery of information technology for information processing, communication, and problem solving than does the traditional definition of computer literacy. Acquiring TK in this manner enables a person to accomplish a variety of different tasks using information technology and to develop different ways of accomplishing a given task. This conceptualization of TK does not posit an

“end state,” but rather sees it developmentally, as evolving over a lifetime of generative, open-ended interaction with technology.

Technological Content Knowledge

Technology and content knowledge have a deep historical relationship. Progress in fields as diverse as medicine, history, archeology, and physics have coincided with the development of new technologies that afford the representation and manipulation of data in new and fruitful ways. Consider Roentgen’s discovery of X-rays or the technique of carbon-14 dating and the influence of these technologies in the fields of medicine and archeology. Consider also how the advent of the digital computer changed the nature of physics and mathematics and placed a greater emphasis on the role of simulation in understanding phenomena. Technological changes have also offered new metaphors for understanding the world. Viewing the heart as a pump, or the brain as an information-processing machine are just some of the ways in which technologies have provided new perspectives for understanding phenomena. These representational and metaphorical connections are not superficial. They often have led to fundamental changes in the natures of the disciplines.

Understanding the impact of technology on the practices and knowledge of a given discipline is critical to developing appropriate technological tools for educational purposes. The choice of technologies affords and constrains the types of content ideas that can be taught. Likewise, certain content decisions can limit the types of technologies that can be used. Technology can constrain the types of possible representations, but also can afford the construction of newer and more varied representations. Furthermore, technological tools can provide a greater degree of flexibility in navigating across these representations.

TCK, then, is an understanding of the manner in which technology and content influence and constrain one another. Teachers need to master more than the subject matter they teach; they must also have a deep understanding of the manner in which the subject matter (or the kinds of representations that can be constructed) can be changed by the application of particular technologies. Teachers need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology—or vice versa.

Technological Pedagogical Knowledge

TPK is an understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies. To build TPK, a deeper understanding of the constraints and affordances of technologies and the disciplinary contexts within which they function is needed.

For example, consider how whiteboards may be used in classrooms. Because a whiteboard is typically immobile, visible to many, and easily editable, its uses in classrooms are presupposed. Thus, the whiteboard is usually placed at the front of the classroom and is controlled by the teacher. This location imposes a particular physical order in the classroom by determining the placement of tables and chairs and framing the nature of student-teacher interaction, since students often can use it only when called upon by the teacher. However, it would be incorrect to say that there is only one way in which whiteboards can be used. One has only to compare the use of a whiteboard in a brainstorming meeting in an advertising agency setting to see a rather different use of this technology. In such a setting, the whiteboard is not under the purview of a single individual. It can be used by anybody in the group, and it becomes the focal point around which discussion and the negotiation/construction of meaning occurs. An understanding of the affordances of technology and how they can be leveraged differently according to changes in context and purposes is an important part of understanding TPK.

TPK becomes particularly important because most popular software programs are not designed for educational purposes. Software programs such as the Microsoft Office Suite (Word, PowerPoint, Excel, Entourage, and MSN Messenger) are usually designed for business environments. Web-based technologies such as blogs or podcasts are designed for purposes of entertainment, communication, and social networking. Teachers need to reject functional fixedness (Duncker, 1945) and develop skills to look beyond most common uses for technologies, reconfiguring them for customized pedagogical purposes. Thus, TPK requires a forward-looking, creative, and open-minded seeking of technology use, not for its own sake but for the sake of advancing student learning and understanding.

Technology, Pedagogy, and Content Knowledge

TPACK is an emergent form of knowledge that goes beyond all three "core" components (content, pedagogy, and technology). Technological pedagogical content knowledge is an understanding that emerges from interactions among content, pedagogy, and technology knowledge. Underlying truly meaningful and deeply skilled teaching with technology, TPACK is different from knowledge of all three concepts individually. Instead, TPACK is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones.

By simultaneously integrating knowledge of technology, pedagogy and content, expert teachers bring TPACK into play any time they teach. Each situation presented to teachers is a unique combination of these three factors, and accordingly, there is no single technological solution that applies for every teacher, every course, or every view of teaching. Rather, solutions lie in the ability of a teacher to flexibly navigate the spaces defined by the three elements of content, pedagogy, and technology and the complex interactions among these elements in specific contexts. Ignoring the complexity inherent in each knowledge component or the complexities of the relationships among the components can lead to oversimplified solutions or failure. Thus, teachers need to develop fluency and cognitive flexibility not just in each of the key domains (T, P, and C), but also in the manner in which these domains and contextual parameters interrelate, so that they can construct effective solutions. This is the kind of deep, flexible, pragmatic, and nuanced understanding of teaching with technology we involved in considering TPACK as a professional knowledge construct.

The act of seeing technology, pedagogy, and content as three interrelated knowledge bases is not straightforward. As said before,

> *. . . separating the three components (content, pedagogy, and technology) . . . is an analytic act and one that is difficult to tease out in practice. In actuality, these components exist in a state of dynamic equilibrium or, as the philosopher Kuhn (1977) said in a different context, in a state of "essential tension". . . . Viewing any of these components in isolation from the others represents a real disservice to good teaching. Teaching and learning with technology exist in a dynamic transactional relationship (Bruce, 1997; Dewey & Bentley, 1949; Rosenblatt, 1978) between the three components in our framework; a change in any one of the factors has to be "compensated" by changes in the other two. (Mishra & Koehler, 2006, p. 1029)*

This compensation is most evident whenever using a new educational technology suddenly forces teachers to confront basic educational issues and reconstruct the dynamic equilibrium among all three elements. This view inverts the conventional perspective that pedagogical goals and technologies are derived from content area curricula. Things are rarely that simple, particularly when newer technologies are employed. The introduction of the Internet, for example—particularly the rise of online learning—is an example of the arrival of a technology that forced educators to think about core pedagogical issues, such as how to represent content on the Web and how to connect students with subject matter and with one another (Peruski & Mishra, 2004).

Teaching with technology is a difficult thing to do well. The TPACK framework suggests that content, pedagogy, technology, and teaching/learning contexts have roles to play individually and together. Teaching successfully with technology requires continually creating, maintaining, and re-establishing a dynamic equilibrium among all components. It is worth noting that a range of factors influences how this equilibrium is reached.

Implications of the Tpack Framework

We have argued that teaching is a complex, ill-structured domain. Underlying this complexity, however, are three key components of teacher knowledge: understanding of content, understanding of teaching, and understanding of technology. The complexity of technology integration comes from an appreciation of the rich connections of knowledge among these three components and the complex ways in which these are applied in multifaceted and dynamic classroom contexts.

Since the late 1960's a strand of educational research has aimed at understanding and explaining "how and why the observable activities of teachers' professional lives take on the forms and functions they do" (Clark & Petersen, 1986, p. 255; Jackson, 1968). A primary goal of this research is to understand the relationships between two key domains: (a) teacher thought processes and knowledge and (b) teachers' actions and their observable effects. The current work on the TPACK framework seeks to extend this tradition of research and scholarship by bringing technology integration into the kinds of knowledge that teachers need to consider when teaching. The TPACK framework seeks to assist the development of better techniques for discovering and describing how technology-related professional knowledge is implemented and instantiated in practice. By better describing the types of knowledge teachers need (in the form of content, pedagogy, technology, contexts and their interactions), educators are in a better position to understand the variance in levels of technology integration occurring.

In addition, the TPACK framework offers several possibilities for promoting research in teacher education, teacher professional development, and teachers' use of technology. It offers options for looking at a complex phenomenon like technology integration in ways that are now amenable to analysis and development. Moreover, it allows teachers, researchers, and teacher educators to move beyond oversimplified approaches that treat technology as an "add-on" instead to focus again, and in a more ecological way, upon the connections among technology, content, and pedagogy as they play out in classroom contexts.

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34

The Learner-Centered Paradigm of Education

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Editor's Note

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This article, the third in a series of four installments, begins by discussing the need for paradigm change in education and for a critical systems approach to paradigm change, and examines current progress toward paradigm change. Then it explores what a learner-centered, Information-Age educational system should be like, including the APA learner-centered psychological principles, the National Research Council's findings on how people learn, the work of McCombs and colleagues on learner-centered schools and classrooms, personalized learning, differentiated instruction, and brain-based instruction. Finally, one possible vision of a learner-centered school is described.

Paradigm Change in Public Education

This is the third in a series of four articles on paradigm change in education. The first (May–June 2008) addressed the need for paradigm change in education and described the AECT FutureMinds Initiative for helping state departments of education to engage their school districts in this kind of change. The second (July–August) described the School System Transformation (SST) Protocol that captures the current state of knowledge about how states can help their school districts to engage in paradigm change. This article describes the nature of the learner-centered paradigm of education, and it addresses why this paradigm is needed. The final article (November–December) will explore a full range of roles that technology might play in this new paradigm of education.

Introduction

The dissatisfaction with and loss of trust in schools that we are experiencing these days are clear hallmarks of the need for change in our school systems. The strong push for a learner-centered paradigm of instruction in today's schools reflects our society's changing educational needs. We educators must help our schools to move into the new learner-

centered paradigm of instruction that better meets the needs of individual learners, of their work places and communities, and of society in general. It is also important that we educators help the transformation occur as effectively and painlessly as possible. This article begins by addressing the need for transforming our educational systems to the learner-centered paradigm. Then it describes the nature of the learner-centered paradigm.

The Need for Change and the (critical) Systems Approach to Educational Change

Information-age vs. Industrial-age Education

Whereas society has shifted from the Industrial Age into what many call the 'Information Age' (Toffler, 1984; Reigeluth, 1994; Senge, Cambron-McCabe, Lucas, Smith, Dutton, & Kleiner, 2000), current schools were established to fit the needs of an Industrial-Age society (see Table 1). This factory-model, Industrial-Age school system has highly compartmentalized learning into subject areas, and students are expected to learn the same content in the same amount of time (Reigeluth, 1994). The current school system strives for standardization and was not designed to meet individual learners' needs. Rather it was designed to sort students into laborers and managers (see Table 2), and students are forced to move on with the rest of the class regardless of whether or not they have learned the material, and thus many students accumulate learning deficits and eventually drop out.

Table 1. Key markers of Industrial vs. Information Age education (Reigeluth, 1994).

Industrial Age Bureaucratic Organization	Information Age Team Organization
Autocratic leadership	Shared leadership
Centralized control	Autonomy, accountability
Adversarial relationships	Cooperative relationships
Standardization (mass production, mass marketing, mass communications, etc.)	Customization (customized production, customized marketing, customized communications, etc.)
Compliance	Initiative
Conformity	Diversity
One-way communications	Networking
Compartmentalization (division of labor)	Holism (integration of tasks)

Table 2. Key features: Sorting vs. learning.

Sorting Based Paradigm of Education	Learning Based Paradigm of Education
Time-based	Attainment-based
Group-based	Person-based
Teacher-based	Resource-based
Norm-based assessment	Criterion-based assessment

The (critical) Systems Approach to Educational Change

Systemic educational transformation strives to change the school system to a learner-centered paradigm that will meet all learners' educational needs. It is concerned with the creation of a completely new system, rather than a mere retooling of the current system. It entails a paradigm shift as opposed to piecemeal change. Repeated calls for massive reform of current educational and training practices have consistently been published over the last several decades. This has resulted in an increasing recognition of the need for systemic transformation in education, as numerous piecemeal approaches to education reform have been implemented and have failed to significantly improve the state of education. Systemic transformation seeks to shift from a paradigm in which time is held constant, thereby forcing achievement to vary, to one designed specifically to meet the needs of Information-Age learners and their communities by allowing students the time that each needs to reach proficiency.

Systemic educational change draws heavily from the work on critical systems theory (CST) (Flood & Jackson, 1991; Jackson, 1991a, 1991b; Watson, Watson, & Reigeluth, 2008). CST has its roots in systems theory, which was established in the mid-twentieth century by a multi-disciplinary group of researchers who shared the view that science had become increasingly reductionist and the various disciplines isolated. While the term system has been defined in a variety of ways by different systems scholars, the central notion of systems theory is the importance of relationships among elements comprising a whole.

CST draws heavily on the philosophy of Habermas (1973, 1984, 1987). The critical systems approach to social systems is of particular importance when considering systems wherein inequality of power exists in relation to opportunity, authority, and control. In the 1980s, CST came to the forefront (Jackson, 1985; Ulrich, 1983), influencing systems theory into the 1990s (Flood & Jackson, 1991; Jackson, 1991a, 1991b). Liberating Systems Theory uses a post-positivist approach to analyze social conditions in order to liberate the oppressed, while also seeking to liberate systems theory from tendencies such as self-imposed insularity, cases of internal localized subjugations in discourse, and liberation of system concepts from the inadequacies of objectivist and subjectivist approaches (Flood, 1990). Jackson (1991b) explains that CST embraces five key commitments:

- critical awareness of examining values entering into actual systems design;
- social awareness of recognition in pressures leading to popularization of certain systems theories and methodologies;
- dedication to human emancipation for full development of all human potential;
- informed use of systems methodologies; and
- informed development of all alternative positions and different theoretical systems approaches.

Banathy (1991) and Senge *et al.* (2000) apply systems theory to the design of educational systems. Banathy (1992) suggests examining systems through three lenses: a "still picture lens" to appreciate the components comprising the system and their relationships; a "motion picture lens" to recognize the processes and dynamics of the system; and a "bird's eye view lens" to be aware of the relationships between the system and its peers and suprasystems. Senge et al. (2000) applies systems theory specifically to organizational learning, stating that the organization can learn to work as an interrelated, holistic learning community, rather than functioning as isolated departments.

Current Progress of Systemic Change in Education

While systemic educational transformation is a relatively new movement in school change, there are currently various attempts to advance knowledge about it. Examples include: The Guidance System for Transforming Education (Jenlink, Reigeluth, Carr, & Nelson, 1996, 1998), Duffy's Step-Up-To-Excellence (2002), Schlechty's (1997, 2002) guidelines for leadership in school reform, Hammer and Champy's (1993, 2003) Process Reengineering, and Ackoff's (1981) Idealized Systems Design.

There are also stories of school districts making fundamental changes in schools based on the application of systemic change ideas. One of the best practices of systemic transformation is in the Chugach School District (CSD). The students in CSD are scattered throughout 22,000 square miles of remote area in South-central Alaska. The district was

in crisis twelve years ago due to low student reading ability, and the school district committed to a systemic transformation effort. Battino and Clem (2006) explain how the CSD's use of individual learning plans, student assessment binders, student learning profiles, and student life-skills portfolios support and document progress toward mastery in all standards for each learner. The students are given the flexibility to achieve levels at their own pace, not having to wait for the rest of the class or being pushed into learning beyond their developmental level. Graduation standards exceed state requirements as students are allowed extra time to achieve that level if necessary, but must meet the high rigor of the graduation level. Student accomplishment in academic performance skyrocketed as a result of these systemic changes (Battino & Clem, 2006).

Caine (2006) also found strong positive changes through systemic educational change in extensive engagement on a project called "Learning to Learn" in Adelaide, South Australia, an initiative of the South Australian Government that covered a network of over 170 educational sites. From preschool to 12th grade, brain-based, learner-centered learning environments were combined with a larger set of systemic changes, leading to both better student achievement and significant changes in the culture and operation of the system itself.

Imagining Learner-centered Schools

Given the need for paradigm change in school systems, what should our schools look like in the future? The changes in society as a whole reflect a need for education to focus on learning rather than sorting students (McCombs & Whisler, 1997; Reigeluth, 1997; Senge et al., 2000; Toffler, 1984). A large amount of research has been conducted to advance our understanding of learning and how the educational system can be changed to better support it. There is solid research about brain-based learning, learner-centered instruction, and the psychological principles of learners that provide educators with a valuable framework for the Information-Age paradigm of education (Alexander & Murphy, 1993; Bransford, Brown, & Cocking, 1999; Hannum & McCombs, 2008; Lambert & McCombs, 1998; McCombs & Whisler, 1997).

Apa Learner-centered Psychological Principles

With significant research showing that instruction should be learner-centered to meet all students' needs, there have been several efforts to synthesize the knowledge on learner-centered instruction. First, the American Psychological Association conducted wide-ranging research to identify learner-centered psychological principles based on educational research (American Psychological Association's Board of Educational Affairs, 1997; Lambert & McCombs, 1998). The report presents 12 principles and provides the research evidence that supports each principle. It categorizes the psychological principles into four areas: (1) cognitive and metacognitive, (2) motivational and affective, (3) developmental and social, and (4) individual difference factors that influence learners and learning (see Table 3).

Table 3. Learner-Centered Psychological Principles (American Psychological Association's Board of Educational Affairs, Center for Psychology in Schools and Education, 1997).

APA Learner-Centered Psychological Principles

Cognitive and Metacognitive Factors	• Nature of the learning process. The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience. • Goals of the learning process. The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge. • Construction of knowledge The successful learner can link new information with existing knowledge in meaningful ways. • Strategic thinking The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals. • Thinking about thinking. Higher-order strategies for selecting and monitoring mental operations facilitate creative and critical thinking. • Context of learning. Learning is influenced by environmental factors, including culture, technology, and instructional practices.
Motivational and Affective Factors	• Motivational and emotional influences on learning. What and how much is learned is influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests and goals, and habits of thinking. • Intrinsic motivation to learn. The learner's creativity, higher-order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control. • Effects of motivation on effort. Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion.
Developmental and Social Factors	• Developmental influences on learning. As individuals develop, there are different opportunities and constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account. • Social influences on learning. Learning is influenced by social interactions, interpersonal relations, and communication with others.

Individual Differences Factors	• Individual differences in learning. Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity. • Learning and diversity Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account. • Standards and assessment. Setting appropriately high and challenging standards and assessing the learner as well as learning progress—including diagnostic, process, and outcome assessment—are integral parts of the learning process.

National Research Council's "how People Learn."

Another important line of research was carried out by the National Research Council to synthesize knowledge about how people learn (Bransford *et al*., 1999). A two-year study was conducted to develop a synthesis of new approaches to instruction that "make it possible for the majority of individuals to develop a deep understanding of important subject matter" (p. 6). Their analysis of a wide range of research on learning emphasizes the importance of customization and personalization in instruction for each individual learner, self-regulated learners taking more control of their own learning, and facilitating deep understanding of the subject matter. They describe the crucial need for, and characteristics of, learning environments that are learner-centered and learning-community centered.

Learner-centered Schools and Classrooms

McCombs and colleagues (Baker, 1973; Lambert & McCombs, 1998; McCombs & Whisler, 1997) also address these new needs and ideas for instruction that supports all students. They identify two important features of learner-centered instruction:

> *. . . a focus on individual learners (their heredity, experiences, perspectives, backgrounds, talents, interests, capacities, and needs) [and] a focus on learning (the best available knowledge about learning, how it occurs, and what teaching practices are most effective in promoting the highest levels of motivation, learning, and achievement for all learners). (McCombs & Whisler, 1997, p. 11)*

This twofold focus on learners and learning informs and drives educational decision-making processes. In learner-centered instruction, learners are included in these educational decision-making processes, the diverse perspectives of individuals are respected, and learners are treated as co-creators of the learning process (McCombs & Whisler, 1997).

Personalized Learning

Personalized Learning is part of the learner-centered approach to instruction, dedicated to helping each child to engage in the learning process in the most productive and meaningful way to optimize each child's learning and success. Personalized Learning was cultivated in the 1970s by the National Association of Secondary School Principals (NASSP) and the Learning Environments Consortium (LEC) International, and was adopted by the special education movement. It is based upon a solid foundation of the NASSP's educational research findings and reports as to how students learn most successfully (Keefe, 2007; Keefe & Jenkins, 2002), including a strong emphasis on parental involvement, more teacher and student interaction, attention to differences in personal learning styles, smaller class sizes, choices in personal goals and instructional methods, student ownership in setting goals and designing the learning process, and technology use (Clarke, 2003). Leaders in other fields, such as businessman Wayne Hodgins, have presented the idea that learning will soon become personalized, where the learner both activates and controls her or his own learning environment (Duval, Hodgins, Rehak, & Robson, 2004).

Differentiated Instruction

The recent movement in differentiated instruction is also a response to the need for a learning-focused (as opposed to a sorting-focused) approach to instruction and education in schools. Differentiated instruction is an approach that enables teachers to plan strategically to meet the needs of every student. It is deeply grounded in the principle that there is diversity within any group of learners and that teachers should adjust students' learning experiences accordingly (Tomlinson, 1999, 2001, 2003). This draws from the work of Vygotsky (1986), especially his "zone of proximal development" (ZPD), and from classroom researchers. Researchers found that with differentiated instruction students learned more and felt better about themselves and the subject area being studied (Tomlinson, 2001). Evidence further indicates that students are more successful and motivated in schools if they learn in ways that are responsive to their readiness levels (Vygotsky, 1986), personal interests, and learning profiles (Csikszentmihalyi, 1990; Sternberg, Torff, & Grigorenko, 1998). The goal of differentiated instruction is to address these three characteristics for each student (Tomlinson, 2001, 2003).

Brain Research and Brain-based Instruction

Another area of study that gives us an understanding of how people learn is the work on brain research which describes how the brain functions. Caine and colleagues (1997, 2005, 2006) provide a useful summary of work on how the brain functions in the process of learning through the 12 principles of brain-based learning. Brain-based learning begins when learners are encouraged to actively immerse themselves in their world and their learning experiences. In a school or classroom where brain-based learning is being practiced, the significance of diverse individual learning styles is taken for granted by teachers and administrators (Caine & Caine, 1997). In these classrooms and schools, learning is facilitated for each individual student's purposes and meaning, and the concept of learning is approached in a completely different way from the current classrooms that are set up for sorting and standardization.

An Illustration of the New Vision

What might a learner-centered school look like? An illustration or synthesis of the new vision may prove helpful.

Imagine that there are no grade levels for this school. Instead, each of the students strives to master and check off their attainments in a personal "inventory of attainments" (Reigeluth, 1994) that details the individual student's progress through the district's required and optional learning standards, kind of like merit badges in Scouting. Each student has different levels of progress in every attainment, according to his or her interests, talents, and pace. The student moves to the next topic as soon as she or he masters the current one. While each student must reach mastery level before moving on, students also do not need to wait for others who are not yet at that level of learning. In essence, now, the schools hold time constant and student learning is thereby forced to vary. In this new paradigm of the learner-centered school, it is the pace (learning time) that varies rather than student learning. All students work at their own maximum pace to reach mastery in each attainment. This individualized, customized, and self-paced learning process allows the school district to realize high standards for its students.

The teacher takes on a drastically different role in the learning process. She or he is a guide or facilitator who works with the student for at least four years, building a long-term, caring relationship (Reigeluth, 1994). The teacher's role is to help the student and parents to decide upon appropriate learning goals and to help identify and facilitate the best way for the student to achieve those goals—and for the parents to support their student. Therefore, each student has a personal learning plan in the form of a contract that is jointly developed every two months by the student, parents, and teacher.

This system enhances motivation by placing greater responsibility and ownership on the students, and by offering truly engaging, often collaborative work for students (Schlechty, 2002). Teachers help students to direct their own learning through the contract development process and through facilitating real-world, independent or small-group projects that focus on developing the contracted attainments. Students learn to set and meet deadlines. The older the students get, the more leadership and assisting of younger students they assume.

The community also works closely with schools, as the inventory of attainments includes standards in service learning, career development, character development, interpersonal skills, emotional development, technology skills, cultural awareness, and much more. Tasks that are vehicles for such learning are authentic tasks, often in real community environments that are rich for learning (Reigeluth, 1994). Most learning is interdisciplinary, drawing from both specific and general knowledge and interpersonal and decision-making skills. Much of the focus is on developing deep understandings and higher-order thinking skills.

Teachers assess students' learning progress through various methods, such as computer-based assessment embedded in simulations, observation of student performances, and analysis of student products of various kinds. Instead of grades, students receive ratings of "emerging," "developing," "proficient" (the minimum required to pass), or "expert."

Each teacher has a cadre of students with whom she or he works for several years—a developmental stage of their lives. The teacher works with 3–10 other teachers in a small learning community (SLC) in which the learners are multi-aged and get to know each other well. Students get to choose which teacher they want (stating their first, second, and third choice), and teacher bonuses are based on the amount of demand for them. Each SLC has its own budget, based mainly on the number of students it has, and makes all its own decisions about hiring and firing of its staff, including its principal (or lead teacher). Each SLC also has a school board made up of teachers and parents who are elected by their peers.

While this illustration of a learner-centered school is based on the various learner-centered approaches to instruction reviewed earlier and the latest educational research, this is just one of many possible visions, and these ideas need revision, as some are likely to vary from one community to another, and most need further elaboration on details. Nonetheless, this picture of a learner-centered paradigm of schooling could help us to prevail over the industrial-age paradigm of learning and schools so that we can create a better place for our children to learn.

Conclusion

Our society needs learner-centered schools that focus on learning rather than on sorting (McCombs & Whisler, 1997; Reigeluth, 1997; Senge et al., 2000; Toffler, 1984). New approaches to instruction and education have increasingly been advocated to meet the needs of all learners, and a large amount of research has been conducted to advance our understanding of learning and how the educational system can be changed to better support it (Alexander & Murphy, 1993; McCombs & Whisler, 1997; Reigeluth, 1997; Senge *et al.*, 2000). Nevertheless, transforming school culture and structure is not an easy task.

Isolated reforms, typically at the classroom and school levels, have been attempted over the past several decades, and their impact on the school system has been negligible. It has become clear that transforming the paradigm of schools is not a simple job. Teachers, administrators, parents, policy-makers, students, and all other stakeholder groups must work together, as they cannot change such a complex culture and system alone. In order to transform our schools to be truly learner-centered, a critical systems approach to transformation is essential.

The first article in this series (Reigeluth & Duffy, 2008) described the FutureMinds approach for state education departments to support this kind of change in their school districts. The second article (Duffy & Reigeluth, 2008b) described the School System Transformation (SST) Protocol, a synthesis of current knowledge about how to help school districts use a critical systems approach to transform themselves to the learner-centered paradigm of education. Hopefully, with state leadership through FutureMinds, the critical systems approach to educational change in the SST Protocol, and the new knowledge about learner-centered instruction, we will be able to create a better place for our children to learn and grow. However, this task will not be easy. One essential ingredient for it to succeed is the availability of powerful tools to help teachers and students in the learner-centered paradigm. The fourth article in this series will address this need.

Application Exercises

- Review the author's theoretical learner centered school. What do you see as the strengths of this format? What are its weaknesses?
- The authors of this article suggest giving students authentic tasks in the community to help them achieve their academic goals. What authentic, community project would you have designed for yourself as a high school student? Now?
- Do a little bit of research and share what tools are available to aid instructors in becoming more learner centric. What limitations do these tools have? What do they do well? What factors of the learner environment must change to make these tools more effective?
- How would you design a learner-centered school that may be different from the version that are discussed in this article?

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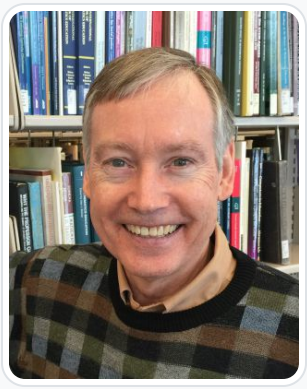

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35

Distance Learning

Florence Martin & Beth Oyarzun

Use of online and blended learning continues to grow in higher education. As of 2015, approximately 70% of degree-granting institutions have some online offerings (Allen & Seaman, 2015). Research in online learning has been conducted at micro and macro levels. Micro level research has been conducted at the course or individual case study level, investigating variables such as effective instructional strategies or demographic profiles of successful learners in these environments. Macro level research has been conducted at the national or global levels, investigating access to education via free online courses such as Massively Open Online Courses, otherwise known as MOOCs, and examining global standards for online learning.

This chapter explores several research trends in order to assess the state of online learning and identify opportunities for future research. In order to better understand the research trends, definitions are presented first followed by quality standards for online learning courses, and programs developed by professional organizations are summarized. Student, faculty, and administrator perceptions of online learning are reviewed in addition to best practices in design and implementation in online learning. Best practices regarding faculty and learner support are also discussed. Finally, the chapter concludes with a list of academic journals dedicated to online learning research, and a review of trends in online learning to watch.

Definitions of Delivery Methods

In this section, we briefly define the various terms involved with online delivery methods.

Table 1. Definition of Online Delivery Methods

Asynchronous online learning	A course where most of the content is delivered online and students can participate in the online course from anywhere at anytime. There are no real time online or face-to-face meetings.
Synchronous online learning	A course where most of the content is delivered online and students can participate in courses from anywhere. There are real time online meetings and students login from anywhere but at the same time to participate in the course.
MOOC	These are Massive Open Online Courses where an unlimited number of students can access the open source content free of cost.
Blended/Hybrid	A course with a combination of face-to-face and asynchronously online delivery with a substantial portion of the course delivered online.

Blended Synchronous	A combination of face-to-face and synchronously online students in the course.
Multi-Modal	A combination of synchronous and asynchronous online learning in the course.

Distance education and online learning are terms that are often used interchangeably. However, online learning and its components are encompassed within distance education, which contains two components that are not representative of online learning: correspondence courses and satellite campuses. Figure 1 is a visual representation of the delivery methods of distance education.

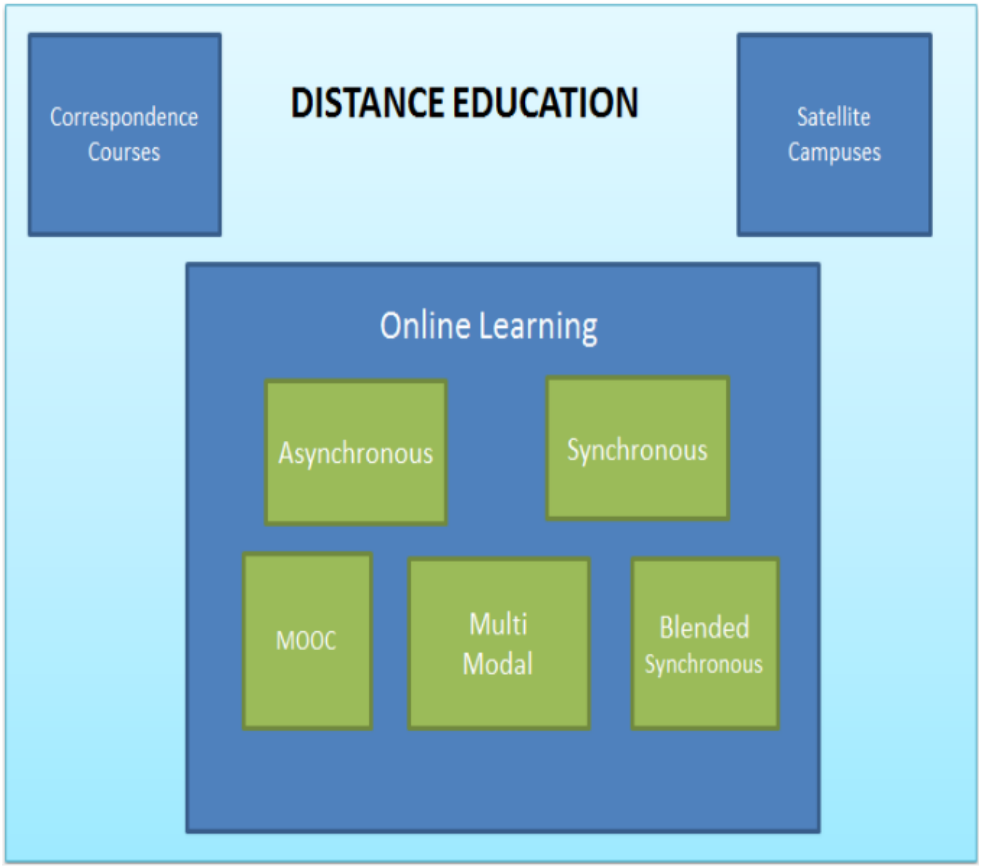

Figure 1. Online Learning Delivery Methods

Standards and Frameworks for Online Learning

Various standards and frameworks are available for instructors and administrators to use when designing and implementing online learning. Shelton (2011) reviewed 13 paradigms for evaluating online learning and suggested a strong need for a common method for assessing the quality of online education programs. Shelton (2011) found that a theme of institutional commitment, support, and leadership was frequently seen in these standards. At least 10 of the standards included an institutional commitment, support, and leadership theme as a primary indicator of quality. Teaching and learning was the second most cited theme for indicating quality.

Daniel and Uvalic-Trumbic (2013) in their review of quality online learning standards list institutional support (vision, planning, and infrastructure), course development, teaching and learning (instruction), course structure, student support, faculty support, technology, evaluation, student assessment, and examination security as elements essential for quality online learning. They also add that to assure quality online learning in higher education the most essential requirement is the institutional vision, commitment, leadership, and sound planning.

Martin, Polly, Jokiaho, and May (2017) on reviewing twelve different global standards for online learning found that the number of standards varied in these documents from 17 to 184 (Table 21). Instructional analysis, design, and development (N=164); student attributes, support, and satisfaction (N=115); and institutional mission, structure, and support (N=102) were the top categories. Course facilitation, implementation, and dissemination (N=40); policies and planning (N=33); and faculty support and satisfaction (N=27) were rated the lowest three.

Table 2. Standard Details (Name, Year, Sponsor, Number of Sections and Number of Standards). Used with permission from Martin, Polly, Jokiaho & May (2017).

Standard Name	Year	Sponsor	Number of Sections	Number of Standards
Quality on the Line: Benchmarks for Success in Internet Based Distance Education	2000	Institute for Higher Ed Policy, supported by NEA and Blackboard	7	24
Open eQuality Learning Standards (Canada), http://www.eife-l.org/publications/quality/ oeqls/intro	2004	Canada	4	25
Online Learning Consortium (Formerly Sloan-C) Quality Scorecard	2005	OLC Consortium	8	75
Blackboard Exemplary Rubric	2000	Blackboard	4	17
Quality Matters	2015, 5th edition	Quality Matters	8	45
CHEA Institute for Research and Study of Accreditation and Quality Assurance	2002 revision 1	Council for Higher Education Accreditation	7	7
NADEOSA (South Africa)	2005 revision of 1996 document		13	184
ACODE (The Australasian Council on Open, Distance and e-learning)	2014	Australasian Council on Open, Distance and e-learning	8	64
AAOU (Asian Association of Open Universities)	no date	Asian Association of Open Universities	10	54
ECBCheck	2012		13	46
UNIQUe	2011		10	71
International Organization for Standardization (ISO)	2005		7	38

These three analyses of the quality standards and frameworks over time echo similar results that institutional factors such as vision, support, and planning are important indicators of quality online learning.

Perception of Online Learning

Several researchers have examined student, faculty, and administrator perceptions of online learning on various online learning characteristics. In the following section, research studies on key online learning characteristics are categorized.

Student Perception

Table 3 summarizes the key perceptions of students on online learning, including benefits and challenges.

Table 3. Student Perception of Online Learning

Online Learning Characteristics	Research Studies
Flexibility and convenience	Schwartzman (2007); Leasure, Davis, & Thievon (2000); Petrides (2002) ; Schrum (2002); Poole's (2000);, Karaman (2011)
Online discussion helps in providing thoughtful/supporting responses	Meyer (2003);, Petrides (2002);, Vonderwell (2003)
Belongingness in online learning community	Lapointe & Reisette (2008)
Interaction and engagement	Greener (2008); Martin, Parker & Deale (2012)
Self-aware and self-directed	Greener (2008)
Lack of immediacy	Petrides (2002); Vonderwell (2003)
Lack of sense of community/ feeling isolated	Vonderwell (2003); Woods (2002)

Faculty Perception

Table 4 summarizes the key perceptions of faculty on online learning, including benefits and challenges.

Table 4. Faculty Perception of Online Learning

Online Learning Characteristics	Research Studies
Flexibility	Hiltz, Shea, &and Kim (2007)
Reach more diverse students	Hiltz, Shea, &and Kim (2007);, Bolliger & and Wasilik (2009)
Technological difficulties	Bolliger &and Wasilik (2009); , Lieblein (2000);, Hunt, Davis, Richardson, Hammock, Akins, & Russ, (2014)
Workload issues	Bolliger &and Wasilik (2009);, Mandernach, Hudson, & Wise, (2013)
Importance of Institutional Support	Gaytan (2015);, Martin &and Parker (2014)

Administrators Perception

Table 5 summarizes the key perceptions of administrators on online learning, including benefits and challenges.

Table 5. Administrator Perception of Online Learning

Online Learning Characteristics	Research Studies
Time, cost, instructional design, instructor student relationships, reward structure, degree programs, policy, training	Rockwell, Schauer, Fritz, & Marx, (1999)
Measuring seat time, student outcomes, syllabi consistency, faculty support, faculty input, grading policy and criteria, grading disputes, testing	Sellani, & Harrington (2002)
Advocacy for online education, staying informed and learning about online education, collaborating with faculty, procedural changes, changes in schemas and roles	Garza (2009)
Faculty compensation and time; organizational change; and technical expertise, support, and infrastructure for online teaching; institutional direction for online learning	Orr, Williams, & Pennington (2009).

Best Practices for Course Design and Implementation

The research trends in online learning from the course perspective are organized into two sections: course design and implementation. Muilenburg and Berge (2007) conducted a factor analysis study to determine student barriers to online learning. Eight factors were identified: (1) administrative issues, (2) social interaction, (3) academic skills, (4) technical skills, (5) learner motivation, (6) time and support, (7) cost and internet access, and (8) technical problems. Research in online course design and implementation has tried to address these issues. One example is the development and research of the Community of Inquiry framework (Garrison, Anderson, & Archer, 1999) which provides guidelines for faculty and designers to create meaningful interactive learning experiences that increase the level of social interaction.

Course Design

Recently, Lister (2014) conducted an analysis of online learning literature to identify patterns and themes for the design of online courses. Four themes emerged: course structure, content presentation, collaboration and interaction, and timely feedback. Similarly, Mayes, Luebeck, Ku, Akarasriworn, and Korkmaz (2011) conducted a literature review around six themes to identify specific recommendations for designing quality online courses. The themes used were learners and instructors, medium, community and discourse, pedagogy, assessment, and content. Recommendations identified included structuring courses, developing student-centered interactive learning activities, building collaboration through group projects, incorporating frequent assessments and strategies for equitable scoring such as rubrics, and providing sufficient detail and soliciting student feedback.

Jaggers (2016) developed a course design rubric that assessed organization/orientation, objectives/assessments, interpersonal interaction, and the use of technology for their effects on student achievement. The results showed that well organized courses with specific objectives were more desirable but may not have an impact on student achievement. However, the quality of interpersonal interaction within the courses positively correlated with student grades. The following sections explore research in course design and implementation trends in more depth.

Instructors may have various levels of control over the design of the course structure, depending on organizational philosophies. Lee, Dickerson, and Winslow (2012) defined three approaches to faculty control of course structure: fully autonomous, basic guidelines, and highly specified. When faculty have less control of their course design, the courses are designed by the institution with instructors serving more as facilitators. Regardless of the amount of faculty control,

there are basic elements to course structure that research has shown to be effective such as a having a consistent course structure throughout the course (Swan, 2001).

Gamification and the use of games, virtual worlds, and simulations have also gained traction in the online learning research. Gamification is defined as the application of game design elements, such as digital badges, in non-game contexts. Hamari et al. (2014) conducted a literature review of gamification studies and found that gamification can have positive effects, but those effects depended on the context in which the strategies were implemented and the audience. For example, in the context of applying gamification in an educational setting learners experienced increased motivation and engagement. However, some negative outcomes were also identified such as increased levels of competition. However, in areas such as health and exercise increased levels of competition may not be considered a negative outcome. Similarly, the different qualities of the users may also have effects on levels of motivation and engagements. Merchant et al. (2014) conducted a meta-analysis to examine the effects of games, virtual worlds, and simulations as instructional methods. The results showed that students had higher learning gains with games over virtual worlds and simulations. More recently, Clark et al. (2016) found similar results when investigating the literature for effects of games on learning outcomes. The effectiveness of the content delivery method depends on the effectiveness of the design of the instruction and the suitability of the method for the context of instruction.

Assessment affects how learners approach learning and the content as well as how learners engage with one another and the instructor (Kolomitro & MacKenzie, 2017). Students access course content based upon the belief that the course will help them learn and have better outcomes (Murray, Perez, Geist, & Hedrick, 2012). Therefore the design of online assessments should promote active learning and ensure that success depends on retaining course content. Martin and Ndoye (2016) examined learner-centered assessment in online learning and how instructors can use learning analytics to improve the design and delivery of instruction to make it more meaningful. They demonstrated several data analytic techniques that instructors can apply to provide feedback to students and to make informed data-driven decisions during instruction as opposed to after instruction. Applying such techniques can increase retention of online students.

Interaction, Collaboration, and Engagement

Transactional distance theory defined the feeling of isolation or psychological distance that online learners often experience (Moore, 1989). To lessen transactional distance, Moore defined three types of interaction: (a) learner-to-learner, (b) learner-to-instructor, and (c) learner-to-content to guide faculty to create quality distance education experiences. Bernard et al. (2009) conducted a meta-analysis on 74 distance education studies on the effects of Moore's three types of interaction and found support for their importance for achievement.

The Community of Inquiry framework built upon these types of interaction and defined a quality education experience for an online learner in terms of three overlapping presences: cognitive, social, and teaching (Garrison, Anderson, & Archer, 1999). However, the Community of Inquiry framework's ability to create deep and meaningful learning experiences has come into question because much of the research used self-reporting, achievement, and perception measures (Rourke and Kanuka, 2009; Annand, 2011).

Another research lens used to address online learner isolation is learner engagement. Engagement in any learning is important. However in online learning engagement is more important because online learners have fewer chances to interact with each other, the instructor, and the institution. Chickering and Gamson (1987) proposed a framework composed of seven principles of good practices to ensure students' engagement. These principles established high standards for face-to-face courses but can be applied to the design and implementation of online courses in order to increase engagement. The table below lists the principles of engagement proposed by Chickering and Gamson and the comparative principles for effective online teaching proposed by Graham et al., (2001).

Table 6. Principles of Engagement

Seven Principles of Engagement,	Seven Principles of Effective Online Teaching,

Chickering and Gamson (1987)	Graham, Cagiltay, Lim, Craner, & Duffy (2001)
Increases the contact between student and faculty	Provides clear interaction expectations
Provides opportunities for students to work in cooperation	Facilitates meaningful cooperation through well-designed assignments
Encourages students to use active learning strategies	Requires course project presentations
Provides timely feedback on students' academic progression	Provides information and acknowledgment feedback
Requires students to spend quality time on academic tasks	Uses deadlines and milestones to keep students on track
Communicates high expectations	Creates challenging tasks and case studies, and communicates positive feedback for quality work
Addresses different learner needs in the learning process	Allows students to choose topics for assessments in order to incorporate diverse views

More recently, Dixon (2010) created and validated a scale to measure online learner engagement. The instrument was used to survey 186 online learners from six different campuses. Results showed that multiple communication channels or meaningful and multiple ways of interaction may result in higher learner engagement. However, more research should be conducted to validate these results.

Research on all of these frameworks echo the importance of collaborative or cooperative learning. Borokhovski et al. (2012) conducted a follow-up study to the Bernard (2009) meta-analysis investigating the effects of online collaborative learning on achievement. The results indicated that collaborative learning activities had higher effects on student achievement. Conversely, Oyarzun and Morrison (2013) conducted a quasi-experimental study investigating the effects of cooperative online learning on achievement and found no significant difference in achievement between students who completed the assignment individually or cooperatively. However, more experimental research is needed to validate the effects of collaborative learning and to identify effective methods of online collaborative learning.

Course Implementation

Muilenburg and Berge (2007) identified several issues related to online learning implementation from the student perspective, including course materials that are not always delivered on time, instructors not knowing how to teach online, lack of timely feedback, and lack of access to instructor. Three of these deal specifically with instructor immediacy or responsiveness. Bodie and Michel (2014) conducted an experimental study manipulating immediacy strategies for 576 participants in an introductory psychology course. Results revealed that learners in the high immediacy group showed greater learning gains and retention. Martin, Wang and Sadaf (2017) investigated the effects of 12 different facilitation strategies on instructor presence, connection, learning, and engagement. They found that students perceived timely response to questions and feedback on assignments from instructors helpful. It was also noted that instructors' use of video aided in building a connection with the instructor. Timeliness and immediacy are common themes in the research. Again, more experimental research should be conducted to identify specific strategies for faculty.

In addition, Oncu and Cankir (2011) identified four main research goals for course design and implementation to address achievement, engagement, and retention issues in online learning. The four goals are (1) learner engagement & collaboration, (2) effective facilitation, (3) assessment techniques, and (4) designing faculty development. They further recommended that experimental research be conducted to identify effective practices in these areas. Thus, there are many frameworks and principles for effective design and implementation of online learning, but there is still a lack of research validating many of these ideas or providing effective cases.

Faculty and Learner Support

Faculty Support

Several universities who offer online courses are providing online course planning and development support and technology support to their faculty, along with institutional support.

Online teaching can be very demanding on faculty. A recent study found that online teaching demanded 14% more time than traditional teaching and fluctuated considerably during times of advising and assessment (Tomei, 2006). With the spread of online teaching practices in higher education, many academic staff are faced with technological and pedagogical demands that require skills they don't necessarily possess (Weaver, Robbie, & Borland, 2008). The quality of online programs depends upon the pedagogical practices of online teachers; therefore, faculty support in online programs is very important (Baran & Correia, 2014).

Some believe that the success of online teaching depends upon the support of faculty on three main levels: teaching, community, and organization (Baran & Correia, 2014). The teaching level includes assistance with technology, pedagogy, and content through workshops, training programs, and one-on-one assistance. The challenge here is often the fact that academic staff find it hard to adapt to changes in their teaching or to allow someone else to tell them how to teach. Therefore individuals who design online programs need to first establish themselves as experts and to be viewed as such by faculty (Weaver, Robbie & Borland, 2008).

The community level includes collegial learning groups, peer support programs, peer observation, peer evaluation, and mentoring programs. Some have highlighted the importance of creating a supportive community for online instructors who often feel isolated (Eib & Miller, 2006). Building learning communities and communities of practice for online teachers as well as providing opportunities for students and online faculty helps combat feelings of isolation (Eib & Miller, 2006; Top, 2012).

The institutional level of support consists of rewards and recognition and the promotion of a positive organizational culture towards online education (Baran & Correia, 2014, p. 97). Institutional support is seen as supremely important (Baran & Correia, 2014; Weaver, Robbie & Borland, 2008). On one hand, if the deans and department heads do not support online teaching, the faculty who does may feel marginalized, unsupported within their discipline, and isolated. On the other hand, if upper management adopts online teaching and pushes for too many changes too quickly, planned implementation and adequate training can be grossly neglected, resulting in dissatisfaction among academic staff (Weaver, Robbie & Borland, 2008).

Learner Support

Online education is supported by technology-assisted methods of communication, instruction, and assessment. The methods of communication in online learning are very important since feedback given to students depends on them. For some students, synchronous communication helps with receiving direct feedback; whereas, for others, asynchronous communication methods allow for more control on the part of the students to process feedback and respond at their own pace (Gold, 2004). Some have stressed the importance of not simply creating online interaction but rather developing high quality technology-assisted communication to promote student outcomes (Gold, 2004). Students report that the most common negative aspects of online classes are technology problems and feeling lost in

cyberspace. On the other hand, they appreciate the flexibility of online classes and find instructor availability and a sense of community to be positive aspects of online learning (El Mansour & Mupinga, 2007).

Community building in online classes has received more attention in recent years. Social presence refers to "the strength of the social relationships and emotional connection among the members of a class or learning community" (Rubin, 2013, p. 119). On an individual level, social presence refers to how involved and engaged each individual student is in the community, and his or her motivation and drive to share, interact, and learn from others. On a community level, social presence refers to the shared sense of belonging of the students in the classroom. Teachers can influence social presence by designing group assignments, creating discussion forums, rewarding community building behaviors and modeling openness and sharing (Rubin, 2013). Teacher presence refers to designing learning experiences, guiding and leading students' work, providing feedback, and facilitating interaction and community building (Rubin, 2013).

Technology characteristics in online learning are important considerations. Some have suggested that interface design, function, and medium richness play a key role in student satisfaction. The medium should accommodate both synchronous and asynchronous communication and the interface should be appealing, well structured, easy to use, allow for different media such as text, graphics, and audio and video messages, and have the capability of providing prompt feedback to students (Volery & Lord, 2000). Ice, Curtis, Lunt and Curran (2010), Merry and Orsmond (2007) and Philips and Wells (2007) found that students responded positively to audio feedback.

Within the context of learner support, providing accommodations and support for students with disabilities is also an important consideration in online education. In particular, for students with cognitive impairments, navigating an online course can be particularly challenging, as existing platforms typically do not support such learners (Grabinger, Aplin & Ponnappa-Brenner, 2008).

Trends/ Future Directions of Online Learning

Online learning is bringing about constant change. Smith (2014) in the Educational Technology magazine identified 10 online learning trends to watch. Though this was listed in 2014, these are still trends to consider: (1) big data, (2) gamification, (3) personalization, (4) m-learning, (5) focus on return on investment, (6) APIs, (7) automation, (8) augmented learning, (9) corporate MOOCs, and (10) rise of cloud LMS. In 2017, Friedman (2017) identified the following five online learning trends to watch in 2017: (1) greater emphasis on nontraditional credentials, (2) increased use of big data to measure student performance, (3) greater incorporation of artificial intelligence into classes, (4) growth of nonprofit online programs, and (5) online degrees in surprising and specialized disciplines. It is important for educators to keep up with these changing trends to better prepare students.

Additional Resources

Table 7. Journals focusing on Online Learning

American Journal of Distance Education	https://edtechbooks.org/-Ce
Distance Education: An International Journal	https://edtechbooks.org/-eq
Distance Learning Magazine	https://edtechbooks.org/-mD
European Journal of Open and Distance Learning (EURDL)	http://www.eurodl.org/
International Journal of Instructional Technology & Distance Learning	http://www.itdl.org/index.htm
International Journal on E-Learning	https://edtechbooks.org/-oa
International Journal of Online Pedagogy and Course Design	https://edtechbooks.org/-BV

International Review of Research in Open and Distance Learning (IRRODL)	http://www.irrodl.org/
Journal of Distance Education	https://edtechbooks.org/-VD
Journal of Interactive Online Learning	http://www.ncolr.org/jiol/
Online Journal of Distance Learning Administration	https://edtechbooks.org/-xe
Online Learning Journal (OLJ)	https://edtechbooks.org/-pk
Open Learning: The Journal of Open and Distance Learning	https://edtechbooks.org/-Ku
Turkish Online Journal of Distance Education	https://edtechbooks.org/-qd

Application Exercises

- What are the strengths and weaknesses of synchronous and asynchronous online education?
- Describe at least 3 factors which have been shown to have a positive impact on distance learning.

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36

Old Concerns with New Distance Education Research

Media Comparison Studies Have Fatal Flaws That Taint Distance Learning Research Relying On This Strategy

Barbara Lockee, Mike Moore, & John Burton

Editor's Note

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Lockee, B. B., Moore, M., & Burton, J. (2001). Old concerns with new distance education research. *Educause Quarterly*, *24*(2), 60–62. Retrieved from https://net.educause.edu/ir/library/pdf/EQM0126.pdf

Distance educators who have gone through the process of designing, developing, and implementing distance instruction soon realize that the investment is great and the results of their efforts possibly tenuous. Ultimately, the question arises, "Does it work?" Unfortunately, to answer the question, many educators use a strategy of comparing distance courses with traditional campus-based courses in terms of student achievement. This phenomenon, called the media comparison study, has actually been in use since the inception of mediated instruction.

The following analysis looks at research currently being conducted by some stakeholders in the name of valid distance learning research. Such "research" essentially repeats the mistakes of prior media studies that use the long-discredited media comparison approach.

Flawed Research Design

A popular educational research strategy of the past compared different types of media-based instruction (for example, film to television) or compared mediated instruction to teacher-presented instruction (lecture) to determine which was "best." These types of studies became known as media comparison studies.[1] These studies assumed that each medium was unique and could or could not affect learning in the same way. The researcher who conducted this type of research — comparing one medium to another — looked at the whole unique medium and gave little thought to each one's attributes and characteristics, to learner needs, or to psychological learning theories.

The research design is based on the standard scientific approach of applying a treatment variable (otherwise known as the independent variable) to see if it has an impact on an outcome variable (the dependent variable). For example, to determine if a new medicine could cure a given illness, scientists would create a treatment group (those with the illness who would receive the new medicine) and a control group (those with the illness who would receive a placebo). The researchers would seek to determine if those in the treatment group had a significantly different (hopefully positive) reaction to the drug than those in the control group. (The terms "significant difference" and "no significant difference" are statistical phrases referring to the measurement of the experimental treatment's effect on the dependent variable.)

In the case of media comparison studies, the delivery medium becomes the treatment variable and student achievement, or learning, is seen as the dependent variable. While such an approach may seem logical at face value, it's unfortunately plagued with a variety of problems. Such a design fails to consider the many variables that work together to create an effective instructional experience. Such factors include, but are certainly not limited to, learner characteristics, media attributes, instructional strategy choices, and psychological theories.

Learner Characteristics

In media comparison studies, researchers view students as a homogenous unit instead of as individuals with unique characteristics and learning needs. As anyone who has ever taught knows, learners bring with them a variety of qualities and experiences. For example, if learners have a certain cognitive style that affects their perception of complex visual information (that is, field dependence), they may be disadvantaged in Web-based courses, particularly if the interface lacks intuitiveness or consistency. To lump all learners together ignores important traits that may affect learning.

Media Attributes

Media comparison studies usually provide little information about a specific medium's capabilities.[2] The comparison design inherently assumes that each medium is unique and can affect learning in some way. The confounding factor here is that each medium consists of many attributes that may affect the value of the medium's instructional impact.

Media attributes are traditionally defined as "…the properties of stimulus materials which are manifest in the physical parameters of media."[3] Levie and Dickie provided a comprehensive taxonomy of media attributes, including type of information representation (text, image, or sound), sensory modalities addressed (auditory, visual, and so on), level of realism (abstract to concrete), and ability to provide feedback (overt, covert, immediate, or delayed). So, instead of treating a distance delivery medium as amorphous, we could ask a more relevant question by targeting the specific qualities or attributes of the medium.

For example, is a videotape instructionally successful because of the movement it illustrates, the realistic color image, the close-up detail, the authentic sound, or some combination of these characteristics? Individual attributes need to be isolated and tested as variables in and of themselves, instead of treating the whole delivery system as one functional unit.

Instructional Strategies

Clark[4] maintained that one of the primary flaws in media comparison studies is the confusion of instructional methods with the delivery medium. Instead of treating the distance delivery technology as a facilitator of the chosen instructional strategies, many who engage in such comparisons treat the medium (Web-based instruction, for example) as the strategy itself. For example, comparing a face-to-face course to a Web-based course doesn't tell us anything about what the teacher or students did in a face-to-face class, or what strategies the Web-based event employed. Perhaps a Web-based event succeeded because students engaged in collaborative problem-solving compared to students in the face-to-face setting who simply received information through lectures. Note that the students in a face-to-face class could

also engage in collaborative problem-solving. In fact, occupying the same room during such an exercise might actually enhance the experience.

Any instructional environment can support a variety of instructional methods, some better than others. To credit or blame the delivery medium for learning ignores the effectiveness of the instructional design choices made while creating a learning event.

Theoretical Foundations

The conduct of research relies on the testing of some theory. Research regarding the processes of learning should frame its inquiries around the psychological theories that underpin these processes. For example, the theoretical position of behaviorism depends on the use of reinforcement to strengthen or weaken targeted learning behaviors.[5] A research study that invokes this theory might investigate the use of positive reinforcement to reduce procrastination in distance education, for example. The primary concern related to media comparison studies is that they test no theoretical foundation — they simply evaluate one instructional delivery technology against another. Inquiry devoid of theory is not valid research.

As indicated earlier, many factors work together to create an effective instructional event. In addition to the previous variables, any study should also consider instructional content and context, as well as the type of learning (cognitive, affective, or psychomotor). It's possible that the interactions of all these elements contribute to more effective experiences. Given the many good questions to ask, it should prove relatively easy to avoid asking a poor one — like comparing different distance delivery media.

In 1973, Levie and Dickie[6] suggested that comparison studies were "fruitless" and that most learning could be received by means of "a variety of different media." To avoid the same errors, we should heed their advice and seek answers to more beneficial questions. Unfortunately, problems affecting comparison studies often don't stop with their research design flaws, but continue with the interpretation of their outcomes.

Misuse of Results

Ask a poor question, get a poor answer. Clearly, any outcomes generated by comparison studies are invalid, based on the fact that the questions themselves are inherently confounded. However, that fact doesn't stop those who conduct such studies from misinterpreting and misapplying their results.

Most media comparison studies result in "no significant difference" findings. This means that the treatment had no measurable effect on the outcome, or dependent, variable. A distance-education comparison study typically compares the achievement of students on campus to the achievement of students engaged in distance-delivered instruction. Unfortunately, researchers often incorrectly interpret a "no significant difference" result as evidence that the mediated, or distance-delivered, instruction is as effective as traditional, or teacher-led, instruction in promoting learning.

Many early comparison studies aimed to prove an instructional medium's effectiveness to justify the purchase and implementation of new technologies (radio, television, computers, and so forth). The outcomes of current distance-education comparison studies are being used to demonstrate not the superiority of the distance experience, but the equality of it. The problem lies in the flawed logic behind the interpretation of "no significant difference."

"No significant difference" is an inconclusive result, much like the "not guilty" assumption in the U.S. legal system. It means just that and nothing more — not guilty does not mean innocent. A finding of "no significant difference" between face-to-face instruction and distance-delivered instruction does not mean they're equally good or bad.

Russell's brief work,[7] as well as his Web site, is widely referenced. Yet he demonstrated an apparent misunderstanding of why comparison studies aren't appropriate:

"[A department head]…long felt that such studies amounted to beating a dead horse." This is true. There no longer is any doubt that the technology used to deliver instruction will not impact the learning for better or for worse. Comparative studies, such as those listed in the "no significant difference" document, are destined to provide the same "no significant difference" results. So why do they continue to be produced?

Could it be that the inevitable results are not acceptable? When this listing was first compiled and published in 1992, it was stated that it was and continues to be folly to disagree with those who say that it is time to stop asking the question: Does the technology used to deliver instruction improve it? Clearly, it does not; however, it does not diminish it either. As far as learning is concerned, there is just "no significant difference."[8]

In this statement, Russell showed little understanding of the problems inherent in comparison studies that we described (technically, the inherent violations of the assumption of ceteris paribus — that all things are assumed equal except for those conditions that are actually manipulated; see Orey,[9] for example). Worse, he commited the fallacy of assuming that "no significant difference" means "the same."

Research and Evaluation

Many authors of early comparison studies intended to justify implementation of new media or replacement of "traditional" methods of teaching with more efficient (but equally effective) approaches. These reasons are painfully similar to what current research is being asked to do concerning the quality of distance education experiences. On a positive note, the past 20 years have seen attempts to move away from these comparison approaches and place more emphasis on content to be learned, the role of the learner, and the effectiveness of instructional design decisions, rather than on the instructional quality of a specific medium.

Many investigators who engage in media comparison studies sincerely believe they're conducting valid research that will generalize to the larger distance learning population. More probably, they need to focus on the localized evaluation of their particular distance education courses and programs.

The distinction between research and evaluation sometimes blurs because they share many of the same methods. However, the intentions differ considerably. Research involves testing theories and constructs to inform practice, while evaluation seeks to determine if a product or program was successfully developed and implemented according to its stakeholders' needs. To assess the effectiveness of a given distance education experience, investigators can answer relevant questions through the more appropriate evaluation techniques.

Application Exercises

- According to the author, what would be a valid method of evaluating distance education?
- In what ways do media and pedagogy intersect? Which do you believe to have a greater impact on student learning?
- In your own words, describe why media comparison studies may not be productive.
- In a small group, design a study that would more accurately test the difference between in-class and online classes. How would you isolate the variables Lockee suggests?

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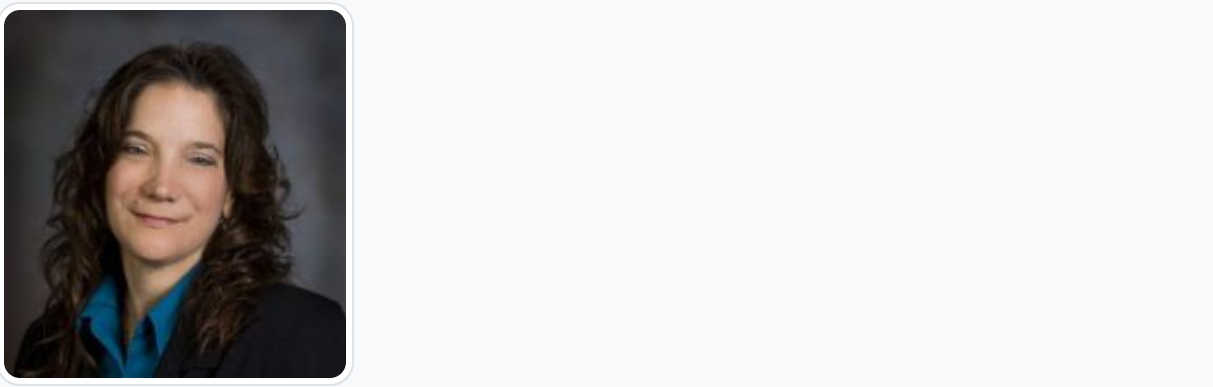

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37

Open Educational Resources

David Wiley

Editor's Note

The following was submitted by David Wiley as a good introduction to his thoughts on open educational resources and is a preprint of an essay set to appear in Bonk, Lee, Reeves, and Reynolds's book, MOOCs and Open Education around the World. It may have undergone additional editing before publication. This essay remixes some material that was previously published on Wiley's website, opencontent.org and is available at https://edtechbooks.org/-dB.

Wiley, D. (2014, September 18). The MOOC misstep and the open education infrastructure [Web log post]. Retrieved from https://edtechbooks.org/-Dm

Ted Talk

For additional learning from Wiley about open educational resources and their relevance to education, see his TEDx Talk.

Watch on YouTube

In this piece I briefly explore the damage done to the idea of “open” by MOOCs, advocate for a return to a strengthened idea of “open,” and describe an open education infrastructure on which the future of educational innovation depends.

Moocs: One Step Forward, Two Steps Back for Open Education

MOOCs, as popularized by Udacity and Coursera, have done more harm to the cause of open education than anything else in the history of the movement. They have inflicted this harm by promoting and popularizing an abjectly impoverished understanding of the word “open.” To fully appreciate the damage they have imposed requires that I lightly sketch some historical context.

The openness of the Open University of the UK, first established in 1969 and admitting its first student in 1971, was an incredible innovation in its time. In this context, the adjective “open” described an enlightened policy of allowing essentially anyone to enroll in courses at the university—regardless of their prior academic achievement. For universities, which are typically characterized in metaphor as being comprised of towers, silos, and walled gardens, this opening of the gates to anyone and everyone represented an unprecedented leap forward in the history of higher education. For decades, “open” in the context of education primarily meant “open entry.”

Fast-forward 30 years. In 2001 MIT announced its OpenCourseWare initiative, providing additional meaning to the term “open” in the higher education context. MIT OCW would make the materials used in teaching its on campus courses available to the public, for free, under an “open license.” This open license provided individuals and organizations with a broad range of copyright-related permissions: anyone was free to make copies of the materials, make changes or

improvements to the materials, and to redistribute them (in their original or modified forms) to others. All these permissions were granted without any payment or additional copyright clearance hurdles.

While there are dozens of universities around the world that have adopted an open entry policy, in the decade from 2001–2010 open education was dominated by individuals, organizations, and schools pursuing the idea of open in terms of open licensing. Hundreds of universities around the globe maintain opencourseware programs. The open access movement, which found its voice in the 2002 Budapest Open Access initiative, works to apply open licenses to scholarly articles and other research outputs. Core learning technology infrastructure, including Learning Management Systems, Financial Management Systems, and Student Information Systems are created and published under open licenses (e.g., Canvas, Moodle, Sakai, Kuali). Individuals have begun contributing significantly to the growing collection of openly licensed educational materials, like Sal Khan who founded the Khan Academy. Organizations like the William and Flora Hewlett Foundation are pouring hundreds of millions of dollars into supporting an idea of open education grounded in the idea of open licensing. In fact, the Hewlett Foundation's definition of "open educational resources" is the most widely cited:

> *OER are teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge (Hewlett, 2014).*

According to Creative Commons (2014), there were over 400 million openly licensed creative works published online as of 2010, and many of these can be used in support of learning.

Why is the conceptualization of "open" as "open licensing" so interesting, so crucial, and such an advance over the simple notion of open entry? In describing the power of open source software enabled by open licensing, Eric Raymond (2000) wrote, "Any tool should be useful in the expected way, but a truly great tool lends itself to uses you never expected." Those never expected uses are possible because of the broad, free permissions granted by open licensing. Adam Thierer (2014) has described a principle he calls "permissionless innovation." I have summarized the idea by saying that "openness facilitates the unexpected" (Wiley, 2013). However you characterize it, the need to ask for permission and pay for permission makes experimentation more costly. Increasing the cost of experimentation guarantees that less experimentation will happen. Less experimentation means, by definition, less discovery and innovation.

Imagine you're planning to experiment with a new educational model. Now imagine two ways this experiment could be conducted. In the first model, you pay exorbitant fees to temporarily license (never own) digital content from Pearson, and you pay equivalent fees to temporarily license (never own) Blackboard to host and deliver the content. In a second model, you utilize freely available open educational resources delivered from inside a free, open source learning management system. The first experiment cannot occur without raising venture capital or other significant funding. The second experiment can be run with almost no funding whatsoever. If we wish to democratize innovation, as von Hippel (2005) has described it, we would do well to support and protect our ability to engage in the second model of experimentation. Open licenses provide and protect exactly that sort of experimental space.

Which brings us back to MOOCs. The horrific corruption perpetrated by the Udacity, Coursera, and other copycat MOOCs is to pretend that the last forty years never happened. Their *modus operandi* has been to copy and paste the 1969 idea of open entry into online courses in 2014. The primary fallout of the brief, blindingly brilliant popularity of MOOCs was to persuade many people that, in the educational context, "open" means open entry to courses which are not only completely and fully copyrighted, but whose Terms of Use are more restrictive than that of the BBC or New York Times. For example, consider this selection from the Coursera Terms of Use:

> *You may not take any Online Course offered by Coursera or use any Statement of Accomplishment as part of any tuition-based or for-credit certification or program for any college, university, or other academic*

> *institution without the express written permission from Coursera. Such use of an Online Course or Statement of Accomplishment is a violation of these Terms of Use.*

The idea that someone, somewhere believes that open education means "open entry to fully copyrighted courses with draconian terms of use" is beyond tragic. Consequently, after a decade of progress has been reversed by MOOCs, advocates of open education once again find ourselves fighting uphill to establish and advance the idea of "open." The open we envision provides just as much access to educational opportunity as the 1960s vision championed by MOOCs, while simultaneously enabling a culture of democratized, permissionless innovation in education.

An "open" Worth the Name

How, then, should we talk about "open?" What strengthened conception of open will promote both access and innovation? I believe we must ground our open thinking in the idea of open licenses. Specifically, we should advocate for open in the language of the 5Rs. "Open" should be used as an adjective to describe any copyrightable work that is licensed in a manner that provides users with free and perpetual permission to engage in the 5R activities:

1. Retain – the right to make, own, and control copies of the work (e.g., download, duplicate, store, and manage)
2. Reuse – the right to use the work in a wide range of ways (e.g., in a class, in a study group, on a website, in a video)
3. Revise – the right to adapt, adjust, modify, or alter the work itself (e.g., translate it into another language)
4. Remix – the right to combine the original or revised work with other open works to create something new (e.g., incorporate the work into a mashup)
5. Redistribute – the right to share copies of the original work, your revisions, or your remixes with others (e.g., give a copy of the work to a friend)

These 5R permissions, together with a clear statement that they are provided for free and in perpetuity, are articulated in many of the Creative Commons licenses. When you download a video from Khan Academy, some lecture notes from MIT OpenCourseWare, an article from Wikipedia, or a textbook from OpenStax College—all of which use a Creative Commons license—you have free and perpetual permission to engage in the 5R activities with those materials. Because they are published under a Creative Commons license, you don't need to call to ask for permission and you don't need to pay a license fee. You can simply get on with the business of supporting your students' learning. Or you can conduct some other kind of teaching and learning experiment—and you can do it for free, without needing additional permissions from a brace of copyright holders.

How would a change in the operational definition of "open" affect the large MOOC providers? If MOOC providers changed from "open means open entry" to "open means open licenses" what would the impact be? Specifically, if the videos, assessment, and other content in a Coursera or Udacity MOOC were openly licensed would it reduce the "massive" access that people around the world have to the courses? No. In fact, it would drastically expand the access enjoyed by people around the world, as learners everywhere would be free to download, translate, and redistribute the MOOC content. MOOCs could become part of the innovation conversation.

Despite an incredible lift-off thrust comprised of hype and investment, MOOCs have failed to achieve escape velocity. Weighed down by a strange 1960s-meets-the-Internet philosophy, MOOCs have started to fall back to earth under the pull of registration requirements, start dates and end dates, fees charged for credentials, and draconian terms of use. It reminds me of the old joke, "What do you call a MOOC where you have to register, wait for the start date in order to begin, get locked out of the class after the end date, have no permission to copy or reuse the course materials, and have to pay to get a credential?" "An online class."

Despite all the hyperbole, it has become clear that MOOCs are nothing more than traditional online courses enhanced by open entry, and not the innovation so many had hoped for. Worse than that, because of their retrograde approach to "open," MOOCs are guaranteed to be left by the wayside as future educational innovation happens because it is simply too expensive to run a meaningful number of experiments in the MOOC context.

Where will the experiments that define the future of teaching and learning be conducted, then? Many of them will be conducted on top of what I call the open education infrastructure.

Content as Infrastructure

The Wikipedia entry on infrastructure (Wikipedia, 2014) begins:

> *Infrastructure refers to the basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function. It can be generally defined as the set of interconnected structural elements that provide a framework supporting an entire structure of development…*

The term typically refers to the technical structures that support a society, such as roads, bridges, water supply, sewers, electrical grids, telecommunications, and so forth, and can be defined as "the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions." Viewed functionally, infrastructure facilitates the production of goods and services.

What would constitute an education infrastructure? I don't mean a technological infrastructure, like Learning Management Systems. I mean to ask, what types of components are included in the set of interconnected structural elements that provide the framework supporting education?

I can't imagine a way to conduct a program of education without all four of the following components: competencies or learning outcomes, educational resources that support the achievement of those outcomes, assessments by which learners can demonstrate their achievement of those outcomes, and credentials that certify their mastery of those outcomes to third parties. There may be more components to the core education infrastructure than these four, but I would argue that these four clearly qualify as interconnected structural elements that provide the framework underlying every program of formal education.

Not everyone has the time, resources, talent, or inclination to completely recreate competency maps, textbooks, assessments, and credentialing models for every course they teach. As in the discussion of permissionless, democratized innovation above, it simply makes things faster, easier, cheaper, and better for everyone when there is high quality, openly available infrastructure already deployed that we can remix and experiment upon.

Historically, we have only applied the principle of openness to one of the four components of the education infrastructure I listed above: educational resources, and I have been arguing that "content is infrastructure" (Wiley, 2005) for a decade now. More recently, Mozilla has created and shared an open credentialing infrastructure through their open badges work (Mozilla, 2014). But little has been done to promote the cause of openness in the areas of competencies and assessments.

Open Competencies

I think one of the primary reasons competency-based education (CBE) programs have been so slow to develop in the US – even after the Department of Education made its federal financial aid policies friendlier to CBE programs – is the terrific amount of work necessary to develop a solid set of competencies. Again, not everyone has the time or expertise to do this work. Because it's so hard, many institutions with CBE programs treat their competencies like a secret family recipe, hoarding them away and keeping them fully copyrighted (apparently without experiencing any cognitive dissonance while they promote the use of OER among their students). This behavior has seriously stymied growth and innovation in CBE in my view.

If an institution would openly license a complete set of competencies, that would give other institutions a foundation on which to build new programs, models, and other experiments. The open competencies could be revised and remixed according to the needs of local programs, and they can be added to, or subtracted from, to meet those needs as well.

This act of sharing would also give the institution of origin an opportunity to benefit from remixes, revisions, and new competencies added to their original set by others. Furthermore, openly licensing more sophisticated sets of competencies provides a public, transparent, and concrete foundation around which to marshal empirical evidence and build supported arguments about the scoping and sequencing of what students should learn.

Open competencies are the core of the open education infrastructure because they provide the context that imbues resources, assessments, and credentials with meaning—from the perspective of the instructional designer, teacher, or program planner. (They are imbued with meaning for students through these and additional means.) You don't know if a given resource is the "right" resource to use, or if an assessment is giving students an opportunity to demonstrate the "right" kind of mastery, without the competency as a referent. (For example, an extremely high quality, high fidelity, interactive chemistry lab simulation is the "wrong" content if students are supposed to be learning world history.) Likewise, a credential is essentially meaningless if a third party like an employer cannot refer to the skill or set of skills its possession supposedly certifies.

Open Assessments

For years, creators of open educational resources have declined to share their assessments in order to "keep them secure" so that students won't cheat on exams, quizzes, and homework. This security mindset has prevented sharing of assessments.

In CBE programs, students often demonstrate their mastery of competencies through "performance assessments." Unlike some traditional multiple-choice assessments, performance assessments require students to demonstrate mastery by performing a skill or producing something. Consequently, performance assessments are very difficult to cheat on. For example, even if you find out a week ahead of time that the end of unit exam will require you to make 8 out of 10 free throws, there's really no way to cheat on the assessment. Either you will master the skill and be able to demonstrate that mastery or you won't.

Because performance assessments are so difficult to cheat on, keeping them secure can be less of a concern, making it possible for performance assessments to be openly licensed and publicly shared. Once they are openly licensed, these assessments can be retained, revised, remixed, reused, and redistributed.

Another way of alleviating concerns around the security of assessment items is to create openly licensed assessment banks that contain hundreds or thousands of assessments – so many assessments that cheating becomes more difficult and time consuming than simply learning.

The Open Education Infrastructure

An open education infrastructure, which can support extremely rapid, low cost experimentation and innovation, must be comprised of at least these four parts:

- Open Credentials
- Open Assessments
- Open Educational Resources
- Open Competencies

This interconnected set of components provides a foundation that will greatly decrease the time, cost, and complexity of the search for more effective models of education. (It will provide related benefits for informal learning, as well). From the bottom up, open competencies provide the overall blueprint and foundation, open educational resources provide a pathway to mastering the competencies, open assessments provide the opportunity to demonstrate mastery of the competencies, and open credentials which point to both the competency statements and results of performance assessments certify to third parties that learners have in fact mastered the competency in question.

When open licenses are applied up and down the entire stack—creating truly *open* credentials, *open* assessments, *open* educational resources, and *open* competencies, resulting in an *open* education infrastructure—each part of the stack can be altered, adapted, improved, customized, and otherwise made to fit local needs without the need to ask for permission or pay licensing fees. Local actors with local expertise are empowered to build on top of the infrastructure to solve local problems. Freely.

Creating an open education infrastructure unleashes the talent and passion of people who want to solve education problems but don't have time to reinvent the wheel and rediscover fire in the process.

"Openness facilitates the unexpected." We can't possibly imagine all the incredible ways people and institutions will use the open education infrastructure to make incremental improvements or deploy novel innovations from out of left field. That's exactly why we need to build it, and that's why we need to commit to a strong conceptualization of open, grounded firmly in the 5R framework and open licenses.

Application Exercises

- After reading the chapter share your thoughts on the theory that MOOCs have damaged the use of "open" resources.
- Describe a contribution you could make to open educational resources.

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38

The Value of Serious Play

Lloyd Rieber, Lola Smith, & David Noah

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Consider the following two hypothetical situations:

> *Two eight-year old children are building a shopping mall with Legos on a Saturday afternoon. One is working on the entrance way and the other is working on two of the mall stores. As the model gets more elaborate, they see that they will soon run out of blocks if they wish to build the mall according to their grand design. They decide to change their strategy and build instead just the entrance way, but with doorways to the stores. They decide they can later use some old shoe boxes for the stores. They tear apart the stores already built and begin building the mall's entrance way collaboratively with renewed vigor. They even go and get some small house plants and put them in the middle as "trees." They continue working for the rest of the afternoon and into the early evening. The mother of one of the children calls to say it's time to come home for dinner. A bit aggravated by this interruption, the friend agrees to come back tomorrow to help finish the model.*
>
> *A multimedia design team is busy developing the company's latest CD-ROM. The team's two graphic artists, Jean and Pat, have been trying to learn a new 3-D graphics application for use on the project. While both have been learning the tool separately on their own, they decide to work together after lunch one day. Both soon discover that the other has learned some very different things. Both decide to work on a clown figure that Jean began earlier in the week. As they try to learn all of the tricks of the package, the clown figure starts to look ridiculous and both can't help laughing at the "monster" they have created. However, they fail to figure out how to access the animation features of the software. Before they know it, it's almost 7:00 p.m. and they decide to call it a day. Later that night at home, Pat makes a breakthrough on the package and e-mails Jean about it, describing some key ideas they should discuss the next day. Although it's almost midnight, Pat's phone rings. It's Jean. The e-mail note had just arrived and it turns out that Jean had been working on the same problem at home as well. Both laugh and look forward to seeing what the other has discovered the next day.*

What do these two situations have in common? At first glance, very little. The first deals with children entertaining themselves with a favorite toy and the second with highly skilled professionals working on an expensive project for work. However, one soon sees some important similarities. Both stories show people engaged—engrossed—in an activity. All are willing to commit great amounts of time and energy. Indeed, all are unaware of the amount of time transpired, yet none would rather be doing anything else. All go to extraordinary lengths to get back to the activity. Despite the obvious intense efforts, false starts, and frustrations, all seem to be greatly enjoying themselves, as evidenced by the fact that no one is forcing them to spend free time on the activities. The children's project isn't intended to help them on upcoming tests at school, but it would be a mistake to think they are not learning anything. Likewise the graphic designers are not thinking about being "tested" on the graphics package and while probably not willing to share the clown graphic with their boss, they recognize that this "fun experience" is essential to learning the 3-D graphics software they need to use on the project. Both groups talk about their projects as work, yet not the kind filled with drudgery and tedium, but the kind of work leading to satisfaction and a sense of accomplishment. Of course, there is another word that describes the two groups' efforts—play.

Yes, play. We have found no better word to describe that special kind of intense learning experience in which both adults and children voluntarily devote enormous amounts of time, energy and commitment and at the same time derive great enjoyment from experience. We call this serious play to distinguish it from other interpretations which may have negative connotations. For example, while most accept the word play to describe many children's activities, adults usually bristle at the thought of using it to describe what they do. It is true that the majority of research conducted to date on play has been with children and if used or interpreted in the wrong way or wrong context it seems to cheapen or degrade a learning experience. We, too, would probably run for the door if a trainer or instructor started gushing about playing and having fun. But we argue that the same characteristics of children's play also extend well to adults[1] (see Colarusso, 1993; Kerr & Apter, 1991).

The purpose of this article is to propose serious play as a suitable goal or characteristic for those learning situations demanding creative higher-order thinking and a strong sense of personal commitment and engagement. Teachers, instructional designers, and trainers should not shy away from encouraging or expecting play behavior in their students. We go even further to suggest that those learning environments that conjure up serious play in children or adults deserve special recognition. They are doing something right, and that "something" involves a complex set of conditions.

We feel the time is ripe to seriously consider play given the current state of instructional technology. The field has struggled philosophically over the past two decades, first with the transition from a behavioral to a cognitive model of learning (Burton, Moore & Magliaro, 1996; Winn & Snyder, 1996), and more recently with reconciling the value and relevance of constructivist orientations to learning in a field dominated by instructional systems design (Duffy & Cunningham, 1996; Grabinger, 1996). At the same time, the field has witnessed remarkable advances in computer technology. The time has come to apply what we know about learning, motivation, and working cooperatively given the incredible processing power and social connectivity of computers. We feel that play is an ideal construct for linking human cognition and educational applications of technology given its rich interdisciplinary history in fields such as education, psychology, epistemology, sociology, and anthropology, and its obvious compatibility with interactive computer-based learning environments, such as microworlds, simulations, and games.

Reflection

Can you think of an experience you've had similar to Jean and Pat's (described at the beginning of the article)? What was that experience? How does your experience support (or refute) the claims of the article?

Understanding Serious Play

The serious kind of play we support is not easy to define due to its inherently personal nature. However, there is general consensus in the literature that play is a voluntary activity. However, it would be a mistake to believe that all play is voluntary. In many cultures, play activities are embedded in mandatory rituals. Even in Western cultures, when one considers the social pressures for children to join in a sporting event, such as football, or teenagers participating in a social event, such as the senior prom, one can hardly classify these as wholly voluntary acts involving active (often physical) engagement that is pleasurable for its own sake and includes a make-believe quality (Blanchard, 1995; Makedon, 1984; Pellegrini, 1995; Rieber, 1996). Other fields, such as theater arts, have long embraced play concepts.[2] For example, the theater game techniques developed by Viola Spolin not only teach a variety of performance skills but extend students' awareness of problems and ideas fundamental to intellectual growth, such as the development of imagination and intuition. Spolin (1986) maintains there are at least three levels of playing: 1) participation (fun and games); 2) problem solving (development of physical and mental perceiving tools); and 3) catalytic action (wherein opportunities arise that allow an individual to tap into the intuitive, to become spontaneous, so that breakthroughs and creativity can occur). The research literature on play, strongly rooted in anthropology, is generally organized around four themes: Play as progress, play as fantasy, play as self, and play as power (Pellegrini, 1995). Play as progress is the view that play is an activity leading to other outcomes, such as learning. Play as fantasy describes the process of "unleashing" an individual's creative potential. Play as self acknowledges that play itself is to be valued without regard to secondary outcomes. It considers how play can enhance or extend a person's quality of life. Play as power concerns contests in which winners and losers are declared and is very much evident in places such as the school playground, professional football stadiums, and the grass courts of Wimbledon.

The commonsense tendency to define play as the opposite of work makes it easy to be skeptical that play is a valid characterization for adult behaviors. However, Blanchard (1995) describes a simple model of human activity drawn from anthropology that shows a more accurate relationship between play and work, as illustrated in Figure 1. This model has two dimensions, pleasurability and purposefulness, with play and work being orthogonal constructs. The purposeful dimension defines a continuum with work and leisure at opposite ends. Work has a purposeful goal, whereas leisure does not. Interestingly, Blanchard contends that the English language does not have a word describing the opposite of play, so the word "not-play" is used to define opposites on the pleasurability dimension.

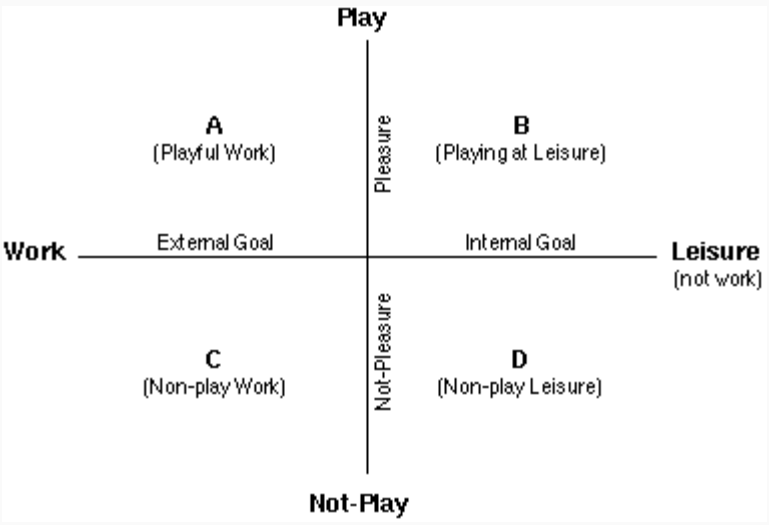

Figure 1. The Dimensions of Human Activity (taken from Blanchard, 1995, permission pending).

The four quadrants of the model encompass the full range of human activities. Quadrant A (playful work) defines the "holy grail" of occupations—getting paid to do a job that is also satisfying and rewarding. Quadrant C (not-play work), on

the other hand, includes types of work that are not enjoyable, but are done due to obligations or financial necessity. Quadrant B (playing at leisure) includes those leisure activities that people devote deliberate effort to, usually over extended periods of times, such as serious hobbies or avocations. These are activities in which people grow intellectually, emotionally, or physically, such as gardening, reading, cycling, or chess. Finally, Quadrant D (not-play leisure) includes those times or activities, technically defined as "leisure," when we find ourselves bored, unsatisfied, and with nothing to do (e.g. sitting in front of the television looking for something interesting to watch). The model applies readily to the adult world of work and leisure, but also appropriately describes school settings (for both children and adults) when you consider school to be a "job." The goals for work (Quadrants A and C) are external to the individual whereas the goals for leisure (Quadrants B and D) are internal.

A person who attains maximum pleasurability (in either Quadrant A or B) could also be described as being in a state of "flow." Flow theory, developed by Mihaly Csikszentmihalyi (1979; 1990), derives its name from the way people describe a certain state of happiness and satisfaction. They are so absorbed that they report being carried by the "flow" of the activity in an automatic and spontaneous way. Experiencing flow is an everyday occurrence, though Csikszentmihalyi is careful to point out that attaining flow demands considerable and deliberate effort and attention. Flow has many qualities and characteristics, the most notable of which are the following: optimal levels of challenge; feelings of complete control; attention focused so strongly on the activity that feelings of self-consciousness and awareness of time disappear. Think to yourself of times that you were so engrossed in an activity that you were shocked to learn that several hours had passed without your knowledge. The "work" involved at attaining flow comes from maintaining a balance between anxiety and challenge. As your experience and skill increases, you look for ways to increase the challenge, but if you try something beyond your capability you quickly become anxious. Flow can only be achieved by successfully negotiating and balancing challenge and anxiety.

Reflection

Can you think of experiences that you've had that fall into each of the four quadrants depicted in Figure 1? How often do you engage in each of them? How does your participation and behavior differ?

Play's Relevancy to Instructional Technology: Learning and Motivation

Our interest in play is derived from the longstanding goal in education of how to promote situations where a person is motivated to learn, is engaged in the learning act, is willing to go to great lengths to ensure that learning will occur, and at the same time finds the learning process (not just learning outcomes) to be satisfying and rewarding. An ambitious goal to say the least and one that seems largely unattainable. However, this is a common everyday occurrence which everyone experiences. Consider the intensity with which adults engage in complex activities during their leisure time, such as wood working, gardening, and sports. Most require the full range of intellectual learning outcomes (facts, concepts, principles, and problem-solving) and physical skill in tandem with creative expression. The intensity of children's activities during non-school time goes far beyond that of adults. For example, the stereotype of mind-numbing video games is quickly erased when you ask players to describe the rules and relationships among objects and characters in a video game (see Turkle, 1984, for an early critique of the "holding power" of video games). One discovers that the children have mastered intricately complex "virtual worlds" and could easily pass the toughest test on this "content" should one be administered (although adults rarely value this knowledge). Learning and motivation seem to reach their pinnacle in such situations.

Traditional views of motivation in education usually reduce down to two things: the motivation to initially participate in a task and subsequently choosing to persist in the task (Lepper, 1988). Motivation is also usually explained in terms of the extrinsic and intrinsic reasons for choosing to participate (Facteau, Dobbins, Russell, Ladd & Kudisch, 1995, add a

third—compliance—for training environments). Extrinsic motivators are external to the person, such as attaining rewards (e.g. pay increases, praise from teachers and parents), or avoiding negative consequences (e.g. punishment, disapproval, losing one's job). In contrast, intrinsic motivators come from within the person, such as personal interest, curiosity, and satisfaction. Malone's (1981; Malone & Lepper, 1987) framework of intrinsic motivation is based on the attributes of challenge, curiosity, fantasy, and control (other notable work in this includes, of course, that of John Keller (1983; Keller & Suzuki, 1988). Challenge refers not only to the level of difficulty but also to performance feedback for the player, and includes goals, predictability of outcome, and self-esteem. Malone also warns against designing games where the curiosity factor is sensory and superficial as opposed to games in which curiosity engages deeper cognitive processes (see research by Rieber & Noah, 1997 for an example).

However, the dichotomy between extrinsic and intrinsic motivation quickly blurs in everyday situations. An employee who loves his/her job will still rely on the social and professional obligations of getting up and going to work in the morning from time to time. Students forced to study for an upcoming test may unexpectantly find themselves enjoying the material. Some extrinsic motivators are perceived as pure rewards or threats (e.g. read 10 books to earn a prize or do your homework every night to avoid a lower grade), but others may be consistent with one's goals or values (e.g. a teenager attending mandatory driver education classes or an adult choosing to enroll in graduate school). Self-determination is the degree to which one reconciles extrinsic motivators with personal choice (Deci & Ryan, 1985). A high degree of self-determination has been shown to affect the quality of one's learning (e.g. Ryan, Connell & Plant, 1990; see review by Rigby, Deci, Patrick & Ryan, 1992). In other words, the intrinsic worth of an activity is often a matter of personal choice and learning can be enhanced when one looks for and finds personal motives to not only participate but also to take responsibility for the outcome. [3]

Prescribing motivation in formal educational settings has long been a puzzle for teachers and instructional designers. Part of the problem is that too many educators consider motivation in terms of "that which gets someone else to do what we want them to." Instructional design models typically treat motivation as an "add-on" feature or concern. Frequently, designers fall prey to first designing instruction from the point of view of the subject matter and then ask "How can I make this motivating to the learner?" Instead, motivation and learning should be considered together from the start. Likewise, serious play is characterized by intense motivation coupled with goal-directed behavior.

For instructional designers, the task is to somehow blend or "wed" motivation to the learning process. Fortunately, there is research and theory that describes this "marriage" between motivation and learning, that of self-regulation (Butler & Winne, 1995; Schunk & Zimmerman, 1994; Zimmerman, 1989; Zimmerman, 1990). Individuals engaged in self-regulated learning generally possess three attributes: 1) they find the learning goals interesting for their own sake and do not need external incentives (or threats) to participate (i.e. intrinsic motivation); 2) they are able to monitor their own learning and are able to identify when they are having trouble; and 3) they consequently take the necessary steps to alter their learning environment to enable learning to take place. The most successful students self-regulate their own learning. However, many students, even if intrinsically motivated, have difficulty monitoring their own learning or employing strategies or finding resources that they need. Consequently, most students need support to varying degrees. This support takes many forms, such as access to resources and sufficient opportunity to use those resources. Students also need adequate time, a fact often neglected or difficult to manage in traditional school or training situations. However, instruction can be one of the most important kinds of support when it is provided in the context of supporting the goals and motives valued by the individual. When viewed in this way, we see no reason why play and instructional design cannot co-exist.

Reconciling play with instructional design requires a very different perspective on the relationship between curriculum, instruction, a teacher, and the individual learner. The traditional view that one group of people (instructional designers, trainers, teachers) have total authority and responsibility to create instructional activities for another group (students) must be reconsidered. A modified view grants individual learners greater authority over what they learn and how they learn it, while setting reasonable expectations consistent with an institutional framework (e.g. school, workplace) (Papert, 1993, referred to this as granting a student the "right to intellectual self-determination," p. 5). This does not negate the need for instruction, but rather puts structured learning experiences in the context of supporting individual

needs and learning goals, while at the same time recognizing that many learning goals will necessarily be external to the individual, such as skills needed in the workplace. This is in keeping with democratic ideals of education, such as those proposed by Dewey (Glickman, 1996).

Serious Play at Work for Learning

Although it is one thing to argue that serious play has value for learning and instruction, it is quite another to figure out how to put these ideas into practice. Meeting the conditions of self-regulated learning is exceedingly demanding and the inherent personal nature of serious play means that it cannot be imposed on someone. Instructional technologists keen on developing prescriptive models will find play an unsuitable and unmanageable candidate for "design principles." But the natural, everyday tendency for play to emerge in children and adults points to a useful design tenet which also turns out to be the simplest: look for ways to trigger or coax play behavior in people and then nurture or cultivate it once it begins, just as one looks for a way to light a candle followed by both protecting and feeding the flame.

Experienced teachers are often able to invoke play and channel it toward achieving goals and objectives within the curriculum. For example, Richard McAfee is a high school social studies teacher at Central Gwinnett High School in Lawrenceville, Georgia. He uses a variety of simulation and gaming activities in his teaching. For example, he has fully integrated the simulation software package SimCity into a unit in his economics course. Here is Richard's description of the unit:

> *I take the first two days to teach the SimCity software to the students because I learned early on that students have a difficult time mastering the controls and tools well enough to complete their projects in the short amount of time we have set aside for the unit. Although the students have a lot of freedom in deciding how their cities will be constructed, everyone has the goal to create a city that is physically sound and provides its citizens with necessary resources. In addition, students are required to turn in three written reports – a transportation plan, a city services plan, and a physical plan. It's remarkable how seriously students get into the process of building a city. Good ideas and strategies are both shared and guarded by students. By the end of the unit, my students literally run into the classroom to get back to their models. Of course, there are problems and not all students are equally successful in building a city that runs smoothly, but I find I can use all the problems and successes as a means for all students to understand the complex economic principles at work.*

The intensity, seriousness, engagement, and enjoyment that Richard reports students experience as they complete their SimCity models is an apt description of the play process. Richard has found a way to let his students play with SimCity within a structure that is consistent with the curriculum objectives that he (and the school district) values. Richard's attempt at integrating SimCity into his teaching and evoking play behavior in his students while they are learning economics is in stark contrast to teachers who give students software like SimCity to play as a reward for doing their "real work." It is important to note that this has not been easy for Richard. It has required a deliberate attempt at restructuring his teaching requiring many hours of preparation. Of course, he could have spent that time preparing "to teach" in the traditional way. The result would have been "traditional" as well—the majority of students suffering through the material in order to pass the unit test. A few would do very well, a few would fail, and the rest would be glad just to get through it. In contrast, Richard's approach gives students a chance to assume "ownership" of the learning process through the act of building the model cities. The learning is richer and deeper even though his "teaching" would be difficult to evaluate using traditional models of teacher appraisal. Richard's approach broadens the definition of instruction. While there is forethought of outcomes, there is much more flexibility and opportunity to learn things that are not predetermined. The students are responsible for learning certain things, but by creating a playful atmosphere built on collaboration, the students come to value the learning outcomes that Richard has set.

This paradoxical and almost contradictory situation of play being at once too complex to fully understand and predict yet an everyday phenomena just waiting to emerge is why we have taken such an interest in microworlds, simulations, and games, especially those which are computer-based (see Rieber, 1992; 1993; 1996 for discussions and examples).

The characteristics of these open-ended explorable learning environments, coupled with the processing and networking capabilities of computers, offer many opportunities for serious play. In particular, we have come to recognize the utility of games, not just for their motivational characteristics, but also for the way they provide structure and organization to complex domains. There is wonderful irony in rediscovering the technology of games—they have historical and cultural significance, but because we experience games and game-like situations continually throughout life, we tend to take them for granted.

Games are also a way of telling stories, and stories are fundamental to both understanding and learning. Part of the power of games lies in the fact that through them we have a chance to take part in cultural narratives. Playing Monopoly, for instance, is an opportunity to participate in the drama of capitalism, playing chess gives us a chance to engage in a story of conflict and resolution. Expert teachers often use stories to teach—some would argue that all learning comes through stories, because all understanding is best conceived as narrative (Schank, 1990).

The digital revolution has opened new possibilities for both gaming and education. The software market sometimes seems driven by games, usually those marketed to the power fantasies of adolescent boys; but new kinds of gaming environments are being made possible by the spread of personal computers. Consequently, new kinds of educational games have also been made possible, ones in which the motivational energy of sophisticated multimedia productions has been joined to the responsiveness of interactive learner engagement to create a gaming space that is motivating, complex, and individualized. The field of computer gaming is barely two decades old and our ability to use this medium well is just beginning to mature (some have suggested that the game Myst may be the first example of a computer game justly considered as “literature”; see Carroll, 1997).

There are two distinct applications of games in education: game playing and game designing. Game playing is the traditional approach where one provides ready made games to students. This approach has a long history and, consequently, a well-established literature. Game designing assumes that the act of building a game is itself a path to learning, regardless of whether or not the game turns out to be interesting to other people. The idea of “learning by designing” is similar to the old adage that teaching is the best way to learn something. This approach has gained increased prominence due to the proliferation of computer-based design and authoring tools.

Research has suggested that many instructional benefits may be derived from the use of educational games (Dempsey, Lucassen, Gilley & Rasmussen, 1993-1994; Randel, Morris, Wetzel & Whitehill, 1992). These benefits have been found to include improvement in practical reasoning skills, motivational levels, and retention. Reports of the effectiveness of educational games, measured as student involvement with the instructional task, have not been as consistently favorable, though a breakdown of the available studies by subject matter reveals that some knowledge domains are particularly suited to gaming, such as mathematics and language arts (Randel et al, 1992). Learning from designing games has received far less attention. This approach turns powerful authoring tools and design methodologies over to the students themselves. Consider the many projects produced in graduate-level instructional design and multimedia classes. Even if no one in the “intended audience” learns anything from the project, the designers themselves always know a great deal more about the project’s content from the act of building it. Learning by designing is a central idea in constructivism (Harel & Papert, 1990, 1992; Perkins, 1986) and game design is beginning to attract attention in the constructivist literature (Kafai, 1992, 1994a, 1994b). Likewise, our experiences with children support game design as an authentic, meaningful approach for students to situate school learning (Rieber, Luke & Smith, 1998).

Instructional designers also need to give serious attention to the differential exposure of boys and girls in gaming environments (Lever, 1976). Although choices of play activities change for both boys and girls as they grow older, gender play preference differences are found at all age levels (Almqvist, 1989; Beato, 1997; Clarke, 1995; Krantz, 1997; Paley, 1984; Provenzo, 1981). Until recently, however, few video games were designed with female play preferences in mind. A survey by U.S. News and World Report (1996) indicated more than 6 million U.S. households included females between 8 and 18 with access to multimedia computers, yet there were relatively few computer games that were even marketed to girls. As a result, girls were not playing these games in great numbers. Thus, with greater hands-on experience, many boys regarded aspects of computers with greater confidence and familiarity than girls (Wajcman, 1991). However, after years of disregard, it now appears the industry is beginning to experience a change of heart.

Some experts expect 200 new games, based on research that emphasizes girl's play preferences, to reach store shelves by the fall of 1997 (Beato, 1997). This is a tenfold increase from 1996. For example, the company Purple Moon is specifically targeting the market of adolescent girls with help from video game pioneer Brenda Laurel. Companies are finally recognizing that girls have different interests and agendas. The stereotype that girls want "easy games" is also finally disappearing. As Krantz (1997, p. 49) notes, "Girls don't think boys' games are hard; they think they're too stupid." If girls are to have the same technological chances as boys, then teachers and parents need to seek the inclusion of computer "play" materials in the curriculum that motivates females as well as males.

Closing

Play is an essential part of the learning process throughout life and should not be neglected. We feel that instructional design will benefit from recognizing this fact. Play that is serious and focused within a learning environment can help learners construct a more personalized and reflective understanding. As educators, our challenge is to implicate motivation into learning through play, and to recognize that play has an important cognitive role in learning. As instructional technologists, we have the opportunity to use the expanding power of computers to provide new venues for play in learning—as simulations, microworlds, and especially games.

Computer games offer a new possibility for wedding motivation and self-regulated learning within a constructivist framework, one which strives to combine both training and education, practice and reflection, into a seamless learning experience. Computers are making possible a new chapter to be written in the long history of games in education. The issue of gender and learning is of particular importance to instructional technologists, since technology is often seen as a male prerogative. Instructors and educational game designers are beginning to have a better understanding of how gender differences affect learning, and how to implement that understanding in better instructional design.

Research on computer programming by Sherry Turkle and Seymour Papert illustrate our perspective on the value of play in instructional technology. Turkle and Papert's research (1991) contrasts two different programming styles that they describe as "hard" and "soft" mastery. Hard mastery is compared to the clarity and control of the engineer or scientist, while soft mastery is more like the give and take of a negotiator or artist. They equate soft mastery to that of a bricoleur, or tinkerer. Elements are continually and playfully rearranged to arrive at new combinations, often resulting in unexpected results. Just as Turkle and Papert advocate that the computer culture looks beyond a single method of programming, we advocate a variety of approaches to instructional design and learning. The value of play should not be overlooked.

Application Exercise

- When was the last time you had serious play? What was it like? What allowed it to become serious play?
- Describe a time you found yourself in "flow." What were you doing and how did you achieve flow?
- Randomly select one element from each of these lists: [Agriculture, Chemistry, Computer programming, Design skills, Math] [Toddlers, Sixth graders, Families, Young adults, the elderly] Using the principles from this chapter, design a game to teach _____ to _____.

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1. An interesting example of the value of play in the creative process at the corporate level can be found at Avelino Associates, a San Francisco-based organizational development and systems integration firm. Their intent is to create a collaboration between technological and artistic professionals. Multi-talented performing artists are hired by Avelino for creative and organizational skills that are highly transferable between the technological and artistic modes (DeDanan, 1997). ↵
2. In 1963, Viola Spolin in conjunction with Paul Sills founded the Second City Improvisational Theater and as such laid the foundation for all improvisational companies since. ↵
3. There is considerable debate in the motivational literature over whether the intrinsic value of an activity can be undermined by the promise of external rewards, a phenomena often referred to as "turning play into work"—an unfortunate wording, in our opinion, because it promotes the misconception that play is the opposite of work. (See Cameron & Pierce, 1994; Cameron & Pierce, 1996; Greene & Lepper, 1974; Lepper, Greene & Nisbett, 1973; Lepper & Chabay, 1985; Lepper, Keavney & Drake, 1996 for examples of the research and arguments surrounding this debate.) ↵

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39

Video Games and the Future of Learning

David Williamson Shaffer, Richard Halverson, Kurt Squire, & James P. Gee

Editor's Note

The following paper is provided for free on the Internet by the authors and WCER. For more information from Kurt Squire, see the open-access article "Changing the Game: What Happens When Video Games Enter the Classroom?," describing one of his case studies.

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Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, J. P. (2005). Video Games and the Future of Learning.

Computers are changing our world: how we work . . . how we shop . . . how we entertain ourselves . . . how we communicate . . . how we engage in politics . . . how we care for our health. . . . The list goes on and on. But will computers change the way we learn?

We answer: Yes. Computers are already changing the way we learn—and if you want to understand how, look at video games. Look at video games, not because the games that are currently available are going to replace schools as we know them any time soon, but because they give a glimpse of how we might create new and more powerful ways to learn in schools, communities, and workplaces—new ways to learn for a new information age. Look at video games because, although they are wildly popular with adolescents and young adults, they are more than just toys. Look at video games because they create new social and cultural worlds: worlds that help people learn by integrating thinking, social interaction, and technology, all in service of doing things they care about.

We want to be clear from the start that video games are no panacea. Like books and movies, they can be used in antisocial ways. Games are inherently simplifications of reality, and current games often incorporate—or are based on—violent and sometimes misogynistic themes. Critics suggest that the lessons people learn from playing video games as they currently exist are not always desirable. But even the harshest critics agree that we learn something from playing video games. The question is: How can we use the power of video games as a constructive force in schools, homes, and workplaces?

In answer to that question, we argue here for a particular view of games—and of learning—as activities that are most powerful when they are personally meaningful, experiential, social, and epistemological all at the same time. From this perspective, we describe an approach to the design of learning environments that builds on the educational properties of games, but deeply grounds them within a theory of learning appropriate to an age marked by the power of new technologies.

Video Games as Virtual Worlds for Learning

The first step towards understanding how video games can (and, we argue, will) transform education is changing the widely shared perspective that games are "mere entertainment." More than a multibillion dollar industry, more than a compelling toy for both children and adults, more than a route to computer literacy, video games are important because they let people participate in new worlds. They let players think, talk, and act—they let players *inhabit*—roles otherwise inaccessible to them. A 16-year-old in Korea playing *Lineage* can become an international financier, trading raw materials, buying and selling goods in different parts of the virtual world, and speculating on currencies (Steinkuehler, 2004a). A *Deus Ex* player can experience life as a government special agent, where the lines between state-sponsored violence and terrorism are called into question.

These rich virtual worlds are what make games such powerful contexts for learning. In game worlds, learning no longer means confronting words and symbols separated from the things those words and symbols are about in the first place. The inverse square law of gravity is no longer something understood solely through an equation; students can gain virtual experience walking in worlds with smaller mass than the Earth, or plan manned space flights that require understanding the changing effects of gravitational forces in different parts of the solar system. In virtual worlds, learners experience the concrete realities that words and symbols describe. Through such experiences, across multiple contexts, learners can understand complex concepts without losing the connection between abstract ideas and the real problems they can be used to solve. In other words, the virtual worlds of games are powerful because they make it possible to develop *situated understanding*.

Although the stereotype of the gamer is a lone teenager seated in front of a computer, game play is also a thoroughly social phenomenon. The clearest examples are massively multiplayer online games: games where thousands of players are simultaneously online at any given time, participating in virtual worlds with their own economies, political systems, and cultures. But careful study shows that most games—from console action games to PC strategy games—have robust game-playing communities. Whereas schools largely sequester students from one another and from the outside world, games bring players together, competitively and cooperatively, into the virtual world of the game and the social community of game players. In schools, students largely work alone with school-sanctioned materials; avid gamers seek out news sites, read and write FAQs, participate in discussion forums, and most important, become critical consumers of information (Squire, in press). Classroom work rarely has an impact outside the classroom; its only real audience is the teacher. Game players, in contrast, develop reputations in online communities, cultivate audiences by contributing to discussion forums, and occasionally even take up careers as professional gamers, traders of online commodities,[1] or game modders and designers. The virtual worlds of games are powerful, in other words, because playing games means developing a set of *effective social practices*.

By participating in these social practices, game players have an opportunity to explore new identities. In one well-publicized case, a heated political contest erupted for the presidency of Alphaville, one of the towns in *The Sims Online*. Arthur Baynes, the 21-year-old incumbent, was running against Laura McKnight, a 14-year-old. The muckraking,

accusations of voter fraud, and political jockeying taught young Laura about the realities of politics; the election also gained national attention on National Public Radio as pundits debated the significance of games where teens could not only argue and debate politics, but also run a political system in which the virtual lives of thousands of real players were at stake. The complexity of Laura's campaign, political alliances, and platform—a platform that called for a stronger police force and a significant restructuring of the judicial system—shows how deep the disconnect has become between the kinds of experiences made available in schools and those available in online worlds. The virtual worlds of games are rich contexts for learning because they make it possible for players to experiment with new and *powerful identities* (Steinkuehler, 2004b).

The communities that game players form similarly organize meaningful learning experiences outside of school contexts. In the various Web sites devoted to the game *Civilization*, for example, players organize themselves around the shared goal of developing expertise in the game and the skills, habits, and understandings that requires. At Apolyton.net, one such site, players post news feeds, participate in discussion forums, and trade screenshots of the game. But they also run a radio station, exchange saved game files in order to collaborate and compete, create custom modifications, and, perhaps most uniquely, run their own university to teach other players to play the game more deeply. Apolyton University shows us how part of expert gaming is developing a set of values—values that highlight enlightened risk taking, entrepreneurship, and expertise rather than the formal accreditation emphasized by institutional education (Squire & Giovanetto, in press). If we look at the development of game communities, we see that part of the power of games for learning is the way they *develop shared values*.

In other words, by creating virtual worlds, games integrate knowing and doing. But not just knowing and doing. Games bring together ways of knowing, ways of doing, ways of being, and ways of caring: the situated understandings, effective social practices, powerful identities, and shared values that make someone an expert. The expertise might be that of a modern soldier in *Full Spectrum Warrior*, a zoo operator in *Zoo Tycoon*, a world leader in *Civilization III*. Or it might be expertise in the sophisticated practices of gaming communities, such as those built around *Age of Mythology* or *Civilization III*.

There is a lot being learned in these games. But for some educators, it is hard to see the educational potential in games because these virtual worlds aren't about memorizing words, or definitions, or facts.

Video games are about a whole lot more.

From the Fact Fetish to Ways of Thinking

A century ago, John Dewey argued that schools were built on a fact fetish, and the argument is still valid today. The fact fetish views any area of learning—whether physics, mathematics, or history—as a body of facts or information. The measure of good teaching and learning is the extent to which students can answer questions about these facts on tests.

But *to know* is a verb before it is a noun, *knowledge*. We learn by doing—not just by doing any old thing, but by doing something as part of a larger community of people who share common goals and ways of achieving those goals. We learn by becoming part of a community of practice (Lave & Wenger, 1991) and thus developing that community's ways of knowing, acting, being, and caring—the community's situated understandings, effective social practices, powerful identities, and shared values.

Of course, different communities of practice have different ways of thinking and acting. Take, for example, lawyers. Lawyers act like lawyers. They identify themselves as lawyers. They are interested in legal issues. And they know about the law. These skills, habits, and understandings are made possible by looking at the world in a particular way—by thinking like a lawyer. The same is true for doctors but through a different way of thinking. And for architects, plumbers, steelworkers, and waiters as much as for physicists, historians, and mathematicians.

The way of thinking—the epistemology—of a practice determines how someone in the community decides what questions are worth answering, how to go about answering them, and how to decide when an answer is sufficient. The epistemology of a practice thus organizes (and is organized by) the situated understandings, effective social practices, powerful identities, and shared values of the community. In communities of practice, knowledge, skills, identities, and values are shaped by a particular way of thinking into a coherent *epistemic frame* (Shaffer, 2004a). If a community of practice is a group with a local culture, then the epistemic frame is the grammar of the culture: the ways of thinking and acting that individuals learn when they become part of that culture.

Let's look at an example of how this might play out in the virtual world of a video game. *Full Spectrum Warrior*(Pandemic Studios, for PC and Xbox) is a video game based on a U.S. Army training simulation.[2] But *Full Spectrum Warrior* is not a mere first-person shooter in which the player blows up everything on the screen. To survive and win the game, the player has to learn to think and act like a modern professional soldier.

In *Full Spectrum Warrior*, the player uses the buttons on the controller to give orders to two squads of soldiers, as well as to consult a GPS device, radio for support, and communicate with rear area commanders. The instruction manual that comes with the game makes it clear from the outset that players must take on the values, identities, and ways of thinking of a professional soldier to play the game successfully: "Everything about your squad," the manual explains, "is the result of careful planning and years of experience on the battlefield. Respect that experience, soldier, since it's what will keep your soldiers alive" (p. 2).

In the game, that experience—the skills and knowledge of professional military expertise—is distributed between the virtual soldiers and the real-world player. The soldiers in the player's squads have been trained in movement formations; the role of the player is to select the best position for them on the field. The virtual characters (the soldiers) know part of the task (various movement formations), and the player knows another part (when and where to engage in such formations). This kind of distribution holds for every aspect of military knowledge in the game. However, the knowledge that is distributed between virtual soldiers and real-world player is not a set of inert facts; what is distributed are the values, skills, practices, and (yes) facts that constitute authentic military professional practice. This simulation of the social context of knowing allows players to act as if in concert with (artificially intelligent) others, even within the single-player context of the game.

In so doing, *Full Spectrum Warrior* shows how games take advantage of situated learning environments. In games as in real life, people must be able to build meanings on the spot as they navigate their contexts. In *Full Spectrum Warrior*, players learn about suppression fire through the concrete experiences they have while playing. These experiences give a working definition of suppression fire, to be sure. But they also let a player come to understand how the idea applies in different contexts, what it has to do with solving particular kinds of problems, and how it relates to other practices in the domain, such as the injunction against shooting while moving.

Video games thus make it possible to "learn by doing" on a grand scale—but not just by wandering around in a rich computer environment to learn without any guidance. Asking learners to act without explicit guidance—a form of learning often associated with a loose interpretation of progressive pedagogy—reflects a bad theory of learning. Learners are novices. Leaving them to float in rich experiences with no support triggers the very real human penchant for finding creative but spurious patterns and generalizations. The fruitful patterns or generalizations in any domain are the ones that are best recognized by those who already know how to look at the domain and know how complex variables in the domain interrelate. And this is precisely what the learner does not yet know. In *Full Spectrum Warrior*, in contrast, the player is immersed in activity, values, and ways of seeing. But the player is guided and supported by the knowledge built into the virtual soldiers and the weapons, equipment, and environments in the game. Players are not left free to invent everything for themselves. To succeed in the game, they must live by—and ultimately master—the epistemic frame of military doctrine.

Full Spectrum Warrior immerses the player in the activities, values, and ways of seeing—the epistemic frame—of a modern soldier. In this sense, it is an example of what we suggest is the promise of video games and the future of learning: the development of *epistemic games* (Shaffer, in press).

Epistemic Games for Initiation and Transformation

We have argued that video games are powerful contexts for learning because they make it possible to create virtual worlds, and because acting in such worlds makes it possible to develop the situated understandings, effective social practices, powerful identities, shared values, and ways of thinking of important communities of practice. To build such worlds, one has to understand how the epistemic frames of those communities are developed, sustained, and changed. Some parts of practice are more central to the creation and development of an epistemic frame than others, so analyzing the epistemic frame tells you, in effect, what might be safe to leave out in a recreation of the practice. The result is a video game that preserves the linkages between knowing and doing central to an epistemic frame—that is, an epistemic game (Shaffer, in press). Such epistemic games let players participate in valued communities of practice: to develop a new epistemic frame or to develop a better and more richly elaborated version of an already mastered epistemic frame.

Initiation

Developing games such as *Full Spectrum Warrior* that simultaneously build situated understandings, effective social practices, powerful identities, shared values, and ways of thinking is clearly no small task. But the good news is that in many cases existing communities of practice have already done a lot of that work. Doctors know how to create more doctors; lawyers know how to create more lawyers; the same is true for a host of other socially valued communities of practice. Thus, we can imagine epistemic games in which players learn biology by working as a surgeon, history by writing as a journalist, mathematics by designing buildings as an architect or engineer, geography by fighting as a soldier, or French by opening a restaurant—or more precisely, by inhabiting virtual worlds based on the way surgeons, journalists, architects, soldiers, and restaurateurs develop their epistemic frames.

To build such games requires understanding how practitioners develop their ways of thinking and acting. Such understanding is uncovered through *epistemographies* of practice: detailed ethnographic studies of how the epistemic frame of a community of practice is developed by new members. That is more work than is currently invested in most "educational" video games. But the payoff is that such work can become the basis for an alternative educational model. Video games based on the training of socially valued practitioners let us begin to build an educational system in which students learn to work (and thus to think) as doctors, lawyers, architects, engineers, journalists, and other important members of the community. The purpose of building such educational systems is not to train students for these pursuits in the traditional sense of vocational education. Rather, we develop those epistemic frames because they can provide students with an opportunity to see the world in a variety of ways that are fundamentally grounded in meaningful activity and well aligned with the core skills, habits, and understandings of a postindustrial society (Shaffer, 2004b).

One early example of such a game is *Madison 2200*, an epistemic game based on the practices of urban planning (Beckett & Shaffer, in press; Shaffer, in press). In *Madison 2200*, players learn about urban ecology by working as urban planners to redesign a downtown pedestrian mall popular with local teenagers. Players get a project directive from the mayor, addressed to them as city planners, including a city budget plan and letters from concerned citizens about crime, revenue, jobs, waste, traffic, and affordable housing. A video features interviews with local residents, business people, and community leaders about these issues. Players conduct a site assessment of the street and work in teams to develop a land use plan, which they present at the end of the game to a representative from the city planning office.

Not surprisingly, along the way players learn something about urban planning and its practices. But something very interesting happens in an epistemic game like *Madison 2200*. When knowledge is first and foremost a form of activity and experience—of doing something in the world within a community of practice—the facts and information eventually come for free. A large body of facts that resists out-of-context memorization and rote learning comes easily if learners are immersed in activities and experiences that use these facts for plans, goals, and purposes within a coherent knowledge domain. Data show that in *Madison 2200*, players form—or start to form—an epistemic frame of urban planning. But they also develop their understanding of ecology and are able to apply it to urban issues. As one player commented: "I really noticed how [urban planners] have to . . . think about building things . . . like, urban planners also

have to think about how the crime rate might go up, or the pollution or waste, depending on choices." Another said about walking on the same streets she had traversed before the workshop: "You notice things, like, that's why they build a house there, or that's why they build a park there."

The players in *Madison 2200* do enjoy their work. But more important is that the experience lets them inhabit an imaginary world in which they are urban planners. The world of *Madison 2200* recruits these players to new ways of thinking and acting as part of a new way of seeing the world. Urban planners have a particular way of addressing urban issues. By participating in an epistemic game based on urban planning, players begin to take on that way of seeing the world. As a result, it is fun, too.

Transformation

Games like *Full Spectrum Warrior* and *Madison 2200* expose novices to the ways professionals make sense of typical problems. Other games are designed to transform the ways of thinking of a professional community, focusing instead on *atypical* problems: places where ways of knowing break down in the face of a new or challenging situation.

Just as games that initiate players into an epistemic frame depend on epistemographic study of the training practices of a community, games designed to transform an epistemic frame depend on detailed examination of how the mature epistemic frame of a practice is organized and maintained—and on when and how the frame becomes problematic. These critical moments of *expectation failure* (Schank, 1997) are the points of entry for reorganizing experienced practitioners' ways of thinking. Building the common assumptions of an existing epistemic frame into a game allows experienced professionals to cut right to the key learning moments.

For example, work on military leadership simulations has used *goal-based scenarios* (Schank, 1992; Schank, Fano, Bell, & Jona, 1994) to build training simulations based on the choices military leaders face when setting up a base of operations (Gordon, 2004). In the business world, systems like RootMap (Root Learning, http://www.rootlearning.com) create graphical representations of professional knowledge, offering suggestions for new practice by surfacing breakdowns in conventional understanding (Squire, 2005). Studies of school leaders similarly suggest that the way professionals frame problems has a strong impact on the possible solutions they are willing and able to explore (Halverson, 2003, 2004). This ability to successfully frame problems in complex systems is difficult to cultivate, but Halverson and Rah (2004) have shown that a multimedia representation of successful problem-framing strategies—such as how a principal reorganized her school to serve disadvantaged students—can help school leaders reexamine the critical junctures where their professional understanding is incomplete or ineffective for dealing with new or problematic situations.

Epistemic Games and the Future of Schooling

Epistemic games give players freedom to act within the norms of a valued community of practice—norms that are embedded in non-player characters like the virtual soldiers in *Full Spectrum Warrior* or real urban planners and planning board members in *Madison 2200*. To work successfully within the norms of a community, players necessarily learn to think as members of the community. Think for a moment about the student who, after playing *Madison 2200,* walked down the same streets she had been on the day before and noticed things she had never seen. This is situated learning at its most profound—a transfer of ideas from one context to another that is elusive, rare, and powerful. It happened not because the student learned more information, but because she learned it in the context of a new way of thinking—an epistemic frame—that let her see the world in a new way.

Although there are not yet any complete epistemic games in wide circulation, there already exist many games that provide similar opportunities for deeply situated learning. *Rise of Nations* and *Civilization III* offer rich, interactive environments in which to explore counterfactual historical claims and help players understand the operation of complex historical modeling. *Railroad Tycoon* lets players engage in design activities that draw on the same economic and geographic issues faced by railroad engineers in the 1800s. *Madison 2200* shows the pedagogical potential of bringing students the experience of being city planners, and we are in the process of developing projects that similarly let players

work as biomechanical engineers (Svarovsky & Shaffer, in press), journalists (Shaffer, 2004b), professional mediators (Shaffer, 2004c), and graphic designers (Shaffer, 1997). Other epistemic games might involve players experiencing the world as an evolutionary biologist or as a tailor in colonial Williamsburg (Squire & Jenkins, 2004).

But even if we had the world's best educational games produced and ready for parents, teachers, and students to buy and play, it's not clear that most educators or schools would know what to do with them. Although the majority of students play video games, the majority of teachers do not. Games, with their antiauthoritarian aesthetics and inherently anti-Puritanical values, can be seen as challenging institutional education. Even if we strip aside the blood and guts that characterize some video games, the reality is that as a form, games encourage exploration, personalized meaning-making, individual expression, and playful experimentation with social boundaries—all of which cut against the grain of the social mores valued in school. In other words, even if we sanitize games, the theories of learning embedded in them run counter to the current social organization of schooling. The next challenge for game and school designers alike is to understand how to shape learning and learning environments based on the power and potential of games—and how to integrate games and game-based learning environments into the predominant arena for learning: schools.

How might school leaders and teachers bring more extended experiments with epistemic games into the culture of the school? The first step will be for superintendents and public spokespersons to move beyond the rhetoric of games as violent-serial-killer-inspiring-time-wasters and address the range of learning opportunities that games present. Understanding how games can provide powerful learning environments might go a long way toward shifting the current anti-gaming rhetoric. Although epistemic games of the kind we describe here are not yet on the radar of most educators, they are already being used by corporations, the government, the military, and even by political groups to express ideas and teach facts, principles, and world views. Schools and school systems must soon follow suit or risk being swept aside.

A New Model of Learning

The past century has seen an increasing identification of learning with schooling. But new information technologies challenge this union in fundamental ways. Today's technologies make the world's libraries accessible to anyone with a wireless PDA. A vast social network is literally at the fingertips of anyone with a cell phone. As a result, people have unprecedented freedom to bring resources together to create their own learning trajectories. But classrooms have not adapted. Theories of learning and instruction embodied in school systems designed to teach large numbers of students a standardized curriculum are antiquated in this new world. Good teachers and good school leaders fight for new technologies and new practices. But mavericks grow frustrated by the fundamental mismatch between the social organization of schooling and the realities of life in a postindustrial, global, high-tech society (Sizer, 1984). Although the general public and some policy makers may not have recognized this mismatch in the push for standardized instruction, our students have. School is increasingly seen as irrelevant by many students past the primary grades.

Thus, we argue that to understand the future of learning, we have to look beyond schools to the emerging arena of video games. We suggest that video games matter because they present players with simulated worlds: worlds that, if well constructed, are not just about facts or isolated skills, but embody particular social practices. And we argue that video games thus make it possible for players to participate in valued communities of practice and as a result develop the ways of thinking that organize those practices.

Our students will learn from video games. The questions are: Who will create these games, and will they be based on sound theories of learning and socially conscious educational practices? The U.S. Army, a longtime leader in simulations, is building games like *Full Spectrum Warrior* and *America's Army*—games that introduce civilians to military ideology. Several homeland security games are under development, as are a range of games for health education, from games to help kids with cancer take better care of themselves, to simulations to help doctors perform surgery more effectively. Companies are developing games for learning history (*Making History*), engineering (*Time Engineers*), and the mathematics of design (*Homes of Our Own*) (Squire & Jenkins, 2004).

This interest in games is encouraging, but most educational games to date have been produced in the absence of any coherent theory of learning or underlying body of research. We need to ask and answer important questions about this relatively new medium. We need to understand how the conventions of good commercial games create compelling virtual worlds. We need to understand how inhabiting a virtual world develops situated knowledge—how playing a game like *Civilization III*, for example, mediates players' conceptions of world history. We need to understand how spending thousands of hours participating in the social, political, and economic systems of a virtual world develops powerful identities and shared values (Squire, 2004). We need to understand how game players develop effective social practices and skills in navigating complex systems, and how those skills can support learning in other complex domains. And most of all, we need to leverage these understandings to build games that develop for players the epistemic frames of scientists, engineers, lawyers, political activists, and other valued communities of practice—as well as games that can help transform those practices for experienced professionals.

Video games have the potential to change the landscape of education as we know it. The answers to fundamental questions such as these will make it possible to use video games to move our system of education beyond the traditional academic disciplines—derived from medieval scholarship and constituted within schools developed in the industrial revolution—and towards a new model of learning through meaningful activity in virtual worlds as preparation for meaningful activity in our postindustrial, technology-rich, real world.

Application Exercises

- Create a rough outline of your idea for an educational video game. What would students learn? Would there be opportunities for social connection? How would you hope to see information transfer?
- Play a game on two different electronic platforms – iPhone, iPad, Computer, gaming console, etc – and share your thought on the educational value of the medium you used. Also share what limitations the mediums you used presents.

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What is Gamification?

"What is Gamification? This video provides a few ideas about gamification. The video defines the term gamification, talks about the two types of gamification (structural and content) and gives an example of each type.The focus in mostly on educational uses of gamification." — Karl Kapp

Please complete this short survey to provide feedback on this chapter:
http://bit.ly/VideoGamesandLearning

1. As Julian Dibbell, a journalist for *Wired and Rolling Stone*, has shown, it is possible to make a better living by trading online currencies than by working as a freelance journalist! ↵
2. The commercial game retains about 15% of what was in the Army's original simulation. For more on this game as a learning environment, see Gee (in press). ↵

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40

Educational Data Mining and Learning Analytics

Potentials and Possibilities for Online Education

Ryan S. Baker & Paul Salvador Inventado

Editor's Note

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Over the last decades, online and distance education has become an increasingly prominent part of the higher educational landscape (Allen & Seaman, 2008; O'Neill et al., 2004; Patel & Patel, 2005). Many learners turn to distance education because it works better for their schedule, and makes them feel more comfortable than traditional face-to-face courses (O'Malley & McCraw, 1999). However, working with distance education presents challenges for both learners and instructors that are not present in contexts where teachers can work directly with their students. As learning is mediated through technology, learners have fewer opportunities to communicate to instructors about areas in which they are struggling. Though discussion forums provide an opportunity that many students use, and in fact some students are more comfortable seeking help online than in person (Kitsantas & Chow, 2007), discussion forums depend upon learners themselves realizing that they are facing a challenge, and recognizing the need to seek help. Further, many students do not participate in forums unless given explicit prompts or requirements (Dennen, 2005). Unfortunately, the challenges of help-seeking are general: many learners, regardless of setting, do not successfully recognize the need to seek help, and fail to seek help in situations where it could be extremely useful (Aleven et al., 2003). Without the opportunity to interact with learners in a face-to-face setting, it is therefore harder for instructors as well to recognize negative affect or disengagement among students.

Beyond a student not participating in discussion forums, ceasing to complete assignments is a clear sign of disengagement (Kizilcec, Piech, & Schneider, 2013), but information on these disengaged behaviors is not always available to instructors, and more subtle forms of negative affect (such as boredom) are difficult for an unaided distance instructor to identify and diagnose. As such, a distance educator has additional challenges compared to a local instructor in identifying which students are at-risk, in order to provide individual attention and support. This is not

to say that face-to-face instructors always take action when a student is visibly disengaged, but they have additional opportunities to recognize problems.

In this chapter, we discuss educational data mining and learning analytics (Baker & Siemens, 2014) as a set of emerging practices that may assist distance education instructors in gaining a rich understanding of their students. The educational data mining (EDM) and learning analytics (LA) communities are concerned with exploring the increasing amounts of data now becoming available on learners, toward providing better information to instructors and better support to learners. Through the use of automated discovery methods, leavened with a workable understanding of educational theory, EDM/LA practitioners are able to generate models that identify at-risk students so as to help instructors to offer better learner support. In the interest of provoking thought and discussion, we focus on a few key examples of the potentials of analytics, rather than exhaustively reviewing the increasing literature on analytics and data mining for distance education.

Data Now Available in Distance Education

One key enabling trend for the use of analytics and data mining in distance education is that distance education increasingly provides high-quality data in large quantities (Goldstein & Katz, 2005). In fact, distance education has always involved interactions that could be traced, but increasingly data from online and distance education is being stored by distance education providers in formats designed to be usable. For example, The Open University (UK), an entirely online university with around 250,000 students, collects large amounts of electronic data including student activity data, course information, course feedback and aggregated completion rates, and demographic data (Clow, 2014). The university's Data Wranglers project leverages this data by having a team of analytics experts analyze and create reports about student learning, which are used to improve course delivery. The University of Phoenix, a for-profit online university, collects data on marketing, student applications, student contact information, technology support issue tracking, course grades, assignment grades, discussion forums, and content usage (Sharkey, 2011). These disparate data sources are integrated to support analyses that can predict student persistence in academic programs (Ming & Ming, 2012), and can facilitate interventions that improve student outcomes.

Massive Open Online Courses (MOOCs), another emerging distance education practice, also generate large quantities of data that can be utilized for these purposes. There have been dozens of papers exploiting MOOC data to answer research questions in education in the brief time since large-scale MOOCs became internationally popular (see, for instance, Champaign et al., 2014; Kim et al., 2014; Kizilcec et al., 2013). The second-largest MOOC platform, edX, now makes large amounts of MOOC data available to any researcher in the world. In addition, formats have emerged for MOOC data that are designed to facilitate research (Veeramachaneni, Dernoncourt, Taylor, Pardos, & O'Reilly, 2013).

Increasingly, traditional universities are collecting the same types of data. For example, Purdue University collects and integrates educational data from various systems including content management systems (CMS), student information systems (SIS), audience response systems, library systems and streaming media service systems (Arnold, 2010). This institution uses this data in their Course Signals project, discussed below.

One of the key steps to making data useful for analysis is to pre-process it (Romero, Romero, & Ventura, 2013). Pre-processing can include data cleaning (such as removing data stemming from logging errors, or mapping meaningless identifiers to meaningful labels), integrating data sources (typically taking the form of mapping identifiers—which could be at the student level, the class level, the assignment level or other levels—between data sets of tables), and feature engineering (distilling appropriate data to make a prediction). Typically, the process of engineering and distilling appropriate features that can be used to represent key aspects of the data is one of the most time-consuming and difficult steps in learning analytics. The process of going from the initial features logged by an online learning system (such as correctness and time, or the textual content of a post) to more semantic features (history of correctness on a specific skill; how fast an action is compared to typical time taken by other students on the same problem step; emotion expressed and context in a discussion of a specific discussion forum post) involves considerable theoretical understanding of the educational domain. This understanding is sometimes encoded in schemes for formatting and

storing data, such as the MOOC data format proposed by Veeramachaneni et al. (2013) or the Pittsburgh Science of Learning Center DataShop format (Koedinger, Baker, Cunningham, Skogsholm, Leber, & Stamper, 2010).

Methods for Educational Data Mining and Learning Analytics

In tandem with the development of these increasingly large data sets, a wider selection of methods to distill meaning have emerged; these are referred to as educational data mining or learning analytics. As Baker and Siemens (2014) note, the educational data mining and learning analytics communities address many of the same research questions, using similar methods. The core differences between the communities are in terms of emphasis: whether human analysis or automated analysis is central, whether phenomena are considered as systems or in terms of specific constructs and their interrelationships, and whether automated interventions or empowering instructors is the goal. However, for the purposes of this article, educational data mining and learning analytics can be treated as interchangeable, as the methods relevant to distance education are seen in both communities. Some of the differences emerge in the section on uses to benefit learners, with the approaches around providing instructors with feedback being more closely linked to the learning analytics community, whereas approaches to providing feedback and interventions directly to students are more closely linked to practice in educational data mining.

In this section, we review the framework proposed by Baker and Siemens (2014); other frameworks for understanding the types of EDM/LA method also exist (e.g., Baker & Yacef, 2009; Scheuer & McLaren, 2012; Romero & Ventura, 2007; Ferguson, 2012). The differences between these frameworks are a matter of emphasis and categorization. For example, parameter tuning is categorized as a method in Scheuer and McLaren (2012); it is typically seen as a step in the prediction modeling or knowledge engineering process in other frameworks. Still, mostly the same methods are present in all frameworks. Baker and Siemens (in press) divide the world of EDM/LA methods into prediction modeling, structure discovery, relationship mining, distillation of data for human judgment, and discovery with models. In this chapter, we will provide definitions and examples for prediction, structure discovery, and relationship mining, focusing on methods of particular usefulness for distance education.

Prediction

Prediction modeling occurs when a researcher or practitioner develops a model, which can infer (or predict) a single aspect of the data, from some combination of other variables within the data. This is typically done either to infer a construct that is latent (such as emotion), or to predict future outcomes. In these cases, good data on the predicted variable is collected for a smaller data set, and then a model is created with the goal of predicting that variable in a larger data set, or a future data set. The goal is to predict the construct in future situations when data on it is unavailable. For example, a prediction model may be developed to predict whether a student is likely to drop or fail a course (e.g., Arnold, 2010; Ming & Ming, 2012). The prediction model may be developed from 2013 data, and then utilized to make predictions early in the semester in 2014, 2015, and beyond. Similarly, the model may be developed using data from four introductory courses, and then rolled out to make predictions within a university's full suite of introductory courses.

Prediction modeling has been utilized for an ever-increasing set of problems within the domain of education, from inferring students' knowledge of a certain topic (Corbett & Anderson, 1995), to inferring a student's emotional state (D'Mello, Craig, Witherspoon, McDaniel, & Graesser. 2008). It is also used to make longer-term predictions, for instance predicting whether a student will attend college from their learning and emotion in middle school (San Pedro, Baker, & Gobert, 2013).

One key consideration when using prediction models is distilling the appropriate data to make a prediction (sometimes referred to as feature engineering). Sao Pedro et al. (2012) have argued that integrating theoretical understanding into the data mining process leads to better models than a purely bottom-up data-driven approach. Paquette, de Carvalho, Baker, and Ocumpaugh (2014) correspondingly find that integrating theory into data mining performs better than either approach alone. While choosing an appropriate algorithm is also an important challenge (see discussion in Baker,

2014), switching algorithms often involves a minimal change within a data mining tool, whereas distilling the correct features can be a substantial challenge.

Another key consideration is making sure that data is validated appropriately for its eventual use. Validating models on a range of content (Baker, Corbett, Roll, & Koedinger, 2008) and on a representative sample of eventual students (Ocumpaugh, Baker, Gowda, Heffernan & Heffernan, 2014) is important to ensuring that models will be valid in the contexts where they are applied. In the context of distance education, these issues can merge: the population of students taking one course through a distance institution may be quite different than the population taking a different course, even at the same institution. Some prediction models have been validated to function accurately across higher education institutions, which is a powerful demonstration of generality (Jayaprakash, Moody, Lauría, Regan, & Baron, 2014).

As with other areas of education, prediction modeling increasingly plays an important role in distance education. Arguably, it is the most prominent type of analytics within higher education in general, and distance education specifically. For example, Ming and Ming (2012) studied whether students' final grades could be predicted from their interactions on the University of Phoenix class discussion forums. They found that discussion of more specialized topics was predictive of higher course grades. Another example is seen in Kovacic's (2010) work studying student dropout in the Open Polytechnic of New Zealand. This work predicted student dropout from demographic factors, finding that students of specific demographic groups were at much higher risk of failure than other students.

Related work can also be seen within the Purdue Signals Project (Arnold, 2010), which mined content management system, student information system, and gradebook data to predict which students were likely to drop out of a course and provide instructors with near real-time updates regarding student performance and effort (Arnold & Pistilli, 2012; Campbell, DeBlois, & Oblinger, 2007). These predictions were used to suggest interventions to instructors. Instructors who used those interventions, reminding students of the steps needed for success, and recommending face-to-face meetings, found that their students engaged in more help-seeking, and had better course outcomes and significantly improved retention rates (Arnold, 2010).

Structure Discovery

A second core category of learning LA/EDM is structure discovery. Structure discovery algorithms attempt to find structure in the data without an a priori idea of what should be found: a very different goal than in prediction. In prediction, there is a specific variable that the researcher or practitioner attempts to infer or predict; by contrast, there are no specific variables of interest in structure discovery. Instead, the researcher attempts to determine what structure emerges naturally from the data. Common approaches to structure discovery in LA/EDM include clustering, factor analysis, network analysis, and domain structure discovery.

While domain structure discovery is quite prominent in research on intelligent tutoring systems, the type of structure discovery most often seen in online learning contexts is a specific type of network analysis called Social Network Analysis (SNA) (Knoke & Yang, 2008). In SNA, data is used to discover the relationships and interactions among individuals, as well as the patterns that emerge from those relationships and interactions. Frequently, in learning analytics, SNA is paired with additional analytics approaches to better understand the patterns observed through network analytics; for example, SNA might be coupled with discourse analysis (Buckingham, Shum, & Ferguson, 2012).

SNA has been used for a number of applications in education. For example, Kay, Maisonneuve, Yacef, and Reimann (2006) used SNA to understand the differences between effective and ineffective project groups, through visual analysis of the strength of group connections. Although this project took place in the context of a face-to-face university class, the data analyzed was from online collaboration tools that could have been used at a distance. SNA has also been used to study how students' communication behaviors in discussion forums change over time (Haythornthwaite, 2001), and to study how students' positions in a social network relate to their perception of being part of a learning community (Dawson, 2008), a key concern for distance education. Patterns of interaction and connectivity in learning

communities are correlated to academic success as well as learner sense of engagement in a course (Macfadyen & Dawson, 2010; Suthers & Rosen, 2011).

Relationship Mining

Relationship mining methods find unexpected relationships or patterns in a large set of variables. There are many forms of relationship mining, but Baker and Siemens (2014) identify four in particular as being common in EDM: correlation mining, association rule mining, sequential pattern mining, and causal data mining. In this section, we will mention potential applications of the first three.

Association rule mining finds if-then rules that predict that if one variable value is found, another variable is likely to have a characteristic value. Association rule mining has found a wide range of applications in educational data mining, as well as in data mining and e-commerce more broadly. For example, Ben-Naim, Bain, and Marcus (2009) used association rule mining to find what patterns of performance were characteristic of successful students, and used their findings as the basis of an engine that made recommendations to students. Garcia, Romero, Ventura, and De Castro (2009) used association rule mining on data from exercises, course forum participation, and grades in an online course, in order to gather data related to effectiveness to provide to course developers. A closely related method to association rule mining is sequential pattern mining. The goal of sequential pattern mining is to find patterns that manifest over time. Like association rule mining, if-then rules are found, but the if-then rules involve associations between past events (if) and future events (then). For example, Perera, Kay, Koprinska, Yacef, and Zaiane (2009) used sequential pattern mining on data from learners' behaviors in an online collaboration environment, toward understanding the behaviors that characterized successful and unsuccessful collaborative groups. One could also imagine conducting sequential pattern mining to find patterns in course-taking over time within a program that are associated with more successful and less successful student outcomes (Garcia et al., 2009). Sequential patterns can also be found through other methods, such as hidden Markov models; an example of that in distance education is seen in Coffrin, Corrin, de Barba, and Kennedy (2014), a study that looks at patterns of how students shift between activities in a MOOC.

Finally, correlation mining is the area of data mining that attempts to find simple linear relationships between pairs of variables in a data set. Typically, in correlation mining, approaches such as post-hoc statistical corrections are used to set a threshold on which patterns are accepted; dimensionality reduction methods are also sometimes used to first group variables before trying to correlate them to other variables. Correlation mining methods may be useful in situations where there are a range of variables describing distance education and a range of student outcomes, and the goal is to figure out an overall pattern of which variables correspond to many successful outcomes rather than just a single one.

Uses to Benefit Learners

As the examples above indicate, there are several potential uses for data mining and analytics in distance education. These methods can be used to learn a great deal about online and distance students, their learning processes, and what factors influence their outcomes. In our view, the primary uses can be categorized in terms of automated feedback and adaptation.

Automated feedback to students about their learning and performance has a rich history within online education. Many distance education courses today offer immediate correctness feedback on pop-up quizzes or other problem-solving exercises (see Janicki & Liegle, 2001; Jiang et al., 2014), as well as indicators of course progress. Research suggests that providing distance education students with visualizations of their progress toward completing competencies can lead to better outcomes (Grann & Bushway, 2014). Work in recent decades in intelligent tutoring systems and other artificially intelligent technologies shows that there is the potential to provide even more comprehensive feedback to learners. In early work in this area, Cognitive Tutors for mathematics showed students "skill bars," giving indicators to students of their progress based on models of student knowledge (Koedinger, Anderson, Hadley, & Mark, 1997). Skill bars have since been extended to communicate hypotheses of what misconceptions the students may have (Bull,

Quigley, & Mabbott, 2006). Other systems give students indicators of their performance across a semester's worth of subjects, helping them to identify what materials need further study prior to a final exam (Kay & Lum, 2005). Some systems provide learners with feedback on engagement as well as learning, reducing the frequency of disengaged behaviors (Walonoski & Heffernan, 2006). These intelligent forms of feedback are still relatively uncommon within distance education, but have the potential to increase in usage over time.

Similarly, feedback to instructors and other university personnel has a rich history in learning analytics. The Purdue Signals Project (discussed above) is a successful example of how instructors can be empowered with information concerning which students are at risk of unsuccessful outcomes, and why each student is at risk. Systems such as ASSISTments provide more fine-grained reports that communicate to instructors which skills are generally difficult for students (Feng & Heffernan, 2007), influencing ongoing instructional strategies. In the context of distance education, Mazza and Dimitrova (2004) have created visualizations for instructors that represent student knowledge of a range of skills and participation in discussion forums. Another example is TrAVis, which visualizes for instructors the different online behaviors each student has engaged in (May, George, & Prévôt, 2011). These systems can be integrated with tools to support instructors, such as systems that propose types of emails to send to learners (see Arnold, 2010).

Finally, automated intervention is a type of support that can be created based on educational data mining, where the system itself automatically adapts to the individual differences among learners. This is most common in intelligent tutoring systems, where there are systems that automatically adapt to a range of individual differences. Examples include problem selection in Cognitive Tutors (Koedinger et al., 1997), where exercises are selected for students based on what material they have not yet mastered; pedagogical agents that offer students support for meta-cognitive reasoning (Biswas, Leelawong, Belynne, Viswanath, Schwartz, & Davis. 2004), engagement (Arroyo, Ferguson, Johns, Dragon, Meheranian, Fisher, Barto, Mahadevan, & Woolf, 2007), and collaboration (Dyke, Leelawong, Belynne, Viswanath, Schwartz, & Davis, 2013); and memory optimization, which attempts to return to material at the moment when the student is at risk of forgetting it (Pavlik & Anderson, 2008). Intelligent tutoring systems have been used at scale more often for K-12 education than for higher education, but there are examples of their use in the latter realm (Mitrovic & Ohlsson, 1999; Corbett et al., 2010). The use of intelligent tutor methodologies in distance education can be expected to increase in the coming years, given the acquisition of Carnegie Learning, a leading developer of intelligent tutoring systems, by the primarily distance education for-profit university, the University of Phoenix.

Limitations and Issues to Consider

Educational data mining and learning analytics have been successful in several areas, but there are several issues to consider when applying learning analytics. A key issue, in the authors' opinion, is model validity. As discussed above, it is important that models be validated (tested for reliability) based on genuine outcome data, and that models be validated using data relevant to their eventual use, involving similar systems and populations. The invalid generalization of models creates the risk of inaccurate predictions or responses.

In general, it is important to consider both the benefits of a correctly applied intervention and the costs of an incorrectly applied one. Interventions with relatively low risk (sometimes called "fail-soft interventions") are preferable when model accuracy is imperfect. No model is perfect, however; expecting educational at-risk models to be more reliable than standards for first-line medical diagnostics may not be entirely realistic.

Another important consideration is privacy. It is essential to balance the need for high-quality longitudinal data (that enables analysis of the long-term impacts of a student behavior or an intervention) with the necessity to protect student privacy and follow relevant legislation. There is not currently a simple solution to the need to protect student privacy; simply discarding all identifying information protects privacy, but at the cost of potentially ignoring long-term negative effects from an intervention, or ignoring potential long-term benefits.

Conclusion

Data mining and analytics have potential in distance education. In general, as with many areas of education, distance education will be enhanced by the increasing amounts of data now becoming available. There is potential to enhance the quality of course materials, identify at-risk students, and provide better support both to learners and instructors. By doing so, it may be possible to create learning experiences that create a level of individual personalization better than what is seen in traditional in-person courses, instead emulating the level of personalization characteristic of one-on-one tutoring experiences.

Application Exercises

- Name five ways educational data mining and learner analytics could help you design an online learning course.
- As taught in this chapter, "Research suggests that providing distance education students with visualizations of the progress toward completing competencies can lead to better outcomes." Why do you think this is the case?

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41

Opportunities and Challenges with Digital Open Badges

Tadd Farmer & Richard E. West

Editor's Note

The following article was originally published in Educational Technology *and i*s used here by permission of the editor. For more information on open badges, "Open Badges: trusted, portable digital credentials, Doug Belshaw" is an excellent presentation from Doug Belshaw, who worked on the original project. Also, the K–12 BadgeChat on Flipboard from the Open Badge Alliance contains many curated articles and information related to K–12 use of open badges.

Farmer, T., & West, R. E. (2016). Opportunities and challenges with digital open badges. *Educational Technology*, *56*(5), 45–48. Retrieved from http://www.academia.edu/29863552/Opportunities_and_Challenges_with_Digital_Open_Badges

In 2011, Arne Duncan, Secretary of the U.S. Department of Education, gave a speech at the MacArthur Foundation Digital Media and Lifelong Learning Competition and detailed the need to establish certifications of achievement recognizing informal learning experiences. He said, "Today's technology-enabled, information-rich, deeply interconnected world means learning not only can—but *should*—happen anywhere, anytime. We need to recognize these experiences" (Duncan, 2011, para. 14). Informal learning settings such as web-based and blended learning environments, after-school and extracurricular activities, and vocational and work-based training programs are becoming increasingly prevalent. However, participants in these environments have difficulty being recognized for the competencies they develop.

This inability to recognize learning in informal contexts is one of many concerns with traditional assessing approaches. A second concern is that traditional credentials are not always effective communicators of a student's skill or knowledge. When a student is given an "A" at the conclusion of a course, what does that grade symbolize? How easy is it for a student, parent, or teacher to look inside that grade to discern the specific competencies acquired by a particular student? On a larger scale, how easy is it for a potential employer to analyze the degree and GPA of a prospective employee and understand the full range of that prospect's skills and competencies? Such indicators fail to provide a transparent picture of an individual's experience and qualifications.

These two challenges of how to recognize and reward informal learning, and how to increase transparency in traditional grading practices are two credentialing challenges begging for a solution. In the last several years, advances in the field

of microcrendentialing, specifically digital badging, has shown promise in solving these assessment challenges.

What Are Digital and Open Badges?

The definition for digital and open badges includes both concepts of structure and function for the users. Structurally speaking, digital badges are small digital images that represent an individual's learning within a specific domain. These images are embedded with rich metadata that increases transparency into what is actually learned (Gamrat, Zimmerman, Dudek, & Peck, 2014; Gamrat & Zimmerman, 2015). This metadata could include information about the badge issuer (institution name, date of issue, rubric and requirements for the badge) and badge earner (name, evidence of learning, and feedback from the issuer), providing a more transparent picture of what has been learned and the observable evidence of that learning.

Open badges are a unique type of digital badge with additional affordances built into the technology that allow for the credential to be integrated into any compatible learning or portfolio system. While some digital badges are useful indicators of learning within a closed system (e.g. Khan Academy, Duolingo), open badges can be exported into open backpacks that collect and display these microcredentials from many different formal and informal learning systems.

Because of their digital and open affordances, open badges can also serve a variety of functions, including as a map of learning pathways or trajectories (Bowen & Thomas, 2014; Newby, Wright, Besser, & Beese, 2015; Gamrat & Zimmerman, 2015), "descriptions of merit" (Rughinis & Matei, 2013), signposts of past and future learning (Rughinis & Matei, 2013), a reward or status symbol (Newby et al., 2015), promoters of motivation and self-regulation (Newby et al., 2015; Randall, Harrison, & West, 2013), "tokens of accomplishment" (O'Byrne, Schenke, Willis, & Hickey, 2015), a learning portfolio or repository (Gamrat et al., 2014), and a goal-setting support (Gamrat & Zimmerman, 2015).

Benefits of Open Badges

This long list of functions served by open badges illuminates some of the major benefits and affordances of badges, including positive effects on motivation, guidance, and recognition.

Using digital badges as an incentive for learning or performance is a common practice. Upon completion of a badge, learners are awarded a badge that becomes an outward symbol of a successful learning experience. Careful badge design could even create appeal for a learner's intrinsic motivation by rewarding effort and improvement instead of performance (Jovanovic, Devedzic, 2014), and by providing choices for learners, thus increasing their autonomy and self-direction (West & Randall, 2016).

In fact, many organizations with badging structures include self-direction as a major component. The Sustainable Agriculture & Food Systems Major (SA&FS) at University of California, Davis allows students to create completely customized badges (content and criteria) that will recognize an individual's learning and achievements across various learning contexts (University of California, Davis, 2014).

Additionally, as badges increase learner autonomy and choice, they can also improve how we guide and scaffold students to new, engaging, and personalized learning experiences that are relevant to their preferences, abilities, and aptitudes. Indeed, Green, Facer, Rudd, Dillon, and Humphreys (2005) argued that there were four key aspects of personalized learning through digital technologies, including giving learners choices, recognizing different forms of skills and knowledge, and learner-focused assessment. Open badges address these key attributes of personalized learning by increasing learning options, assessing discrete skills at a micro level, and credentialing learning both within and without traditional formal institutions. These badges can then be organized into learning paths that provide guidance to learners in particular domains. An example is from Codeschool (https://edtechbooks.org/-jc), which uses paths to direct students through micro-learning activities within certain areas. In this way, badges help scaffold students in taking ownership of their learning process.

Digital badges not only illuminate the learning pathways for future learning, but can also recognize learning experiences that previously have not been easily acknowledged through a credential. By design, badges are microcredentials that display learning discrete competencies along with relevant data. Mehta, Hull, Young, & Stoller, (2013) suggested that this could potentially offer a solution to the medical training profession by helping medical students gain important competencies while staying current on their learning. He suggested that medical students could earn a badge for a specific procedure, test, or even medical explanation. That badge would be displayed on the learner's profile and would reflect their learning across a variety of settings. Additionally, each badge could include an expiration date that would ensure that medical professionals were current in their training, a feature that has also been suggested for other domains such as teacher education (Randall et al., 2013).

Examples in Open Badging

Over the last several years, open badges have attracted attention as a way to solve many difficult educational problems. As of March 2013, Mozilla Open Badges, a major host of the badging community, had 700 unique registered issuers that linked to over 75,000 digital badges (Gibson, Ostashewski, Flintoff, Grant, & Knight, 2015). Other research estimates that over 2,000 organizations have currently implemented badging into their learning environments (Jovanovic & Devedzic, 2014). From analyzing web search trends in more recent years, we can assume that these numbers have only increased.

The attention received by digital badges is increasing due to examples of successful badging programs in secondary and higher education environments. Teacher Learning Journeys (TLJ) developed through a partnership between Penn State University and NASA, National Aeronautics, and the National Science Teachers Association (NSTA) provides an example of a successful badging program for inservice teachers. This partnership worked together to create 63 professional development activities as part of the TLJ for each teacher. Teachers were asked to browse the various activities and plan which activities they wanted to participate in to develop their teaching abilities. Additionally, teachers were offered two levels of competencies for each activity: badges and stamps (a lower achievement). Through a careful case study of program participants in TLJ, researchers discovered that the badging structure provided learning pathways that allowed teachers to self-regulate their professional development and learning. Teachers were given options of various content badges, and could choose the level of performance they wanted to develop within the desired content. This program included the principle of self-regulation that are important characteristics in establishing higher levels of motivation (Pink, 2011).

Purdue University's badging system, known as Passport, allows faculty members create, design, and issue their own badges in support of all learning (Bowen & Thomas, 2014). Passport has been a successful tool in establishing badges for intercultural learning courses, educational technology courses, and even for LinkedIn proficiencies through the university's career center. By enabling faculty members to become badge creators, Purdue is encouraging the development of an assessment culture based on transparency, competency, and recognition.

Institutions of higher learning are not the only organizations experimenting with open badges. Primary and secondary schools are also beginning to implement badging systems to motivate, direct, and recognize student learning. The MOUSE Squad, an organization aimed at helping disadvantaged students, utilizes badges to motivate, assess, and recognize student learning both in school and with after school programs. A case study of the program outlined the successful experience of a young girl named Zainab who immigrated to the United States from Nigeria at age 12. Through engaging in the MOUSE program, Zainab gained technological skills in a social collaborative experience to create a device for the visually impaired that would alert them when food was placed on their plate. The skills and competencies developed by Zainab were represented as badges on her college application and helped her earn a full scholarship to the University of Virginia (O'Byrne et al., 2015).

Badges can recognize learning beyond the physical walls of an organization as well as beyond the typical organizational schedule. One leader in the area of digital badges, although these badges are not open and compliant with the Open Badge Infrastructure, is Khan Academy. In addition to course content, Khan Academy uses a digital badge structure that

acts as learning pathways for future learning as well as recognition of skills and competencies previously developed. In addition to concrete content skills, Khan Academy is notable for its collection of badges issued for “soft skills” such as listening, persistence, and habit formation (“Badges,” 2015)—an idea that may begin to spread to open badge systems as well.

Challenges in Digital Badges

While digital badges offer promise for solving some difficult educational challenges, critics have pointed out several concerns, particularly with issues of scope, awareness, and assessment practices.

With so many institutions experimenting with badging systems, it is possible that the flood of badges is undermining the efforts to use badges as an effective assessment tool. In their assessment of badges, West and Randall (2016) hypothesized that unless the badging community can show how badges can be a rigorous and meaningful assessment tool, the idea of badges will fade away without making any difference on the educational environment. This flood of badges, particularly “lightweight” badges, can clutter the badging landscape and hinder the ability for the end user (e.g. employer, academic institution, etc.) to determine the value and quality of badges. Therefore, the responsibility of the badging community is to create and issue badges that are rigorous and meaningful.

Another challenge to open badges is the struggle to be recognized outside of their native badging ecosystem. In badging, an ecosystem is made up of badge developers, earners, issuers, and end users that interact with each other to learn, display, and recognize competencies. Ecosystems can be local in nature, where badges are intended to be used within an individual’s learning space, or global where badges are designed to be displayed and recognized beyond the institution’s community. While both badging ecosystems can serve an important purpose, creating a global badging ecosystem requires organizations outside the institution to recognize and accept the badge performance and assessment. This recognition is difficult to achieve with institutions who have standards, requirements, and objectives that often do not align. However, because of the portability of the open badge technology, it is possible for like-minded institutions of learning to form consortiums where badges could hold value with peer institutions within the consortium. Professional organizations with a vested interest in those skills might consider endorsing these badges to give them increased weight and importance (Ma, 2015).

Much like any start-up organization trying to enter into a new market, new ideas, such as open badges, require brand awareness by consumers to begin gaining cultural acceptance. Generally speaking, consumers must be made aware through positive interactions with a product or idea before they are willing to embrace it. Although open badges are becoming more common in work and educational settings, a lack of awareness about badges persists. Decision makers in government, business, and education appear to be generally unaware of the potential of badges to motive, direct, and recognize learning.

The inability of badges to be diffused and implemented into a wider educational context may be due to a larger struggle between traditional and competency-based grading. Competency demands mastery of content and allows for the variables of time, resources, and location of learning to vary (Reigeluth & Garfinkle, 1994). Traditional approaches to assessment allow for student’s learning to vary while keeping other variables constant. Open badges can be used in a competency approach to assessment that encourages students to redo and rework problems until they have mastered the skill and fulfilled the requirements for the badge.

Conclusion

The inability to effectively recognize informal and formal learning competencies in traditional business and educational contexts begs for new ways of assessment and new forms of credentials. Well designed digital open badging systems offer potential solutions. While badges are becoming increasingly common, proponents of widespread adoption of badges face difficult challenges in creating common norms around the scope for badges and the learning they represent, how to successfully build badge awareness and credibility that extends beyond institutional boundaries, and

how to effectively navigate to more competency-based styles of assessment. What is needed for an innovation like open badges to be successful, at this stage, are additional examples of effective badging practices, along with rigorous research into the principles of quality badging. Scholars could study how teachers, learners, and organizations have implemented open badging successfully, and what challenges they have faced. Other research could investigate how to increase awareness and acceptance of badge credentials, the most effective scope and granularity for effective badges, how badges may or may not contribute to effective e-portfolios and overcome the challenges these portfolios have traditionally faced, how to effectively scale and manage badging systems, and how badges may contribute to enhanced motivation and self-regulation. By exploring these and other issues, we can better determine whether open badges are another technological fad, or a potentially disruptive innovation.

Application Exercises

- What are two informal learning experiences you have participated in that could be assessed with an open badge?
- Think of a skill you would like to learn. Then, look for different resources that offer badges in that skill. Compare the resources, and pick one that you would prefer to use. Explain your choice.
- The authors list several challenges to spreading the use of badges more fully. Choose one of those barriers and share some strategies you think would help address that concern.

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V. Becoming an LIDT Professional

Becoming an LIDT professional is more than knowing some theory, and having some design or technical skills. You must learn how to network with other professionals, engage with professional organizations, and perhaps (hopefully!) contribute your growing insights back to the research and design literature through publication. These chapters will seek to guide you on this journey, as well as in establishing a moral foundation for your work as an LIDT professional.

The Moral Dimensions of Instructional Design
Creating an Intentional Web Presence
Where Should Educational Technologists Publish Their Research?
Rigor, Influence, and Prestige in Academic Publishing
Educational Technology Conferences
Networking at Conferences
PIDT, the Important Unconference for Academics

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42

The Moral Dimensions of Instructional Design

Russell T. Osguthorpe, Richard Osguthorpe, W. James Jacob, & Randall S. Davies

Editor's Note

The following was previously published in *Educational Technology.*

Osguthorpe, R. T., Osguthorpe, R. D., Jacob, W. J., & Davies, R. (2003). The Moral Dimensions of Instructional Design. *Educational Technology*, *43*(2), 19–23.

While visiting a graduate student, who was completing her internship in a training division of a large corporation, I (the senior author) was escorted by her supervisor into their conference room. Pointing to immense charts covering each of the four walls, she explained, "This is our instructional design model. We're pretty proud of it." As I examined the charts, I was astonished at the level of detail. Each of the major components in the ADDIE model included layer after layer of sub-steps. Trying not to judge the model too quickly, I asked, "So, what do you see as the major benefit of this model over a more simplified one?"

"Oh," she responded, "following this model helps us accomplish our overall goal of zero defects."

Somewhat puzzled, I asked, "Zero defects? You mean the model helps you find problems in your company's products."

"No, not in the products," she responded, "in the people."

A little stunned, I asked, "And how do you decide that a person is defective?"

Without hesitating, she explained, "Any time a trainee answers a test item incorrectly, that's considered a defect."

Anyone who has worked extensively with instructional design models should not be surprised at such an extreme application of their principles. The models are grounded on what Jackson (1986) has called the "mimetic" tradition, which "gives a central place to the transmission of factual and procedural knowledge from one person to another, through an essentially *imitative* process" (p. 117). Mimetic instruction usually includes five steps that are hauntingly similar to the ADDIE model: (1) test, (2) present, (3) perform/evaluate, (4) reward correct performance/remediate incorrect performance, and (5) advance to the next unit.

But there is another way to frame education: Jackson (1986) calls it the "transformative" tradition. Rather than adding knowledge to a student's brain—the goal of mimetic instruction—transformative teaching attempts to change the student in a more fundamental way (see Cranton, 1994). In this tradition, students change the way they see themselves

in relation to others and to the world around them. In transformative education a teacher cares for students in their wholeness. The teacher is concerned not only with improvements in test performance, but with improvements in character.

Teaching and teacher education have long considered their disciplines to be moral in nature. Fenstermacher (1990) asserts that moral dimensions are *always* present when one person is trying to teach another:

> *What makes teaching a moral endeavor is that it is, quite centrally, human action undertaken in regard to other human beings. Thus, matters of what is fair, right, just, and virtuous are always present. When a teacher asks a student to share something with another student, decides between combatants in a schoolyard dispute; sets procedures for who will go first, second, third, and so on; or discusses the welfare of a student with another teacher, moral considerations are present. (p. 133)*

So what if we replaced the word *teacher* with *instructional designer?* Because instructional designers are usually not present when students are learning, should they be satisfied with performance as the sole criterion for success? Can they ignore the broader, more fundamental needs of their students—the transformative needs? To address these questions, we will first present a case for viewing instructional design as a moral endeavor. Next we will offer a framework for discussing the moral dimensions of the profession. Finally, we will discuss ways the framework can be used to improve the practice of instructional design.

In each section we cite data from studies that we are currently conducting. In one study, 86 college students and 27 sixth graders reflected on and reported on their most frustrating and most fulfilling learning experiences. In another study, in depth interviews were conducted with 9 instructional designers asking them to reflect on their experience in designing online college courses.

The Case for Moral Dimensions

When asked for the most common criticism of online courses, a director of evaluation at a large center for instructional design, said, “That’s easy, students who don’t like online courses usually say that the courses are too cook-booky.” The following student comment on an experience with an online course reinforces this conclusion:

> *In order to make the class testable, the professor focused on banalities that would easily fit a multiple choice format. The end result was that I binged/purged a lot of nonsense that I will never use in my life, rather than coming away with significant insights.*

The course this student was evaluating clung firmly to the mimetic tradition of transferring facts from computer screen to student, and at least for this student the course failed to accomplish even this. So how can instructional designers avoid creating courses that do not result in important student learning? We propose that just as the fields of teaching and teacher education are beginning to embrace moral dimensions of their practice, so should instructional design. Why would we make such a recommendation? For two reasons: (1) Instructional design is as much a human endeavor as face-to-face teaching, and all human endeavors are moral by nature, and (2) the more instructional designers focus on the higher or deeper dimensions of learning and teaching that are ensconced in moral principles, the more likely transformative learning will occur—both for the student and for the instructional designer.

Before presenting our framework for the moral dimensions of instructional design, we will explain what we mean by the word *moral,* or more accurately, what we do *not* mean. First, we are not considering professional ethics as included in the book *Instructional Design Competencies: The Standards* (Richey, Fields, & Foxon, 2001). Every worthy profession has ethical codes of conduct. For instructional designers, these standards ensure that client and societal needs and rights are not violated: e.g., instructional designers will not plagiarize others’ work. Although these standards have clear moral implications, they have little to do with the moral dimensions we refer to. Second, we are not suggesting the direct teaching of virtues (e.g., slipping a little lesson on honesty into the online accounting course).

Our use of the word *moral* emphasizes neither ethical codes of conduct nor direct teaching of virtues; rather we wish to focus on the ways in which instructional designers conduct and view their work in relation to those who will use their instructional products. Thus the practice of designing instructional interactions becomes a moral endeavor (see Hansen, 2001).

A Moral Dimensions Framework

Our framework provides an alternative lens through which the practice of instructional design might be viewed. It is grounded primarily in moral and educational philosophy rather than in behavioral psychology. The framework does not prevent designers from relying on extant models and theories; it simply encourages designers to examine more carefully how these theories relate to the higher, transformative purposes of instruction. As shown in Figure 1, an instructional designer must develop traditional competencies, as Richy, Fields, and Foxon (2001) have recommended. Such competency development, we believe, can lead to effective mimetic learning for students. The more proficient the designer is in all 23 stated competencies, the more likely students will master the intended learning goals. However, we suggest that there is more to instructional design than mastering 23 competencies. We believe, as does Green (1999), that conscience formation transcends the learning of specified objectives. In his book *Voices: The Formation of Conscience,* Tom Green asserts that unless teachers focus on conscience, they will never reach the highest goals of education.

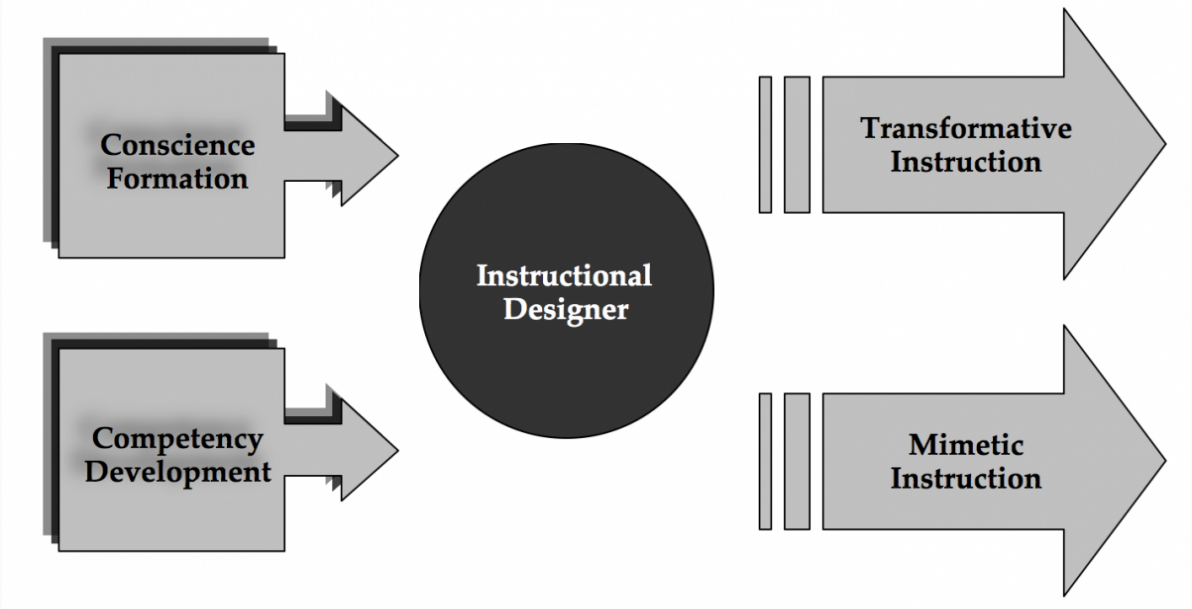

Figure 1. Including the moral dimensions in instructional design

Conscience of craft. Green (1999) identifies five different types of personal conscience. We will briefly describe how each conscience relates to the instructional design profession. The *conscience of craft* refers to one's desire to adhere to often unstated but overarching standards of one's profession. While working on a piece of sculpture, the artist strives to meet the standards of good art. Sometimes these standards have been made explicit, other times they are more illusive, but nonetheless powerful in directing the sculptor's work. Comparing her work to the most respected works of art, the sculptor constantly strives to meet the highest standard—not because the piece will generate more profit, but because the sculptor desires to be a good artist.

An instructional designer likewise can develop a conscience of craft by striving for excellence beyond that which a client may demand. The more developed the designer's conscience, the better the resulting instruction. We are acquainted with a designer who quickly produces the first prototype and then methodically and relentlessly obtains feedback from students and teachers on how to improve the instruction. No one is requiring the designer to be so exacting. The designer simply has a well-developed conscience of craft—never being satisfied with something that others would call "good enough."

Conscience of membership. The conscience of membership is closely related to that of craft. An instructional designer might ask, "What does it mean to be a member of this profession? What must I live up to? What do I owe my profession?" Each profession has its norms, its acceptable modes of conduct. One might argue that while instructional design as a field has generated norms, these norms are not as strong as they might be. And this weakness could be a result of designers not construing their work as having moral aims.

During an interview, an instructional designer who had helped develop a college course, lamented how deadlines got in the way of quality work:

> *We had a manuscript and we just started building things and we were literally finishing lessons the week before they were supposed to be going to the students. We recognized that it was just not a successful mode. In fact, I think only one-third of the students who took the course indicated that they would take another online course.*

Conscience of sacrifice. Green (1999) describes the conscience of sacrifice as "truth telling and promise keeping." This conscience causes a person to act on more than simply self-interest. Green argues that an educator must perform acts that "fall beyond the limits of mere duty. Any perfectly gratuitous act of caring or kindness aimed at the good of another has this characteristic." (p. 93) When asked if she ever went beyond the requirements in the course, a college student responded, "And why would I want to do that? Do you think I'm crazy?" Green might say that this student's conscience of sacrifice was not very well developed.

In contrast another student in an online course completed not only all of the requirements but contributed to the online discussion three times more often than the average for the class. In a class of 53, students on average accessed the discussion board 152 times, while this student accessed it 421 times. And the quality of her contributions was clearly better than most.

The conscience of sacrifice applies equally to the designer. Is the designer totally honest with the rest of the design team, with students who pilot the course? To what extent does the designer act out of concern for those who will experience the instruction, as well as for those who are working on the team?

A critic of our framework might say,

> *Okay, stop right there; you're not being realistic. Instructional designers might enjoy acting on moral instincts of caring, of sacrificing, or promise keeping, but they are under constant pressure to produce—to deliver a product, and you can't ask them to listen to these voices of conscience when they hardly have time to meet with the subject matter expert.*

Our response to such criticism is that we recognize the constraints on designers, as on all educators, to ignore the deeper, more far-reaching aspects of their work. But that is actually the point. The more one ignores these fundamentally moral aims of one's work, the less effective will be the resulting product. Are the voices of conscience that Green proposes too lofty? We think not. We argue that the field needs to reach deeper and higher at the same moment if the discipline is to continue to develop in appropriate ways.

Conscience of memory. Green speaks of the conscience as a way of drawing upon one's past, of building on the traditions that are unique to an individual. He calls this type of memory "rootedness." Humans, he argues, have a powerful need to be rooted: to know where they came from and what those before them were like. This seems to be an

especially neglected type of conscience in instructional design. Although the history of the field is short, the past is often seen by new students as irrelevant. Some question the need to study what instructional designers were doing before the internet was created. And yet there is much in the history of the field to inform the present, much to propel the discipline in new directions.

The conscience of memory also suggests that instructional designers need to draw more on who they are as individuals. Such a stance argues for assigning instructional design projects carefully, making sure that designers can draw upon their own unique strengths, talents, and interests, as they design a new piece of instruction. And students need to have ways of sharing who they are and how their own desires, goals, and experiences relate to the topic being learned.

Conscience of imagination. The conscience of imagination speaks to one's creativity, one's ability to try something for the first time, one's capacity to envision a new way—in short, to lead. Whether they like to think of themselves in this way or not, instructional designers are leaders. They are charged with *improving* learning and teaching. Simply perpetuating an acceptable, but barely effective way to teach or train is not satisfactory work. Instructional designers must be imaginative; they must avoid seeing themselves as technicians hired to produce a preconceived instructional product. Rather they must be prepared to suggest alternative approaches that their clients may never have considered. To do this, they must have a well-developed conscience of imagination.

Similarly, the students who experience the instruction produced by a good design must be stretched to think in new ways. As Maxine Greene (2000) has explained so eloquently, releasing the imagination of learners is the primary aim of good education. We assert that for instructional designers to release the imagination of others, they must be working in ways that improve their own imagination.

Using the Framework

So how would instructional designers actually use the framework to improve their practice? Our response is quite simple: through reflexive judgment—the act of differentiating what is right and good from what is not (Green, 1999). In Green's theory, reflexive judgment is the essence of conscience formation. The more a person learns how to make wise judgments based upon reflective thought, the more the person will develop the consciences of craft, membership, sacrifice, memory, and imagination.

To illustrate how this type of reflection might help instructional designers, we offer the following account given by an urban district superintendent, as she described with emotion her own experience learning to read:

> *By the fifth grade, I was [still] struggling with reading, and we had the wonderful—though in my memory not so wonderful—SRA kits. In our class, the teacher put the kits in front of the room. The levels of complexity of reading were [designated] by color. And, of course, we knew our colors. If you were able, you used the brown readers, if you were not able, you used the purple readers. It was to my great shame . . . because I was so shy, to go to the front of that class and pick up the purple. It was difficult—[there was] humiliation associated with it. (personal communication, Patti Harrington, October, 2001).*

Even though this superintendent was recounting her story over 30 years later, the recollection still brought with it significant emotion. Perhaps the label "purple" was like the label "defective" used by the director of training we cited earlier. We do not believe that the designers who created the color codes for SRA kits intentionally tried to humiliate children any more than the director of training intentionally tried to humiliate employees. But that is precisely the point: Instruction leads to unintended results, and without careful reflection, those results can harm learners.

Although the SRA designers and the director of training may have reviewed performance data, they were likely not reflecting on the more subtle moral effects of their design decisions. And these moral effects, we assert, are more far reaching than performance data alone. These are the transforming effects, the effects of instruction that endure. And if designers want to create instruction that will have positive rather than negative enduring effects, we believe that they

will need to focus on the moral dimensions. They will need to engage more often in reflexive judgment, a kind of reflection that leads to personal transformation for both the one who teaches and the one who learns.

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43

Creating an Intentional Web Presence

Strategies for Every Educational Technology Professional

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Editor's Note

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Abstract

Educators are pushing for students, specifically graduates, to be digitally literate in order to successfully read, write, contribute, and ultimately compete in the global market place. Educational technology professionals, as a unique type of learning professional, need to be not only digitally literate – leading and assisting teachers and students toward this goal, but also model the digital fluency expected of an educational technology leader. Part of this digital fluency involves effectively managing one's web presence. In this article, we argue that educational technology professionals need to practice what they preach by attending to their own web presence. We share strategies for crafting the components of a vibrant and dynamic professional web presence, such as creating a personal website, engaging in social networking, contributing and sharing resources/artifacts, and attending to search engine optimization (SEO).

> *I recalled that someone worked on a similar project at McMillian Design Group. But when I did a search online, I couldn't find anything about it…not even a contact… Frustrating, I was really hoping we could bring someone in to consult with us on this…*
> *The group was finalizing plans for their conference keynote speaker. "It would be great to have a dynamic presenter speak on the topic of high impact educational practices." "Yes, that's perfect! Let's get online and see if we can find anyone with that expertise. It would be great if we could preview sample slideshows, and maybe even an actual presentation on YouTube!"*
> *It's a busy Friday afternoon. Five members of a search committee are crammed into a room to screen 50 applications for an academic technology coordinator position. At first glance, all of the applicants appear to be qualified for the position. But the members of the search committee are really looking for someone who can support, lead, and inspire faculty at their institution. As the search committee screens the details*

of each application, one member turns to Google. She is interested to see what comes up from a quick search. Do applicants have a professional website? Do they engage with other professionals on social media?

All of these scenarios are likely familiar. For us, the search committee vignette really resonated. Over the years we have been on various search committees. Two things seemed to have happened with every search: dozens of applicants met the minimum qualifications, but very few applicants excited the search committee. When deciding whom to interview, members of the search committee often turned to Google. Our experience, though, is not unique. Research shows that employers regularly use the Internet to screen applicants (Davison et al. 2012; Reicher 2013; Stoughton et al. 2013). But unlike in the past where employers might only screen applicants to see if there is a reason *not* to hire someone, a growing number of employers screen applicants to find a reason *why* they should hire someone. For instance, a growing number of employers are simply looking for validation that an applicant is the professional that he or she claims to be (which Joyce 2014a, refers to as "social proof"); that is, these employers are looking to validate information found in an applicant's cover letter and resume (see Driscoll 2013; Huhman 2014; Joyce 2014a, b). In fact, a growing number of employers report that they have found reasons to hire applicants as the result of an Internet search (see Careerbuilder.com 2006, 2009, 2012, 2014). Thus, we believe that one of the worst things that can happen for an applicant fighting for an interview is for a search committee to find nothing of substance about an applicant from an Internet search. Some people even believe that an empty Internet search suggests that an applicant is out-of-date and/or lazy, has nothing to share, or worse, has something to hide (Joyce 2014a, b; Mathews 2014); this is especially true for applicants in technology-focused disciplines (e.g., instructional design and technology, information technology, computer science, digital and graphic design) whose web presence also serves as reflections of their technology skills and dispositions.

For these reasons, intentionally creating a well-crafted web presence, and corresponding digital footprint, is important not only for recent graduates but for any professional in a community of practice that values technology use and innovation. In this article, we share our thoughts as to why educational technology professionals need to attend to their web presence and suggest a variety of ways in which they can begin crafting their online presence and intentionally shaping their digital footprints.

Background

Despite an ongoing tension over the years about the role of technology (see Lowenthal and Wilson 2010), the field of Educational Technology today is focused in large part on technology (e.g., digital learning, online learning, mobile learning, social networking and media). Further, reflecting how integrated and indispensable the Internet and social networks/media are in our lives as tools and spaces for information curation and communication (Fallows 2005; Yamamoto and Tanaka 2011), members increasingly use technology to connect, collaborate, and grow in social networks. Therefore, professionals in our field can no longer resist technology. Educational technology professionals must have a web presence in order to actively participate in the social discourse; compete with colleagues for positions and work; establish working and collaborative relationships with colleagues, clients, and stakeholders; and stay current in an ever-changing discipline. Educational technology professionals do not need to possess highly technical skills and abilities but they must be digitally-literate leaders who openly model their digital fluency and use it as a platform for creative practice and innovation. Being digitally literate and a member of a professional community of practice involves effectively managing one's web presence (see Sheninger 2014).

Digital Literacy

Literacy is more than simply being able to read and write (Colombi and Schleppegrell 2002; Street 1995). Literacy today, as Koltay (2011) explained, involves "visual, electronic, and digital forms of expression and communication" (p. 214); this *digital literacy* includes a robust knowledge of the affordances and limitations of digital tools and strategies to address goals and needs in a variety of settings and contexts, plus the skill-set and disposition necessary for critical thinking, social engagement, and innovation (Fraser 2012). Digital literacy is much more than simply knowing how to

use a computer or send a text message; a digitally literate professional is able to "adapt to new and emerging technologies quickly and pick up easily new semiotic language for communication as they arise" by embracing "technical, cognitive and social-emotional perspectives of learning with digital technologies, both online and offline" (Ng 2012, p. 1066). Graduates are now expected to be digitally literate as they enter the workforce (Jones and Flannigan 2006; Weiner 2011). As such, educators now have an added responsibility to help develop students' digital literacy throughout their formal education (Van Ouytsel et al. 2014; see related literature on digital citizenship such as ISTE 2014; Hollandsworth et al. 2011; Ohler 2011). Educational technology professionals, as a distinct type of educational professional, must not only be digitally literate but also model their digital fluency, which in turn requires an advanced understanding of how people interact online, as well as varying digital-literacy skills.

Digital Footprint and Identity

An important, foundational aspect of being digitally literate involves being aware of and managing one's digital footprint. A digital footprint, according to Hewson (2013), "outlines a person's online activities, including their use of social networking platforms" (p. 14). A digital footprint is therefore created whenever we use networked technology. However, when left unattended, a digital footprint may fail to reflect what we want it to reflect about ourselves professionally, emphasizing only our personal interactions and activities. For example, during a recent faculty development workshop facilitated by the second author, a group of faculty were surprised that their personal Facebook pages, Pinterest boards, and/or Flickr photo collections came up on an Internet search before any professional content. If professional content did come up on the first page of their search, the associated pages were ones over which they had little direct control (e.g., their university faculty pages and their "Rate My Professor" entry). Each of these faculty had what is sometimes described as a digital shadow (Goodier and Czerniewicz 2015) or a passive digital footprint: a digital footprint "that grows with no deliberate intervention from an individual" (Madden et al. 2007, p. 3).

Educational technology professionals—as professionals who focus on the interface of technology and learning and often serve as digital leaders in their schools, colleges, and universities—must actively and intentionally shape their digital footprints. Doing so involves deciding what one's digital footprint should say and/or represent in the first place. We all have multiple identities, at bare minimum a *professional self* and *personal self*. The key is to effectively manage our identities while still being authentic (for a discussion on maintaining personal and professional identities online see Henry 2012). We posit that a professional web presence can and should emphasize one's best qualities (much like a résumé might) with accuracy and integrity, which in turn will actively shapes one's digital footprint in a positive light.

Building one's web presence (sometimes also referred to as "brand" or online "reputation") and actively monitoring and intentional shaping one's digital footprint is a popular topic these days (see Lowenthal and Dunlap 2012; Croxall 2014; Eyre et al. 2014; Goodier and Czerniewicz 2015; Microsoft n.d.). While very little formal research has been conducted to date on the positive benefits of a well-crafted web presence, people from various fields—such as Career Planning (Tucker 2014), Librarianship (Von Drasek 2011), the medical profession (Carroll and Ramachandran 2014; Greysen et al. 2010) to name a few—are talking about the importance of professionals taking control over their digital footprints by actively managing their web presence and therefore influencing the story that the Internet has to tell about them.

> Take a moment to "google" yourself (using multiple web browsers in a private browsing mode). While once critiqued as a *vanity search* or *ego search*, learning more about your digital self is vital these days and a regular practice of the digitally literate (Hargittai and King 2013; also see Pettiward and O'Reilly n.d.). What does your digital footprint say about you?

Strategies for Creating an Intentional Web Presence

There is not one perfect way for creating a web presence for all educational technology professionals. There are many stages of adoption and levels of participation in creating an intentional web presence, ranging, for instance, from simply

setting up a LinkedIn profile to actively blogging and engaging with others on popular social networks (see Fig. 1 for a visual illustration of what this continuum might look like). We will discuss some of these different ways of establishing a web presence in more depth in the following paragraphs. The first step to creating an intentional web presence, though, is to think about what information you feel comfortable publicly sharing, especially in light of your intended professional audience(s). If you think about your web presence as an instructional message about yourself with a designated audience or audiences (such as a teacher who may wish to consider multiple audiences, e.g., students, parents/guardians of students, colleagues, and administration), then you may consider what content about you is relevant to those audiences and to what level of detail and specificity you are comfortable sharing via a highly public distribution network. This information will be different for different professionals. The privacy of professionals as well as their employers must be taken into consideration; there are far too many examples of bullying and incivility on popular social networks (see Kowalski et al. 2014) as well as poor decisions made that resulted in someone losing their job (Poppick 2014). However, we believe that professionals should share aspects of their professional lives online with the larger professional community when they are permitted to do so. In the end, educational technology professionals should carefully and intentionally create their own web presence and its corresponding digital footprint, rather than leave it up to search engines like Google.

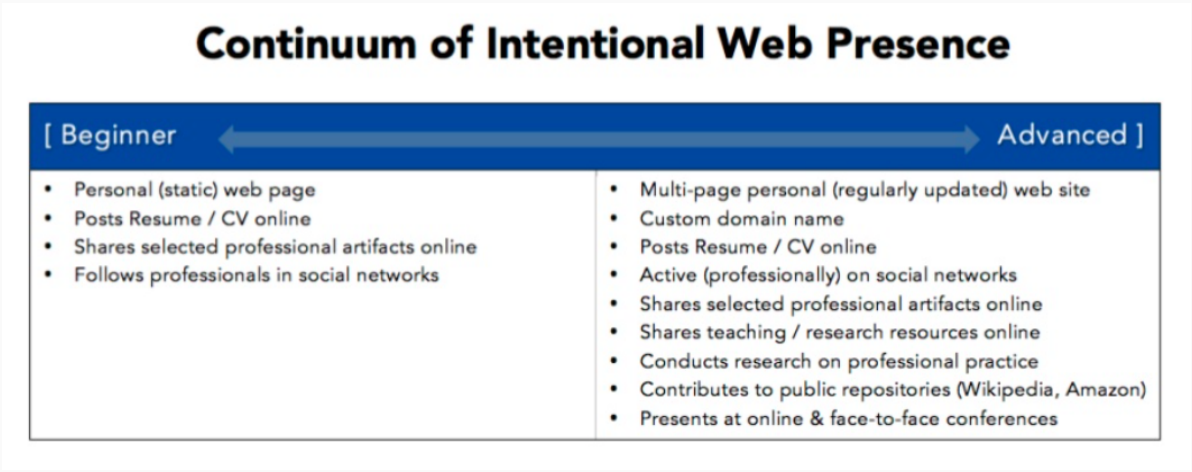

Figure. 1 Continuum of intentional web presence

Below we outline some common strategies to create an intentional web presence in order to participate in, contribute to, and benefit from the larger professional community of practice. The strategies we cover include creating a personal website, engaging in social networking, contributing and sharing resources/artifacts, and attending to search engine optimization (SEO). These strategies are based on our previous work and experience working with faculty and students to establish an intentional web presence (Dunlap and Lowenthal 2009a, 2009b, 2011; Lowenthal and Dunlap 2012), but are also supported by the work of others (e.g., Bozarth 2013, 2014; Goodier and Czerniewicz 2015; Posner et al. 2011; Sheninger 2014; Weller 2011).

Create a Personally Controlled Website

The first step in creating a web presence is establishing a base camp—a place that serves as a centralized hub of operation for all digital and online activity (see Marshall 2015; Sheninger 2014). While many professionals might have a personal webpage or even a multipage website on their employers' servers, we recommend that educational technology professionals set up personally controlled websites that are separate from employer-sponsored sites. A *personally controlled website* is one that is under the full purview of the individual whose work the site is showcasing; it is also a website that will persist over time regardless of changes in employment, as well as help with search engine optimization, which will be discussed later on in this article (see Corbyn 2010 for an in-depth discussion on the value of

a having a personally controlled website). A growing number of easy-to-use tools are available for creating professional-looking websites (e.g., Wix, Weebly, Google Sites, WordPress) for people without web development expertise.

A personally controlled website is also different than an ePortfolio created during and as a culminating comprehensive assessment in a postsecondary program. The ePortfolios created in university programs often include formative assessments of students' progress during their coursework and a summative assessment—in lieu of a culminating, comprehensive exam—for evaluating the achievement of various performance standards (Lowenthal, White, and Cooley, 2011). While academic portfolios are often lauded as helpful in landing jobs after graduation, most academic portfolios are poor examples of showcase portfolios, in part because they tend to be littered with many things that employers are not interested in seeing, such as descriptions of coursework (see Bauer 2009; Clark 2011). Further, in our experience, graduates often do not understand the relevance of maintaining a portfolio of select and recent artifacts or of developing a web presence apart from an ePortfolio throughout their professional career.

Using a personally controlled website as a base camp for professional activity conducted online addresses several important web-presence goals:

- When participating in professional learning and sharing using social media and networking tools, it is helpful to have one central place to host and promote all professional activity.
- Having a base camp gives professionals a web presence that is under their control to ensure consistency and reliability over time; the professionals determine how they are presented professionally online, and when work and ideas are publicly shared.
- As professionals participate in social media and networking sites, they need a place to direct people to find out more about them and their work, and to stay connected. A base camp can help professionals accomplish this linkage.
- Having a base camp that allows professionals to post work and ideas (via blogging, for example) increases their ability to create and share content with others.

Your base camp represents where you are today. It states who you are, where you come from, and what your strongest skill sets are. If you are a contractor, a personal website establishes your relevance to the niche you work in. If you have a secure position, a personally controlled website can be an asset to establishing your status as a thought leader and valuable team member within your organization. In either situation, this online transparency inherently states that you have confidence in your own skill set, which in turn carries weight in many situations. We have found, though, that viewing your base camp as a static website is unrealistic. You should plan to update the website once every 6 months at minimum, whether you are in a secure job or not. Based on our experience working with others to create web presence and reviewing personally controlled websites of other professionals, a personally controlled website may include elements such as:

- Current personal statement
- Biography
- Resume or vita
- Philosophy on instructional design, technology integration, teaching, and/or research
- Curated resources and readings in support of professional learning and activities (knowledge of current forward thinking/lifelong learning)
- Influences
- Projects, products, and other showcased professional activities
- Testimonials, awards, and other professional achievements
- Contact information, including social networks participation

Your personally controlled website is your business card, your résumé, and so much more. In this sense, we believe that the look and feel of your personal website matters. You want to communicate to others that design and details matter—competencies that appear in position descriptions and employment announcements for educational technology professionals (Martin and Winzler 2008; Ritzhaupt et al. 2010). Therefore, you should purchase a personal domain

name for your site and strive to avoid using common templates that are regularly used by others online. In our experience, common templates fail to highlight one's personality or creativity; they can also feel dated over time and can undermine credibility as a digitally literate professional because they fail to illustrate design expertise. Also, when selecting a template, it is important to consider mobile friendliness as many professionals use their mobile devices to access online content. Here are a few examples of personally-controlled websites of educational technology professionals that we believe are aesthetically pleasing while still meeting web-presence goals:

- The eLearning Coach with Connie Malamed: http://theelearningcoach.com
- Daniel Stanfordad: https://edtechbooks.org/-xX
- Jackie Van Nice: http://www.jackievannice.com
- Chris Perez: http://chriswgperez.com

Engage in Social Networking

The interest in and proliferation of networked social tools, technologies, and environments—exemplified by Facebook and Twitter—are affecting ways in which people use, create, and share information (Downes 2007; Veletsianos and Kimmons 2013; Veletsianos et al. 2013). Social networks and environments create a space for people to pursue transformational social and educational relations, collaboration, content creation, and work in general (Dunlap and Lowenthal 2011). By leveraging networked social tools, technologies, and environments, educational technology professionals may more robustly, creatively, and efficiently address educational needs, opportunities, and problems of practice (Joosten 2012). In addition, social networking has the potential to assist educational technology professionals in their pursuit of professional-learning opportunities (Dunlap and Lowenthal 2009a, 2009b, 2011); given that learning happens in a social context, the advent of social networking and media expands the social context for learning beyond formal classroom and training room settings (Brown and Adler 2008). In this way, the social context is no longer solely concentrated in a centralized location, but globally distributed (Kop and Hill 2008; Siemens 2008; Tapscott 2012). This expanding social context is very beneficial to educational technology professionals because it allows them to tap into expertise wherever it is and whenever it is needed or desired, creating a social network that is central to sustained lifelong learning (Couros 2010).

Regardless of the platform or the app, educational technology professionals need to consider how they use social networks to participate in, contribute to, and be inspired by the larger professional community. Professional organizations in the educational technology field all have some type of presence in each of the main social networking platforms, and may be a useful starting place for finding what Seth Godin termed as your tribe(s) (2008). Through social networking, educational technology professionals are able to engage in relevant discussions of problems of practice, share their expertise and current work with other practitioners, while at the same time learning from others (Dunlap and Lowenthal 2011). In our experience, social networking should be as much, if not even more, about networking as it is about broadcasting your latest work. Furthermore, being on every social networking platform is not necessary. We recommend that educational technology professionals start small and build their web presence. Part of establishing and maintaining a web presence involves knowing when and how to use available social networks. The following are three key social networks where educational technology professionals interact:

- **Facebook:** With over 800 million active users, Facebook in many ways is *the* social network. While Facebook remains a primarily "personal" social network where people connect with friends and family, educational technology professionals might interact with dozens of Facebook groups. See Table 1 for examples of Educational Technology Facebook Groups. You can search Facebook for other groups that might better align with your professional interests.

Table 1. Popular social networking groups

Facebook Groups	LinkedIn Groups	Twitter Users / Groups

• AECT Division of Distance Learning: https://edtechbooks.org/-xv	• eLearning Guild: https://edtechbooks.org/-Xd	• Calendar of over 100 education chats on Twitter: https://edtechbooks.org/-SW
• Educational Technology: https://edtechbooks.org/-zG	• ISTE: https://edtechbooks.org/-pC	
• eLearning Feeds: https://edtechbooks.org/-VB	• Instructional Design Central: https://edtechbooks.org/-aQ	

- **LinkedIn:** LinkedIn is often seen as a primarily professional space. Your LinkedIn site allows you to share the details of your professional status without muddying up your base camp with such details. While arguably the drier and most professional location of your online presence, many feel more comfortable participating on this site. In addition, countless groups where educational technology professionals interact are available. Table 1 includes three examples of LinkedIn Groups. There are dozens of other groups to choose from. You can begin searching here: https://edtechbooks.org/-qj
- **Twitter:** Although Twitter may be seen as restrictive, given its 140-character-per-post limitation, Twitter offers educational technology professionals something Facebook and LinkedIn do not: an ability to follow someone without that person following you back. Further, Twitter enables professionals to carefully craft a diverse social network that might include professionals in related fields but who would not show up as members of specific Facebook or LinkedIn groups. In addition, Twitter's hashtaging functionality is often used to support backchannel conversations between participants during conferences and other larger scale events, making it a valuable communication and collaboration tool. Table 1 includes a resource that lists over a 100 tweet chats. You can discover additional ones over time on Twitter.

Not sure where to begin on Twitter? Start by creating an account and following the tweets of professionals with similar interests. You can begin searching at https://edtechbooks.org/-jT. The following are some educational technology professionals who are very active on Twitter:

- Patti Shank @pattishank
- Mike Caulfield @holden
- Jane Bozarth @janebozarth
- George Velestianos @veletsianos
- Jesse Stommel @jessifer
- Bonnie Stewart @bonstewart
- Audrey Watters @audreywatters
- Martin Weller @mweller
- Vicki Davis @coolcatteacher
- Michael Feldstein @mfeldstein67
- George Siemens @gsiemens
- Steve Wheeler @timbuckteeth
- Bud Hunt @budtheteacher
- Alan Levine @cogdog

Another strategy is to follow the tweets of your colleagues, notable scholars and authors who have influenced your thinking and work, professional organizations of which you are a member, and organizations who produce tools and technologies you use on a regularbasis. In this way, you will more quickly experience the value of Twitter in support of your professional learning and work.

It is important to point out, though, that using social networking for professional purposes does not come naturally for everyone. For instance, some teachers face tensions using social networking for professional purposes (Kimmons and Veletsianos 2014, 2015) and others report the need for additional training and support (Joosten et al. 2013). With this in mind, some educational technology professionals strive to keep a clean separation between their personal and professional identities. If you wish to establish separate personal and professional social-networking accounts, you can use pseudonyms or generic handles (e.g., EdTech-Bob) to keep them separate. The disadvantage, though, of this approach is that it could diminish, if only a little, the web-presence goal of establishing yourself—under your name—as an active educational technology professional and thought leader.

Other notable online social networks include Academia (https://www.academia.edu) and Research Gate (https://www.researchgate.net): two popular social networks where academics share research they have conducted with the larger scholarly community. We posit that educational technology professionals, regardless of where they work, are in the educational research business. While scholarship—in the form of original empirical research—historically has been seen as strictly an academic pursuit of university professors and researchers, the increase in educational technology conferences and journals suggests that more and more educational technology professionals are conducting research of their own. Social networks like Academia and Research Gate help educational technology professionals stay in touch with current research conducted by others as well as to share any research that they might be conducting on their day-to-day practice.

Developing a web presence is not simply about having a website and only connecting with others online. Your web presence should be strengthened by and extend and elaborate on your overall engagement with the larger professional community of practice in face-to-face settings. Whenever possible, educational technology professionals should network face-to-face with other professionals in the field at conferences and workshops and through local chapters of national/international professional organizations. In other words, we have found that networking is not simply an online

or face-to-face activity but rather an activity that should take advantage of and leverage the affordances of both types of networking because both enhance your professional presence.

Contribute, Share, and Use Others Instructional Resources/artifacts

Educational technology professionals are constantly creating instructional resources and artifacts—some highly specific to a particular context, but others that are more generalizable and useful in a variety of contexts. And even with the rise of Massive Open Online Courses (MOOCs), open educational resources (OER) (e.g., MERLOT, https://www.merlot.org and TeacherTube, http://www.teachertube.com), and the application of Creative Commons licensing (https://edtechbooks.org/-GX), we have still found that too many educational technology professionals have not fully embraced the "culture of contribution" (Atkins et al. 2007, p. 3) and are not sharing, promoting, or seeking feedback from others outside of their organization about the things they create (see Bozarth 2013, 2014). Barriers to embracing a culture of contribution include concerns about proprietary work; intellectual property in a time of increased competition; merit evaluation processes that value copyrighted ideas in top-tiered journals and patents over social openness; and the ease-of-application of distilled, decontextualized learning objects (Atkins, Brown, and Hammond 2007; Hodgkinson-Williams and Gray 2009). However, given the forward-thinking nature of the educational technology domain and those professionals working in that domain, educational technology professionals should strive to share the results of their labor—the fine work they have produced that others may benefit from as well (see Tapscott 2012, for more on the value of sharing as a principle of openness in an open world). Shared resources may include white papers, application recommendations, program evaluations, reports of pilot studies, teaching and training materials, and creative works. These resources can be shared online via social media sharing sites such as YouTube, TeacherTube, SlideShare, Flickr, and even Amazon (e.g., through self-publishing as well as book and product reviews). Social media sharing sites offer an opportunity to share your expertise with a wider audience. Alternatively, there are many non social-media sites that allow you to open-access distribute your materials—such as Google Drive, Scribd, Box, Dropbox, and OneDrive—if conventional social media sites do not support the format and/or size of certain materials. If you are employed in a situation in which the work you produce is proprietary, then an appropriate solution may be to create an executive summary describing the work and its value, with screen shots or an excerpt if allowable.

Sharing resources and artifacts is good practice for a few reasons. First, selected artifacts can serve as a showcase portfolio that demonstrates your skills and abilities and areas of expertise. Second, sharing work online helps build collaborations with others. Third, sharing work online helps you further establish your digital footprint and present a clearer, more complete story about the work you do. Finally, via this type of sharing, you help to establish your credibility as an educational technology professional—the multiple resources and artifacts available allow the audience to triangulate cognitive authority, information quality, and overall relevance and value of your contributions to the professional community of practice (Hilligoss and Rieh 2008)—and may also enhance your employer's credibility by association (Metzger 2007). The following social media sharing sites are popular, established, and full-featured, making them ideal for professional resource and artifact sharing:

- Merlot [http://www.merlot.org]: A place to share and find open educational resources.
- SlideShare [http://www.slideshare.com]: One of the largest sites to find and share presentations and other professional content.
- Flickr [https://www.flickr.com]: A photo sharing and photo management site.
- Pinterest [https://www.pinterest.com]: A great place to share and discover creative ideas.
- YouTube [http://www.youtube.com]: The largest site to find, watch, and share videos.
- TeacherTube [http://www.teachertube.com]: An online community for sharing instructional videos.

Content curation of others' work is a key facet of professional web presence and can help you find your professional community of practice. Through curating the work of others, not only do you develop relationships with others, but you become a player in solving larger problems; you show that you are continuously learning and ever improving your skills. This transparency will help others realize your worth. And, of course, having access to others' fine resources and artifacts can be helpful in your own work! Here are a few tools that you can use to start publicly curating content:

- Delicious [https://delicious.com]: A social bookmarking website to save, organize, and share web links.
- Diigo [https://www.diigo.com]: A social bookmarking website that is evolving into a larger knowledge management and curation website.
- Flipboard [https://flipboard.com/]: A content curation website.
- Paper.li [http://paper.li/]: A social, content-sharing and curation website.
- Pinterest [https://www.pinterest.com/]: A visual bookmarking tool.
- Scoop it [http://www.scoop.it]: A content curation website.

Attend to Search Engine Optimization (SEO)

Search Engine Optimization (SEO) is the process of improving the ability to locate and access work online from a specific set of search terms. SEO is one final but necessary component to crafting your web presence and intentionally shaping your digital footprint (Lowenthal and Dunlap 2012). Educational technology professionals need to improve the accessibility and reach of the work they share online by thinking about how people will find said work via an Internet search, and then making modifications to how work is presented online to increase the likelihood of others finding it online. This is an important aspect of web presence because—let's face it—for individuals who rely on the Internet for professional learning and networking, if search engines like Google cannot find your work then it is inaccessible and does not fully contribute to the professional community of practice or enhance your web presence.

The most important rule of SEO is to create and share quality content. But another aspect of creating quality content is creating content that others find valuable and want to read and use. Creating and sharing similar and consistent content also helps boost your SEO. Thus, as an educational technology professional, you need to think about what you want to share and what you want to be known for. Then, carefully consider where you share your content as well as how you name and tag it. Some websites get more traffic than others, usually the more visitors the better when it comes to SEO and web presence. For instance, commercial websites like Youtube (100+ million monthly visits) and Slideshare (1.75 million monthly visits) get much more traffic than OER sites like MIT's OpenCourseWare (200,000 monthly visits) and Merlot (17,000 monthly visits) (see Weller 2011). Therefore, sharing your work on high trafficked sites like these can help increase the SEO and overall visibility of your work, as can sharing the same work on multiple websites (e.g., sharing the same slide deck on Slideshare, Academia.edu, and your personally controlled website). Most social media and networking websites also give you some control over how you name, tag, and describe your work. A quick Internet search for similar work from other professionals can help you get a better idea of how best to name, describe, and tag your work.

Finally, we recommend that you spend some time tracking and analyzing the analytics on your personally controlled website (e.g., with Google Analytics) as well as various social networking and social media websites you might regularly use (e.g., Slideshare and Academia) to be better informed on which of your work is most valued by your professional community of practice. You should also spend time tracking topics online (e.g., with Google Alerts or Twitter #searches) that are important to your work so that you may continue to connect and collaborate with like-minded individuals.

Web Presence in Action

Patty's Story

I understood the power of organic SEO and the importance of a well-designed website when I began my graduate studies in educational technology. In the small business I worked, I had revamped my employer's website and presence in online directories. As I built more and more websites, I realized that, regardless of the amount of traffic a website has, ANY web presence would increase one's Google ranking and searchability.

Armed with this knowledge and experience, I created an online professional portfolio to showcase some of the work I was doing in my graduate studies. At this point in my studies, I had two websites (patriciastitson.com and modestmedia.com) that were establishing my digital footprint when I began learning more about social media in my coursework. I setup a Twitter account '@imightwrite', a YouTube and Vimeo account, and, of course, Facebook and LinkedIn. The coursework gave me an opportunity to take a hard look at my digital presence and relate it back to a personal learning network. As I was not a teacher or educator, the idea of a traditional personal learning network (PLN) was hard for me to put into practice. This is why I developed a twist on the model, marrying the principals of PLN with SEO to result in designing my social learning network. This is where content curation became crucial as that is how I 'engaged' with my community. By utilizing Scoop.it to post to both my blog and Twitter, I was able to quickly reach out and gain notice from people as far away as Norway. This is important to me as it establishes me as a lifelong learner and as a global citizen.

Conclusion

To be a successful, lifelong educational technology professional, you need to be digitally literate and model digital fluency in your day-to-day professional activities, including effectively managing your web presence. The strategies shared above will help you craft the components of a vibrant and dynamic professional web presence. However, we want to stress that there is no one right way for educational technology professionals to establish and maintain a web presence. As illustrated in Fig. 1 and previously discussed, you can tend to your web presence in multiple ways. Each professional needs to craft a web presence that is appropriate given the professional audience(s) she/he is trying to attract and connect with, and feels comfortable, authentic, and sustainable over time. Intentionally building a web presence takes time and effort; the key is doing it in a way that leads to positive results by taking control of the story the web tells about you.

Application Exercises

- Take a look at the elements that may be included on a personally controlled website and take a personal inventory. Which elements could you include on a website right now? What could you include with a little work? Which elements are you missing that you would like to have included, and how would you go about gaining the experience(s) to add to your website?
- Google yourself and use 3 or 4 of the ideas from this article to evaluate your current web presence.

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44

Where Should Educational Technologists Publish Their Research?

An Examination of Peer-reviewed Journals Within the Field of Educational Technology and Factors Influencing Publication Choice

Albert D. Ritzhaupt, Christopher D. Sessums, & Margeaux C. Johnson

Editor's Note

The following article was published in Educational Technology with this citation:

Ritzhaupt, A. D., Sessums, C. D., & Johnson, M. C. (2012). Where should educational technologists publish their research? An examination of peer-reviewed journals within the field of educational technology and factors influencing publication choice. *Educational Technology*, *52*(6), 47–56.

For information on open access journals in the field of educational technology, see Ross Perkins and Patrick Lowenthal's analysis of the top OA journals in the field.

The purpose of this study was to examine (1) the academic prestige and visibility of peer-reviewed journals within the field of educational technology, and (2) the factors influencing an individual's choice to publish within a specific journal. Seventy-nine educational technology professionals responded to an online survey designed to address the aforementioned concerns. The authors' results suggest that educational technology professionals generally agree that some publication venues stand out among others. In particular, *Educational Technology Research and Development, British Journal of Educational Technology,* and *Computers & Education* had the highest visibility and prestige ratings of all peer-reviewed journals within the study. Additionally, the results suggest that when one chooses to publish within a particular journal, the fit of the manuscript within the journal, the aims and intent of the journal, and the target audience are among the most important factors.

Introduction

Where should educational technologists publish their research articles? This is a question that is quite common among academic circles in the field of educational technology. Although this seems to be a trivial question at first glance, when

one considers the number of publication outlets available (59 within this study), the pressure on faculty members to publish, and the impact of publishing on tenure and promotion, the question is no longer trivial from a faculty member's perspective (Hardgrave & Walstrom, 1997). Given that publishing research articles plays an extremely important function for faculty members, and that tenure and promotion decisions are greatly influenced by the perceived value of publications, determining which journals to use for publication is important, especially in light of the limited knowledge of multidisciplinary tenure and promotion committees (Bray, 2003; Carr-Chellman, 2006; Elbeck & Mandernach, 2009; Hannafin, 1991; Holcomb, Bray, & Dorr, 2003).

In this study, we investigated which peer-reviewed journals in the field of educational technology were recognized as valuable by educational technology professionals through an online survey. The results indicate the different ways an academic publication's visibility, prestige, accessibility, and measurability (impact factor) affect the way educational technology professionals perceive academic publications in their field. In addition, findings show that a publication's audience, as well as the aims and intent of the publication, influence the decision as to where educational technology professionals focus their own publication efforts. We believe such findings can provide guidance for scholars across disciplines in terms of understanding the value and impact of research in the field of educational technology. Furthermore, such findings offer emerging scholars in the field of educational technology guidance as to where they should consider publishing their own research articles.

Relevant Literature

Though publishing in the field of educational technology is an important topic, very little literature has been published on the subject. In an analysis of scholarly productivity in educational technology, Hannafin (1991) had 23 faculty members within the field identify, classify, and rank leading educational technology journals. The study identified the five leading *basic* research journals as *Educational and Communication Technology Journal* (now *Educational Technology Research and Development*), *Journal of Educational Psychology, American Educational Research Journal, Instructional Science,* and the *Journal of Computer-Based Instruction.* In contrast, the leading applied journals in the field were the *Journal of Instructional Development, Educational Technology* (magazine), *Journal of Performance and Instruction, Phi Delta Kappan,* and *TechTrends.* However, this classification of *basic* and *applied* may not be a fully accurate way to categorize these publication venues.

Price and Maushak (2000) conducted an e-mail survey to examine recommendations of senior faculty to doctoral students and junior faculty about publishing and to identify leading journals within the field of educational technology. Three themes that emerged from the analysis of recommendations were to work with a mentor, believe in yourself and what you are researching, and to write frequently. The analysis of the leading journals in the field revealed that *Educational Technology Research and Development, Performance Improvement Quarterly, Educational Technology* (magazine), *Journal of Educational Computing Research,* and *Instructional Science* were the top five journals according to the faculty surveyed.

Holcomb, Bray, and Dorr (2003) examined 30 journals within the field of educational technology on academic prestige, general reading, and classroom use. The research study invited members of the Association for Educational Communications and Technology (AECT) to respond to a survey evaluating the respective publication venues within the field. The findings of the study showed the five overall top publication venues included *Educational Technology Research and Development, Cognition and Instruction, Educational Technology* (magazine), *Journal of Research on Computing in Education* (now *Journal of Research on Technology in Education*), and *Journal of Educational Computing Research.*

Carr-Chellman (2006) examined the question of where successful emerging scholars are most likely to publish their research. This study considered the publication records of 17 emerging scholars (pre-tenure) from 16 universities. The emerging scholars published a total of 252 discrete papers in journals or magazines, or approximately 15 articles per scholar in the pre-tenure period. The sample of scholars most frequently published in *Educational Technology Research and Development, TechTrends, Journal of Educational Computing Research, Computers in Human Behavior,* and the

Journal of Research on Technology in Education. The average scholar profile that emerges from these data includes 15 publications total with four or five publications in journals recognized by leaders in the field.

The editorial section of the *Australasian Journal of Educational Technology* analyzed their peer group of journals based on the Australian Research Council's Tiers for the Australian Ranking of Journals. Atkinson and McLoughlin (2008) divided the journals into four tiers (A*, top 5%; A, next 15%; B, next 30%; and C, bottom 50%). The leading journals according to their rankings include *Computers & Education* and the *British Journal of Educational Technology.* Those classified as A journals include the *Australasian Journal of Educational Technology; Research in Learning Technology; Journal of Computer-Assisted Learning; Australian Educational Computing; Educational Technology and Society; Journal of Technology and Teacher Education; Technology, Pedagogy & Education;* and *Educational Technology Research and Development.*

Elbeck and Mandernach (2009) examined a subset of 46 journals in the field of educational technology relating specifically to online education. In their study, they used several measures, including journal popularity (as measured by the number of Websites that link to the journal Website), journal importance (as measured by Google's page rank algorithm), and journal prestige (as measured by journal editors) to rank order the journals that are relevant to online educators. Using their classification scheme, five journals rank at the top, including in order *International Review of Research in Open and Distance Learning, Journal of Asynchronous Learning Networks, eLearning Papers, Innovate: Journal of Online Education,* and *The American Journal of Distance Education.*

Outside of these publications, we were not able to identify studies that examined the journals within the field of educational technology. Some of the older studies include journals that are no longer in print or have changed names (Hannafin, 1991; Holcomb, Bray & Dorr, 2003). For instance, the *Journal of Instructional Development* is no longer in print and the *Journal of Computing in Teacher Education* has changed its name to the *Journal of Digital Learning in Teacher Education.* Elbeck and Mandernach (2009) largely based their classification on Web-analytics and to a lesser extent on the perceptions of professionals within the field. Atkinson and McLoughlin (2008) provide a tier system, but do not illustrate the system upon which those classifications are made. Put simply, more research is necessary to investigate publishing within the field of educational technology.

Purpose

Publishing research articles plays an extremely important function for university faculty members. Tenure and promotion decisions are greatly influenced by the perceived value of publications. Further, emerging scholars in the field of educational technology need guidance on where they should publish their research articles. Therefore, the purpose of our survey is to answer two questions:

- What are the most academically prestigious and visible peer-reviewed publication venues in the field of educational technology?
- What factors influence one's choice to publish in a journal in the field of educational technology?

Survey Method

Participants

Seventy-nine survey respondents were recruited from three prominent educational technology listservs: the Association for Educational Communications and Technology (AECT) members' listserv, the ITFORUM listserv, and the American Educational Research Association's (AERA) Special Interest Group on Instructional Technology member listserv. Of the respondents, 57% were male and 43% were female. The respondents averaged 13.44 (SD = 8.30) years of experience in the field of educational technology. The position titles are shown in ***Table 1.*** As can be gleaned, 11% of respondents represented full professors, 23% represented associate professors, 30% represented assistant professors, and the remaining were visiting professors, lecturers, graduate students, or others. Those classified as other included adjunct

professors, teachers, retired professors, and program chairs. Eighty-one percent of the sample came from respondents at doctoral granting universities. Though the vast majority of the respondents were from the United States, other countries were represented in the sample, including Finland, Australia, Greece, Portugal, and Oman.

Table 1. Position titles of survey respondents.

Position	n
Professor	9
Associate Professor	18
Assistant Professor	24
Visiting Professor	2
Post-Doctoral Associate	1
Lecturer	1
Graduate Student	16
Other	8

Instrument

This research necessitated the development of a survey that would (1) determine the most academically prestigious and visible publication venues in the field of educational technology, and (2) determine the most important factors relating to the choice of publishing in a journal in the field of educational technology. The survey was split into three sections: (1) background information, (2) factors relating to publication choice, and (3) journals in the field. The background information section included variables like gender, years in the field, academic classification, ethnicity, and research interests. The research team compiled the factors relating to publication choice based on experience and the literature (Bray, 2003; Carr-Chellman, 2006; Elbeck & Mandernach, 2009; Hannafin, 1991; Holcomb, Bray, & Dorr, 2003; Price & Maushak, 2000). After interviewing three educational technology faculty members, the factors were refined. The final list included 23 unique items. The scale was a semantic differential from (1) not important to (5) very important. This section had more than acceptable internal consistency reliability for these data at $\alpha = .82$.

The journals within the field section of the survey were compiled in four steps. First, the journals listed in the study by Holcomb, Bray, and Dorr (2003) were included. Second, we searched the Internet for related educational technology journals that were not included within the list. Third, we used the *Cabell* (Cabell, 2007) listing of educational technology journals to supplement our list. Finally, to assure the journals were peer-reviewed, we cross referenced all journals using *UlrichsWeb Global Serials Directory* (2010) or the journal Website. The final list included 59 unique journals related to the field of educational technology. The scale ranged from 1 to 10 with 1 = Never heard of journal, 2 = Low academic prestige, and 10 = High academic prestige. The section demonstrated acceptable internal consistency reliability with a Cronbach alpha at $\alpha = .96$. The final complete survey was reviewed by four educational technology faculty members for clarity and usability and was deemed acceptable for use.

Procedures

The instrument was made accessible in a Web-based format using LimeSurvey. The researchers made arrangements to send the survey to three educational technology listservs: the AECT members' listserv, the ITFORUM listserv, and the AERA Special Interest Group on Instructional Technology member listserv. Because the survey was sent to three different listservs with cross membership, exact response rates cannot be calculated. The data were collected in November of 2010 and a three week window was left open for respondents to complete the survey. Respondents of the

survey were informed that the purpose of the research was: (1) to advance the field of educational technology by determining the most academically prestigious and visible publication venues in the field, and (2) to determine the most important factors relating to the choice of publishing in a journal in the field of educational technology. Finally, the data were analyzed using descriptive statistics.

Results

Our first research question was “What are the most academically prestigious and visible publication venues in the field of educational technology?” We answer this question by evaluating several different criteria related to journals within the field of educational technology. These criteria include the journal visibility, journal prestige, open access, impact factor scores, and the acceptance rates of the journals.

Journal Visibility

An important consideration is how well-recognized a journal is by members within a field. The most visible journals (those journals recognized by professionals within the field) are shown in ***Table 2.*** As can be gleaned, the most well-recognized journal within the field is *Educational Technology Research and Development,* followed by *British Journal of Educational Technology,* and *Computers & Education.* According to ***Appendix A,*** the least recognized journals within the field include *Informing Science, Journal of Interactive Instruction Development,* and *Journal of Instruction Delivery Systems.*

Table 2. Top 10 journals by journal visibility.

Rank	Journal	Visibility
1	Educational Technology Research and Development	94.94
2	British Journal of Educational Technology	92.41
3	Computers & Education	89.87
4	TechTrends	88.61
5	Journal of Computing in Higher Education	87.34
6	Australasian Journal of Educational Technology	84.81
7	Journal of Distance Education	84.81
8	Distance Education: An International Journal	83.54
9	Association of the Advancement of Computing in Education Journal	82.28
10	Journal of Research on Technology in Education	82.28

Journal Prestige

How highly regarded is a journal according to the perceptions of professionals within a field? The perceived academic prestige of a journal is an important consideration when evaluating journals. Our results, shown in ***Table 3,***ordered by the mean responses to the scale on the survey, illustrate that *Educational Technology Research and Development, British Journal of Educational Technology,* and *Computers & Education* are the highest ranking journals in terms of academic prestige. According to ***Appendix A,*** the least prestigious journals include *Informing Science, Journal of Instruction Delivery Systems,* and *Journal of Educators Online.*

Table 3. Top 10 journals by journal prestige.

Rank	Journal	M	SD
1	Educational Technology Research and Development	8.63	2.38
2	British Journal of Educational Technology	7.52	2.51
3	Computers & Education	6.59	2.89
4	Distance Education: An International Journal	6.05	2.76
5	The American Journal of Distance Education	6.05	3.17
6	Journal of Research on Technology in Education	6.03	3.09
7	Journal of Computing in Higher Education	5.92	2.62
8	Journal of Distance Education	5.84	2.73
9	Journal of Educational Technology and Society	5.75	3.03
10	Cognition and Instruction	5.68	3.18

Open Access Journals

Open access journals have grown in popularity since the emergence of the World Wide Web. Several of the journals in the field of educational technology are now open access. ***Appendix A*** shows 22 open access journals related to the field of educational technology. Notably, two of the top ten journals as measured by journal prestige are open access journals: *Journal of Distance Education* and *Journal of Educational Technology and Society.* In general, however, it would appear that traditional closed access journals command a higher level of prestige than do open access journals in the field of educational technology.

Acceptance Rates

Acceptance rates are also an important consideration when evaluating a journal. We have compiled the acceptance rates of journals listed in *Cabell's* directory (Cabell, 2002a; Cabell, 2002b; Cabell, 2007). The results are shown in ***Appendix A.*** It appears that the lowest acceptance rates for our journals are somewhere in the range of 11–20%. These journals include *Association of the Advancement of Computing in Education Journal, British Journal of Educational Technology, Cognition and Instruction, Contemporary Educational Psychology, Educational Technology Research and Development, Informing Science, International Journal on E-Learning, International Review of Research in Open and Distance Learning, Journal of Educational Computing Research, Journal of Educational Multimedia and Hypermedia, Journal of Educational Technology and Society, Journal of Interactive Online Learning, Journal of Research on Technology in Education,* and *The American Journal of Distance Education.*

Impact Factor Score Journals

Though impact factor scores have been critiqued within the domain of education (Togia & Tsigilis, 2006), they still remain an important factor when evaluating the relative importance of a journal. The problem within the field of educational technology is that only a handful of our journals have impact scores calculated. Out of the 59 journals examined within this study, only 14 have impact factor scores. These journals and their 2010 impact factor scores are shown in ***Table 4*** ordered by impact factor score. As can be gleaned, *Computers & Education* and *British Journal of Educational Technology* have the highest impact factor scores among the impact factor scored journals. Notably, the median impact factor for the 184 journals in the subject category "Education & Educational Research" is 0.649 (Web of

Knowledge, 2012). All the journals that we categorized as educational technology are well above that score, with the exception of the *Journal of Educational Computing Research.*

Table 4. Journals with impact factor scores.

Journal Name	Impact Factor*
Computers & Education	2.617
British Journal of Educational Technology	2.139
Journal of Computer-Mediated Communication	1.958
Contemporary Educational Psychology	1.928
Cognition and Instruction	1.885
Computers in Human Behavior	1.865
Memory and Cognition	1.797
Australasian Journal of Educational Technology	1.655
Instructional Science	1.473
Journal of Computer Assisted Learning	1.250
Educational Technology Research and Development	1.081
Journal of Educational Technology and Society	1.066
Distance Education: An International Journal	1.000
Journal of Educational Computing Research	0.561

**2010 impact factor score.*

Other Journals

Survey respondents also had the option of providing additional journals in a free-form response. Other journals included *The Journal of the Learning Sciences; Educational Technology* (magazine); *International Journal of Computer-Supported Collaborative Learning; Journal of Science Education and Technology; Educational Researcher; IEEE Spectrum; Journal of Computers in Mathematics and Science Teaching; Technology, Pedagogy, and Education; Learning and Leading with Technology;* and *Journal of Learning Design.*

Factors Influencing Choice to Publish in Journal

Our second research question centers on "What factors influence one's choice to publish in a journal in the field of educational technology?" The decision to publish in a specific journal in educational technology might be influenced by several factors. These factors are illustrated in ***Table 5*** along with their relative importance as rated by individuals who responded to the survey. The items are ordered by the mean responses to the scale on the survey. According to the respondents, the four most important factors to consider when publishing in a journal include the fit of the manuscript in the journal, the aims and intent of the journal, the target audience of the journal, and the language of the journal. The least important three factors include the publication frequency of the journal, the publisher of the journal, and the price of the journal.

Table 5. Importance of factors relating to choice of publishing in a journal.

Factor	M	SD
Fit of the manuscript in the journal	4.66	0.62
Aims and intent of journal	4.54	0.62
Target audience of journal	4.32	0.67
Language of the journal	3.85	1.18
Speed of peer-review process for the journal	3.81	0.89
Acceptance rate of journal	3.76	1.06
Accessibility of journal (e.g., open access)	3.62	1.22
Ranking of the journal	3.59	1.26
Indexing of the journal (e.g., SSCI)	3.54	1.14
Impact factor score of journal	3.46	1.26
Flexibility with regard to manuscript rights	3.44	1.16
Cost/fee for publishing in the journal	3.41	1.43
Method of submission and feedback (e.g., online, e-mail, paper mail)	3.32	1.23
Previous publications with the journal	3.30	1.11
Association publishing journal (e.g., AECT)	3.25	1.21
The journal's circulation size (e.g., bigger is better)	3.25	1.01
A co-author's preference	3.13	1.11
Alignment with a conference presentation	3.05	1.18
Editor of the journal	2.86	1.09
Editorial review board of journal	2.85	1.16
Publication frequency of journal (e.g., quarterly)	2.71	1.11
Publisher of journal (e.g., Springer)	2.48	1.19
Price of the journal	2.27	1.27

Survey respondents also had the option of providing additional factors in a free-form response. Other factors included whether or not the journal is listed in *Cabell's* directories, the quality of feedback provided in a timely manner by the journal, journal's citation style requirements (e.g., APA), the impact of journal on practice, the journal's credibility to the field, and word length or submission requirements.

Discussion of Results

Interpretation of our results must be viewed within the limitations of this study. This study was based on an online survey sent to three leading educational technology listservs. Because of the potential for cross-listings, response rates could not be calculated. The survey was designed from a compilation of journals that may not represent all peer-reviewed journals within the field. For example, we failed to include *The Journal of the Learning Sciences* and *Journal of Computers in Mathematics and Science Teaching,* which are arguably leading publications in the field. Also, our sample only included peer-reviewed publications, so respectable publication outlets like *Educational Technology*magazine were not included by design. This limits the generalizability of the results. Also, our sample represents primarily university faculty members, and thus, does not represent the practitioners within our field. Finally, the results are limited to the expert judgment and candor of the respondents.

By examining the levels of exposure (visibility), respect (prestige), openness (accessibility), and authority (measurability) academic publications offer their readership, survey results suggest that within a community of interest like educational technology members generally agree that there are indeed certain publications that stand out among others. In particular, *Educational Technology Research and Development, British Journal of Educational Technology,* and *Computers & Education* had the highest visibility and prestige ratings and also have impact factor scores. Reasons certain publications rate more favorably still requires further investigation; however, it might be useful to see if the factors considered important by scholars seeking to publish their own works may be connected to their choice of journal.

Our results also provide some helpful contextual information about what factors influence an individual to publish in a particular journal. Respondents suggest that factors like the fit of the manuscript in the journal, the aims and intent of the journal, the target audience of the journal, the language of the journal, and the speed of the peer-review process of the journal are all important factors. Much less important to the respondents was the price of the journal, the publisher of the journal, and the publication frequency of the journal. These results suggest that several factors influence one's choice to publish in a journal.

An academic publication's impact factor score provides reliable evidence marking a scholar's work in his or her field. Yet not all academic journals within the educational technology field are currently indexed. For example, the *Journal of Computing in Higher Education* ranked relatively high in prestige and visibility, yet the journal is not presently indexed by Web of Knowledge (2012). The indexing process itself requires time and money and will eventually catch up with a majority of educational technology publications. For those that are indexed, such ratings are clearly useful for tenure and promotion purposes. However, relying solely on impact data does not clearly show the complete influence of a scholar's work. As such, the results generated from this study offer another method for assessing an educational technology academic publication's reputation among its peers.

For scholars attempting to better understand the value of particular publications in the field of educational technology, such findings provide a gauge for better assessing the broader impact an educational technology scholar's work has in the field. This is important for those educational technology scholars seeking tenure in departments and colleges where educational technology scholarship may not be well understood. Survey findings also offer the publishers of educational technology journals feedback in terms of how their market perceives their products. Such information is still useful for an educational technology publication's editorial and marketing departments.

An area of further research includes a deeper investigation into the role openness plays in an academic publication's perceived value to the field. Given the growth and adoption of new digital technologies and open educational resources, open academic journals provide easy access and broader dissemination opportunities for scholars in all fields of research. Our results suggest that open access journals can still be ranked among the most prestigious (*Journal of Distance Education* and *Journal of Educational Technology and Society*). However, more empirical research is necessary to confirm our findings.

Application Exercises

- The article lists many places that you can publish your research. Find a journal/organization and do a little research online. What is the general mission of the organization? What is the procedure to get published?

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Appendix A: Table of Peer-Reviewed Publication Venues

Journal Name	Open Access	Prestige*	Visibility	Acceptance Rate	Impact Factor
Educational Technology Research and Development	No	8.63	94.94	11–20%	Yes (1.081)
British Journal of Educational Technology	No	7.52	92.41	11–20%	Yes (2.139)
Computers & Education	No	6.59	89.87	–	Yes (2.617)
Distance Education: An International Journal	No	6.05	83.54	21–30%	Yes (1.000)
The American Journal of Distance Education	No	6.05	82.28	11–20%	No
Journal of Research on Technology in Education	No	6.03	82.28	11–20%	No
Journal of Computing in Higher Education	No	5.92	87.34	21–30%	No
Journal of Distance Education	Yes	5.84	84.81	–	No
Journal of Educational Technology and Society	Yes	5.75	81.01	11–20%	Yes (1.066)
Cognition and Instruction	No	5.68	78.48	11–20%	Yes (1.885)
Journal of Educational Computing Research	No	5.65	78.48	11–20%	Yes (0.561)
Instructional Science	No	5.61	77.22	21–30%	Yes (1.473)
Journal of Technology and Teacher Education	No	5.57	81.01	15%	No
TechTrends	No	5.52	88.61	35%	No
Human-Computer Interaction	No	5.46	77.22	–	No
Quarterly Review of Distance Education	No	5.44	79.75	–	No
Australasian Journal of Educational Technology	Yes	5.23	84.81	31%	Yes (1.655)
International Review of Research in Open and Distance Learning	Yes	5.05	75.95	11–20%	No
Journal of Educational Multimedia and Hypermedia	No	5.03	79.75	11–20%	No
Association of the Advancement of Computing in Education Journal	No	4.99	82.28	11–20%	No
Performance Improvement Quarterly	No	4.99	72.15	–	No

Journal of Instructional Science and Technology	Yes	4.81	70.89	21–30%	No
Journal of Asynchronous Learning Networks	No	4.76	77.22	21–30%	No
Journal of Computer-Mediated Communication	Yes	4.71	75.95	–	Yes (1.958)
Memory and Cognition	No	4.71	68.35	–	Yes (1.797)
Journal of Computer Assisted Learning	No	4.55	77.22	–	Yes (1.250)
Canadian Journal of Learning and Technology	Yes	4.54	75.95	34%	No
Contemporary Issues in Technology and Teacher Education	Yes	4.52	77.22	21–30%	No
Internet and Higher Education	No	4.51	75.95	21–30%	No
Journal of Digital Learning in Teacher Education (formerly JCTE)	No	4.41	70.89	–	No
Performance Improvement Journal	No	4.39	68.35	–	No
Computers in Education Journal	No	4.37	73.42	–	No
Contemporary Educational Psychology	No	4.24	68.35	11–20%	Yes (1.928)
Innovate: Journal of Online Education	No	4.17	77.22	26%	No
Computers in Human Behavior	No	4.14	64.56	–	Yes (1.865)
International Journal of Instructional Technology and Distance Learning	Yes	4.10	68.35	–	No
Journal of Educational Technology Systems	No	3.82	62.03	70%	No
Journal of Online Learning and Teaching	Yes	3.82	64.56	45%	No
Journal of Technology Education	Yes	3.78	64.56	–	No
International Journal on E-Learning	No	3.77	62.03	11–20%	No
Educational Media International	No	3.64	63.29	–	No
Electronic Journal of E-Learning	Yes	3.59	64.56	50%	No
Online Journal of Distance Learning Administration	Yes	3.58	64.56	30%	No
Computers in the Schools	No	3.54	64.56	40–50%	No
International Journal of Instructional Media	No	3.53	60.76	–	No

Journal of Interactive Learning Research	No	3.47	56.96	–	No
Learning, Media, and Technology	No	3.46	63.29	–	No
Journal of Technology, Learning, and Assessment	Yes	3.34	60.76	–	No
Electronic Journal for the Integration of Technology in Education	Yes	3.25	59.49	21–30%	No
Journal of Interactive Online Learning	Yes	3.19	56.96	11–20%	No
Education and Information Technologies	No	3.10	50.63	–	No
Interdisciplinary Journal of e-Learning and Learning Objects	Yes	3.06	50.63	11–20%	No
Journal of Interactive Media in Education	Yes	2.97	50.63	60%	No
Turkish Online Journal of Distance Education	Yes	2.92	53.16	60–70%	No
Turkish Online Journal of Educational Technology	Yes	2.86	50.63	35–45%	No
Journal of Interactive Instruction Development	No	2.71	45.57	–	No
Journal of Educators Online	Yes	2.63	48.10	20%	No
Journal of Instruction Delivery Systems	No	2.41	43.04	–	No
Informing Science: The International Journal of an Emerging Transdiscipline	Yes	2.37	40.51	11–20%	No

**Ordered by academic prestige.*

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Please complete this short survey to provide feedback on this chapter: http://bit.ly/WherePublish

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Dr. Albert D. Ritzhaupt is a Professor of Educational Technology and Computer Science Education, and the Associate Director for Graduate Studies in the School of Teaching and Learning at the University of Florida. Dr. Ritzhaupt formerly served as the Program Coordinator for the Educational Technology program. Dr. Ritzhaupt is an accomplished educational researcher and technologist. An award-winning researcher, Dr. Ritzhaupt has published more than 100 journal articles, book chapters, technical reports, and conference proceedings; and has presented his research at numerous state, national, and international conferences. His primary research areas focus on the design, development, utilization, and evaluation of theory-inspired, technology-enhanced learning environments; teaching practices and instructional strategies in computer and information sciences education; operationalizing and measuring technology integration in education, particularly focusing on the factors that facilitate and hinder technology use in formal educational settings; and the professional competencies of individuals in the field of educational technology. Dr. Ritzhaupt was identified as one of the world's most prolific scholarly authors in the field of educational technology from 2007 to 2017 (Bodily, Leary, & West, 2019). Dr. Ritzhaupt was awarded the 2016 UF Research Foundation Professors distinction, a term-limited professorship awarded to tenured professors who have a distinguished current record of research. In 2019, the Florida Educational Research Association selected Dr. Ritzhaupt as the Educational Researcher of the Year.

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Inspired by multiple perspectives, Dr. Ritzhaupt employs a variety of instructional methods in his teaching practice and he consistently receives high scores in his teaching by students. Dr. Ritzhaupt teaches a wide-range of courses for the University of Florida, including on topics like software design and development for educational purposes, multimedia design and development, educational games and simulations, traditional and agile project management, introductory and advanced instructional design, educational research design and applied statistical methods, and advanced seminar courses for doctoral students in the field of Educational Technology. Previously, Dr. Ritzhaupt taught computer science courses for both community colleges and universities in Florida, particularly in the areas of software design and development. Dr. Ritzhaupt is a Level 2 Google Certified Educator (GCE) and a Microsoft Certified Educator (MCE), and commonly uses emerging technologies in his teaching practice. Dr. Ritzhaupt considers his greatest scholarly contribution to be the more than 20 doctoral students he has mentored to completion in the Educational Technology program.

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45

Rigor, Influence, and Prestige in Academic Publishing

Peter J. Rich & Richard E. West

Editor's Note

The following is an abridgment of prepublication version of an article published in Innovative Higher Education. The only additional change made to the text for this book has been to replace the word impact with influence when talking about the three-tiered framework for evaluating research quality. This reflects more recent thinking from Dr. Rich and myself that influence is a more appropriate word to further downplay the role of formal impact factor statistics.

The citation for the full published paper is as follows:
West, R. E., & Rich, P. J. (2012). Rigor, impact and prestige: A proposed framework for evaluating scholarly publications. *Innovative Higher Education, 37*(5), 359–371.

A follow-up article discussed how emerging technologies could facilitate collecting better data according to this Rigor, Impact (Influence), Prestige framework.
Rich, P. J., & West, R. E. (2012). New Technologies, New Approaches to Evaluating Academic Productivity. *Educational Technology, 52*(6), 10–14.

We argue that high-quality publication outlets demonstrate three characteristics. First, they are rigorous, i.e., discerning, critical, and selective in their evaluations of scholarship. Second, they have influence on others in that they are read, cited, and used. Third, by being prestigious, they are well known to other scholars and practitioners, increasing the prestige of the authors they publish and bringing more light and attention to their work and their institutions. These three criteria—rigor, influence, and prestige—have the potential to create a more holistic assessment of the value of a body of scholarly work.

Rigor

High-quality journals are rigorous, meaning they are more critical in their reviews, are more discerning about what they will accept and publish, and apply higher standards for judging quality research than other journals. They question all aspects of an academic study, including theoretical foundations, participant sampling, instrumentation, data collection, data analysis, conclusion viability, and social impact. They make decisions about the quality of research on its own

merits: i.e., through blind review by distinguished and experienced peers and editors. Being published in a rigorous journal lends credibility and acceptance to the research because it indicates that the author(s) have successfully persuaded expert scholars of the merits of the article.

When evaluating the rigor of a journal, authors often consider the acceptance rate as a key indicator. However, judgments based solely on acceptance rates must be made with care because journals calculate their rates differently. Additionally, a lower-tier journal may receive lower-tier quality manuscripts and accept very few of them, resulting in a low acceptance rate but still poor quality publications. Despite these issues, the journal's acceptance rate may be documented as one measure of rigor. Other indicators of rigor might include a policy of double blind peer review, the number of reviewers, and the expertise and skill of these reviewers and the editorial board, who determine how discerning, rigorous, and selective the journal will be.

Editors are especially of primary importance, as they resolve contradictory reviews and make final determinations of scholarship quality.

Many indicators of rigor are currently already documented and ought to be considered when evaluating the quality of a publication outlet. For example, acceptance rates, review policies, and the number of reviewers may be found on the journal's website or through bibliographic sources such as Cabell's Directories (http://www.cabells.com/). It is much harder to document the rigor of the reviewers and editors, and this is ultimately a subjective interpretation. Like all subjective decisions, the best method of verification would be to seek opinions of other qualified scholars in the field to confirm or deny your own.

In collecting evidence of the rigor of a publication outlet, we believe the following questions might be useful:

- How does the acceptance rate compare with other journals in this specific discipline?
- How is the acceptance rate calculated, if known?
- What type of peer review is used? Is it editorial, blind, or double-blind? How many reviewers are used to make decisions?
- What is known about the quality of the reviewers and editorial board? Are they recognizable to other experts in the field and known for their insights into the research? How rigorous would outside experts believe these reviewers and editors to be?

Influence

Influence refers to how extensively individual manuscripts and publications are referenced by other publications and how much they contribute to the scholarly progress of a discipline. In this article, we are referring only to influence on research and theory development, not on actual practice. Undoubtedly influence on practitioners is an important quality of good scholarship, as it could be argued that true impact is only felt on the practitioner level. However, we do not address practitioner impact, because this framework is focused on criteria for evaluating academic research and theory publications. We can conceive of the possibility of another framework being developed to guide the evaluation of how much influence an academic has on actual practices, with different evidence being presented and analyzed, but that is beyond the scope of this article.

In evaluating the academic influence of a publication, in addition to the International Scientific Indexing (ISI) Impact Factor, authors might also review the citation statistics provided by Scopus, SORTI Esteem or Q Scores (i.e., a ranking of journals within specific disciplines), as well as Eigenfactor, Immediacy, hindex, and Cited Half-life Scores, which are other indicators of influence based on statistics that represent attempts to avoid some of the bias in the traditional IF. Because these metrics, available through either ISI, Scopus, Publish or Perish (Harzing, 2011), or Google Scholar Citations, are affected by how extensively a journal is indexed in particular databases, it is important to triangulate influence statistics from multiple venues. For example, while ISI has been reported to only index 26% of educational articles indexed by ERIC (Corby, 2001), we have found Google Scholar to typically index most major educational journals, including those that are not indexed in ISI. In addition, Google Scholar indexes non-academic publications and

handbooks, which are still often valuable but not indexed in ISI or Scopus. Thus we believe that Publish or Perish, which calculates citations in Google Scholar, is often more meaningful and accurate in its influence ratings for our discipline. This may not be the case for every discipline. As the major citation databases were originally invented to provide a picture of citation metrics in the hard sciences, fields such as chemistry and physics seem to be better indexed in the Thomson-ISI.

Additionally, a journal's circulation, its publisher's effectiveness and reach, or the availability of the journal on the Internet indicates its potential for influence (although potential may not be realized). Emerging social networks such as Mendeley (http://mendeley.com) and Academia.edu provide statistics that indicate how often individual manuscripts are searched for or saved to other scholars' citation databases. Analytic data from social networks, search engines, and publisher downloading statistics could provide an interesting estimate of how much a publication or author is read or sought out by others.

Some non-peer-reviewed outlets have greater influence than those that are peer reviewed. For example, publication in a widely read and cited practitioner outlet can have high influence. In addition, a Publish or Perish search reveals that some highly cited books are more highly cited in Google Scholar than many top journals. Thus while peer review would be a prime indicator of the rigor of a journal, non-peer-reviewed outlets may be able to show high influence, indicating they still have value. This also shows the need to triangulate findings from all three criteria.

In collecting evidence of the influence of a publication outlet, we believe the following questions might be useful:

- Is the publication indexed in ISI or Scopus? If so, what is the impact rating (ISI) or citation count, h-index, and SCImago Journal Ranking (Scopus)?
- What are the impact ratings according to Publish or Perish? Here we believe it is useful to use the same time window as that used by ISI or Scopus. So for example, if you typically use the 5-year ISI Impact Factor, then it would be wise to also limit your Publish or Perish search criteria to the last five years to retrieve comparable statistics.
- What is the open-access policy of the publication outlet? Outlets that embrace open-access delivery have the potential to have more influence, as the articles are more easily found through Internet search engines. However, the open-access nature of a publication outlet is only an indicator that it has potential for greater influence, not that it has necessarily achieved this influence.
- What is the circulation of the publication outlet? This is also only an indicator of the potential for influence, as many journals are packaged and sold as bundles to libraries, increasing circulation but not necessarily influence. However, greater circulation does indicate the potential for higher viewership and greater influence.
- Is there any indication that the publication has influence on other scholars? For example, is the book widely adopted as a text for university courses? Is there evidence that the journal is frequently used to influence policy or other research?

Prestige

Prestige is a qualitative judgment about the respect a scholar receives for publishing in a particular outlet. Because it is more qualitative, it is more difficult to evaluate in a promotion dossier or grant application and is perhaps largely a theoretical exercise where scholars honestly question the perceived prestige of a journal where they are considering publication. A possible indication of the prestige of a journal is whether other researchers recognize the journal when asked and whether their intuitive perception is that the journal is of high quality. For example, in the overall field of education, publishing in the Review of Educational Research or the Review of Higher Education is highly regarded because these are prestigious journals, sponsored by major professional organizations, and well known among educational scholars from all disciplines.

More quantifiable and objective measures of prestige might be rigorous surveys of scholars in a discipline to gauge their perception of a publication outlet. As an example, several studies have surveyed researchers in educational technology about publications they recognize, read, and respect (e.g. Holcomb, Bray, & Dorr, 2003; Orey, Jones, &

Branch, 2010; Ritzhaupt, Sessums, & Johnson, 2011). These studies provide valuable information on the relative prestige of a publication outlet. Other indicators of prestige may be whether the publication outlet is officially sponsored by a large national or international professional organization, whether the publisher is reputable, and whether the editor and editorial board are well known and respected.

Often prestige alone is used to evaluate the quality of a journal, but this can be faulty since journals rise and fall in relative quality and because prestige is often so subjective. Thus many journals that were highly prestigious 10–20 years ago might still be well known even though their rigor and influence have fallen, and new journals that are perhaps not yet well known may still be publishing high-quality research. Prestige, then, can be only one indicator of the quality of the journal to be considered in relation to the other indicators.

In collecting evidence of the prestige of a publication outlet, we believe the following questions might be useful:

- Are there any published studies investigating the popularity or respectability of publications in this field? If so, is this specific publication outlet listed?
- How recognizable is the publication outlet to other respected scholars? What is their opinion of its importance?
- Is the publication published by a well-known publisher? Sponsored by a major professional organization?
- How well known and respected is the editorial board to other scholars in the field?

Applying the Criteria

In making and then defending our own decisions about where to publish our work, we have attempted to apply these criteria qualitatively—using the metrics and data to inform an inductive decision based on evidence from all three categories. We have found that those outside our field have found it easier to understand our choices because we can justify them by providing data about the relative rigor, influence, and prestige of a particular publication outlet in comparison with other publication outlets in the discipline. This framework has also been helpful within our School of Education, where multiple departments are housed, but where we often need to explain to each other the relative importance of different publication outlets within our specific disciplines. As we sought a framework that would encompass all of the scholarship being conducted within the School, the principles of rigor, influence, and prestige have proven flexible enough to provide a common language that all departments could use, even though the specific pieces of evidence important in each of their disciplines were unique and nuanced.

The following are a few examples of how these criteria could be applied in describing a variety of different publication outlets. Using publications in our own field, we demonstrate how this framework might be used (see Table 1). We have masked the names of the journals to focus our discussion on the framework and evaluation criteria, not the specific ranking of individual journals.

Table 1

Application of the proposed framework to publications in the field of educational technology

Publication	Rigor	Impact	Prestige
#1	8% acceptance rate; peer-reviewed	Cites/paper 35.83; h-index 87 (PoP) 1.183 (ISI)	Flagship research journal of main professional organization; #1 most prestigious journal in the field (Ritzhaupt et al., 2011).
#2	15–20% acceptance; editorially reviewed.	Cites/Paper 19.89 h-index = 63(PoP)	Published in and respected by well-known researchers; one of the top 3 most read and implemented publications (Holcomb et al., 2003).
#3	25% acceptance rate;	Cites/paper 3.3; h-	Widely read (Holcomb et al., 2003).

	peer-reviewed	index = 22 (PoP)	
#4	66% acceptance rate; peer-reviewed	Cites/Paper 9.71; h-index = 9 (PoP)	Less well-known journal.
#5	Open call, peer-reviewed by established leaders in the field.	Cites/paper 34.55; h-index = 33(PoP)	Used in graduate courses and as a reference for researchers; official handbook for main professional organization.

Decisions on publications such as those represented by #1 and #4 are fairly straightforward. We can see from this chart that Publication #1 scores high in all three categories. As such, we would consider it a top-tier venue for publication. Indeed, we would be hard-pressed to find a scholar in our field that would argue with this evaluation for this journal. On the other end of the spectrum, publication #4 scores relatively poorly in each category, resulting in our own interpretation of a lower-tier outlet for publication.

The difficulty may come in scoring publications #2, #3, and #5. The rigor of #2 appears to be fairly staunch, but it is reviewed only by the editor. However, in relation to its peers, this journal seems to have strong citation numbers. This particular journal is often left out of consideration of measures of prestige because of its lack of blind peer review (Ritzhaupt et al., 2011). However, the leaders in the field regularly use this publication outlet as a venue for publishing new ideas and theories, and consequently this publication is one of the most read in our field (Holcomb et al., 2003). Taken individually, each of the measures we used to rate this publication could be problematic for an external review panel unfamiliar with our field. Taken together, we might rate rigor as mediocre, impact as high, and prestige as high, resulting in an upper, mid-tier publication.

Publication #3 paints a different picture. It has a respectably stringent acceptance rate, but the number of times each article is cited in Google Scholar is low. This may be due to the fact that this publication is viewed as a practitioner journal within our field; and, as such, practitioners are more likely to apply the theories than they are to cite them. Also, in addition to regular research articles, this journal publishes many non-research articles and columns, geared towards informing the members of our professional association. These shorter pieces are indexed in Google Scholar and likely bring down the overall ratio of citations per paper. Finally, this particular journal enjoys high prestige as demonstrated in a survey of important journals in the field, ranking in the top 10 overall. Combining these criteria, our qualitative judgment would be to rate this as a lower, mid-tier publication.

Finally, publication #5 presents an interesting case. It is actually a handbook in the field. As such, it lacks key indicators often used to interpret its worth by those outside the field (i.e. ISI impact factors and acceptance rate). Yet, it is edited by a renowned group of scholars, and the number of times each chapter is cited in Google Scholar is nearly as high as the average number of citations per article in our highly regarded publication #1, demonstrating the high influence of this handbook. It also enjoys great prestige in the field and is used by both novice and experienced scholars. As such, we would rate this as a top-tier publication.

Conclusions

We emphasize that these ideas constitute a proposed theoretical framework for how scholars could make and justify, to those from other disciplines, decisions about where they choose to publish their research. In practice, scholars would still need to engage various sources of data and make sound and well-reasoned arguments for the quality of their publication choices. Even though final judgments about journal quality remain a subjective decision, the framework responds to several of the needs that we identified in current efforts to evaluate the academic quality of publication venues. It is flexible enough to allow for multiple and varied sources of data within the categories of rigor, influence, and prestige. As such, the framework allows for the timely inclusion of new metrics as novel ways of measuring academic quality emerge or evolve. The inclusion of multiple indicators allows the framework to be applied to different disciplines. Finally, it is impossible to use the framework while depending on a single metric as an indicator of quality, which may

help scholars avoid this dangerous trap. We do not advocate joining the many indicators into a single metric as that would mask the diverse ways in which a publication contributes to quality scholarship. We also emphasize that this framework provides a common language that can benefit scholars in justifying their publication decisions and assist promotion committees in knowing what questions to ask about a candidate's publication record. Instead of simply asking what a journal's impact factor is, we hope that committees would seek or request information on the rigor, influence, and prestige of a candidate's publication record, leading to a more holistic and accurate assessment.

We welcome discussion about whether these three criteria are the most useful and accurate in evaluating educational technology publication outlets or whether additional criteria might be added to the framework. Engaging in this discussion is critical. If we cannot clearly articulate the criteria for determining the quality of our publication outlets, then others (i.e., promotion committees and funding agencies) will have to draw their own conclusions using metrics and criteria that may be less useful or even inapplicable to our disciplines. Also, we emphasize that we believe these criteria should be applied flexibly, qualitatively, and intelligently in making decisions about scholarship quality. We do not recommend using these criteria uncritically to generate a ranking of journals that "count" and "do not count" since all of these data points can be skewed, manipulated, or changed from year to year. Still, by intelligently triangulating multiple data points, we can make more holistic judgments on the quality of publication outlets and share a terminology for discussing our publication decisions.

Application Exercises

- Find an academic journal and use the framework from this chapter to assess its rigor, influence, and prestige. Based on its merits, would you consider the journal you have found to be a top-tier journal? Explain.

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Please complete this short survey to provide feedback on this chapter: http://bit.ly/RigorInfluencePrestige

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46

Educational Technology Conferences

Which Conferences Do You Attend? A Look at the Conference Attendance of Educational Technology Professionals

Patrick R. Lowenthal

Editor's Note

The following article was previously published in *Educational Technology* with this citation:

Lowenthal, P. R. (2012). Which conference do you attend? A look at the conference attendance of educational technology professionals. *Educational Technology, 52*(6), 57–61.

Most educational technology professionals attend conferences. Many have funds available, though, to travel to a limited number of conferences each year, so those in the field must make a thoughtful decision about which venues to attend. This article reports on a survey of the conference preferences of educational technology professionals.

Introduction

I regularly attend conferences. They give me a chance to share what I am working on while also learning about what others are doing in my field. In fact, conferences are perhaps my number one source of professional development and networking each year (apart from social media outlets) (see Dunlap & Lowenthal, 2009, 2011 for more on social media). For the past five years I have attended AECT (Association for Educational Communications and Technology) and AERA (American Educational Research Association) as well as a number of other conferences that happened to be in Denver when I was living in Colorado (e.g., EDUCAUSE, ISTE, CiTE, WCET, Technology in Education). But, recently, I began reflecting on why I attend AECT and AERA each year and not other conferences.

During my graduate studies, I was encouraged to attend and present at conferences. The faculty in my program seemed to attend and present at AECT and AERA regularly each year. While it was never explicitly stated, implicitly it became clear to me that these were the conferences to attend and present at. At the same time, though, I worked full-time throughout my graduate studies. For the most part, my colleagues at work (whether in Teacher Education or in faculty support and online learning), attended different conferences (e.g., SITE or EDUCAUSE ELI). But despite this, each year, I

still have found myself going back to AECT and AERA; yet each year I wonder if I am missing out in not attending different conferences. I find myself thinking about what conferences other professionals in the field attend.

In fact, as I began packing for AERA in Vancouver this past spring, these questions began to nag at me once again. So I decided to reach out to the professional community on IT Forum and ask others which conferences they attend. But rather than simply ask for individual responses, I decided to create a simple Google form to collect the responses—mainly in an effort to be able to share the results with the larger community. I created a basic form with four questions (see ***Table 1***).

Table 1. Survey questions for educational technology professionals.

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1. Please select the line below that best describes what you primarily do . . . (I realize this isn't always an easy question). I consider myself a(n):

- educational technologist/instructional technologist
- instructional designer
- professor of instructional design and technology
- trainer
- human performance technology professional
- instructional developer
- eLearning professional
- graduate student
- Other:

2. I regularly attend the following conferences/professional meetings:

- American Educational Research Association (AERA)
- Association for Educational Communications and Technology (AECT)
- American Society for Training & Development (ASTD)
- International Society for Performance Improvement (ISPI)
- Annual Sloan Consortium International Conference on Online Learning
- EDUCAUSE Annual Conference
- EDUCAUSE Learning Initiative (ELI)
- International Society for Technology in Education (ISTE)
- Edmedia
- E-Learn
- Society for Information Technology and Teacher Education (SITE)
- Annual Conference on Distance Teaching & Learning
- Other:

3. Typically . . .

- My place of employment pays for my conference attendance
- I pay for my conference attendance
- My place of employment pays for part of my conference attendance
- Other:

4. Why do you attend these conferences and not others?

The researcher in me, in hindsight, wishes I would have taken more time thinking about the questions to ask (e.g., What was the best conference you have ever attended and why? or Which professional organizations are you a member of? or Do you have to present at a conference to get funding to attend?). But this wasn't a full research study. I simply had a

question for the members of IT Forum. At the same time, though, I suspected (based on my own experience) that what one does for a living might influence which conferences one attends. For example, once I stopped working directly with Teacher Education, I stopped attending conferences focused specifically on Teacher Education—not because of a lack of interest but day-to-day relevance. I also suspected that how one pays for conference attendance influences which conferences someone might attend. Finally, after sending this brief survey out to IT Forum, I feared that I might get skewed results based on IT Forum's membership. As a result, I sent the form out to two different AERA lists, two different EDUCAUSE lists, an AECT list, Tweeted about it, as well as posted it on a number of LinkedIn groups (including ISPI, ASTD, and e-Learning guild).

I was delighted to see that 140 people responded (though a few of them did not complete all of the questions). So let's look at what people had to say.

Question 1: I Consider Myself . .

The field of instructional design and technology is very broad, with individuals doing all sorts of things (see Lowenthal & Wilson, 2010; Lowenthal, Wilson, & Parrish, 2009). In fact, people have questioned whether we should even think of ourselves as a "field." I wanted to get a snapshot of what each person did day-to-day.

The question was set up so that *respondents could select more than one choice*. The largest group of respondents consider themselves "educational technologists/instructional technologists" (60), followed next by "instructional designers" (40), "professors" (30), and "eLearning professionals" (26). While I was primarily interested in what conferences people attend, it was still interesting seeing how people think about what they do day-to-day. For instance, a surprisingly small number of people think of themselves as instructional developers. (See ***Table 2***.)

Table 2. Positions/duties of respondents

Position/Duty*	# of Responses	%
Educational technologist/instructional technologist	60	46%
Instructional designer	40	23%
Professor of instructional design and technology	30	23%
eLearning professional	26	20%
Graduate student	18	14%
Human performance technology professional	10	8%
Instructional developer	10	8%
Trainer	6	5%

**Some respondents made more than one selection.*

Question 2: I Regularly Attend the Following Conferences/professional Meeting(s)

This question really gets at the heart of my concern—which is, where are other educational technology professionals congregating? Which conferences are they attending? I tried to list all of the main conferences that I could think of (though in hindsight I am surprised that I failed to list SALT, WCET, Professors of Instructional Design and Technology

(PIDT), or one of the two main Learning Sciences conferences), but I still left an option for "other"—recognizing that there are many local or international conferences that I am not aware of.

Not surprising given the groups I asked, AECT was selected the most, by 50 of the respondents, followed by EDUCAUSE with 33, and AERA with 32 respondents (see ***Table 3***).

Table 3. Total conference attendance.

Conferences*	# of Responses	%
AECT	50	36%
EDUCAUSE	33	24%
AERA	32	23%
Sloan-C	30	21%
SITE	28	20%
ISTE	27	19%
Annual Distance Ed	27	19%
ELI	24	17%
E-Learn	18	13%
Edmedia	13	9%
ASTD	9	6%
ISPI	5	4%

**Respondents could name more than one conference.*

A few things stood out to me when looking at the results.

- While AECT was selected the most, there wasn't exactly a "clear winner." AECT was selected by only 36% of the respondents.
- AERA, Sloan-C, EDUCAUSE, ISTE, SITE, and the Annual Distance Ed conference were all selected by about the same numbers. I was particularly surprised that more people did not select ISTE. While I have only attended ISTE once, it has a huge yearly conference and a large membership. It could have to do with where I posted the survey as well as the time of the year (the end of the K–12 school year), which led educational technology professionals who work directly in K–12 not to respond.
- When looking at "other" conferences people attend (i.e., ones I wasn't aware of or didn't think to list), there wasn't much commonality. BlackBoard World, Moodle Moots, and WCET were listed by a few respondents, but those were the only ones mentioned by more than two respondents.

I was curious though if there were other patterns. For instance, I attend AECT and AERA each year. I was curious what others who attend AECT or AERA also attend. When looking at those who attend AECT, I found that they also attended the following conferences:
—AERA (23)
—ASTD (4)

—ISPI (4)
—Sloan-C (8)
—EDUCAUSE (7)
—ELI (7)
—ISTE (8)
—Edmedia (8)
—E-Learn (10)
—SITE (13)
—Annual Distance Ed (8)

Further, those who attend AERA also attend:
—AECT (23)
—ASTD (2)
—ISPI (4)
—Sloan-C (2)
—EDUCAUSE (3)
—ELI (3)
—ISTE (8)
—Edmedia (3)
—E-Learn (3)
—SITE (9)
—Annual Distance Ed (8)

Question 3: Typically . .

- My place of employment pays for my conference attendance.
- I pay for my conference attendance.
- My place of employment pays for part of my conference attendance.
- Other:

As mentioned earlier, I was interested in simply getting a feel for how many people receive full or partial funding to attend conferences vs. those who pay out-of-pocket. A surprising 28 out of 131 people, or 21%, value conferences enough that they use their own money to attend them. (See ***Table 4.***)

Table 4. Conference funding.

Who Pays	#	%
Work pays for all of my conference attendance	68	51.9%
Work pays for part of my conference attendance	35	26.7%
I pay for my conference attendance	28	21.4%

Question 4: Why Do You Attend These Conferences and Not Others?

Finally, I was interested in getting a feeling for why people attend certain conferences and not others. For instance, I would love to attend Sloan-C but it often overlaps or is too close to when AECT occurs each year, so I make the choice to attend AECT.* Further, I would also like to attend the Annual Conference on Distance Teaching and Learning, but I find

the timing (right before the start of fall semester) difficult. Finally, my research focuses on computer-mediated communication, so I would love to attend the International Conference on Computer-Supported Collaborative Learning (CSCL), but most years it is held outside of the U.S., which makes it difficult, given the state of travel budgets.

I suspect others make similar choices. I tried to identify themes that emerged and when possible provide a quote from a respondent that captures the theme. Ultimately, there seemed to be a number of reasons why people attended (or didn't attend) conferences, but some of the most frequent had to do with time, money, and relevance.

Cost

- "I typically go to what is paid for. I used to pick up a conference or two on my own as well, but K–12 education is really hurting . . . We're lucky to have jobs and still get a travel budget at all. We haven't had cost-of-living adjustments or raises in 5 years. I just can't afford to pick up anything on my own that's not regional at this point."

Location

- "I can't afford vacations so I use conferences as a way to take my family on a vacation. I attend the conference and they play. In the evenings I'm with them. We extend a few days each time as well."

Focus

- ". . . more practical implementations and not too research focused."
- "I attend the ones that I see as more 'academic' rather than practitioner-focused (e.g., EDUCAUSE and ASTD), and the ones that are more 'general' rather than specifically K–12 only."

Networking/socializing Possibilities

- "I attend AECT for professional networking."

Relevance

- "Relevance to my job and interest."
- "Have friends that attend many of these."
- "Ultimately, it's what will have the most bang for our buck, if we're presenting, and what's most relevant to what we do. There could be great things going on at SITE or E-Learn, but if only one or two sessions are directly relevant, then it's not worth it."

High Standards

- "AECT and AERA have higher standards for submissions and for acceptance of proposals, plus the referees who review the proposals are more competent and capable of selecting high-quality proposals than at ISPI and ASTD."
- ". . . the best for getting new ideas on the research as well as having high standards for my work, also for networking."

Graduate Student Friendly

- ". . . seeing other graduate students presenting."
- "My students can present their work at SITE and E-Learn."
- "Mostly because the graduate programs I attended were supportive of AECT and now I know several people in the organization."
- "AECT is generally more accessible to me as a graduate student."

Respected

- “They are the most respected in the field for research. Since I’m a graduate student and pay my own way to conferences, I have to be selective.”
- “I needed to pick conferences recognized and supported by the colleges I worked for.”

Presenting at Conference

- “I can only attend if I get an accepted poster or session. EDUCAUSE is the hardest to achieve that.”

Proceedings Published

- “Good venues to network with others interested in my research areas. Peer reviewed conference papers, proceedings published.”

Service

- “I’m involved with SIGs.”

Vendors

- “I like the school focus and exhibits at ISTE.”

Inspiration/innovative Ideas

- “To keep abreast of new innovations in educational technology.”

Mixed Group of Attendees

- “I look for industry reputation; diversity of attendees; engaging topics that span research, theory, and practice; opportunities to present or publish.”

Size

- “AERA is a monster, and I get more attendees to my talks there than anywhere else. AECT is smaller and usually affords closer meetings with people whose work I am interested in.”
- “I’m basically looking at one large and one small.”
- “AECT is a conference I regularly attend because of the intimate nature, knowing many of the attendees, and the content of the presentations as well as the mission of AECT fits with what I value.”

Time

- “Lack of resources—especially time to attend. I would love to attend more of these, but the university resources are very limited (and being cut further), and we have not replaced professors who have retired, so the time to attend these conference is impacted, too.”

Concluding Thoughts

I set forth to get a better idea of the conferences other professionals in my field attend. For better or worse, I find that I am not that different from most of the respondents. I love to attend conferences and I have attended (at least at one time or another) most of the conferences that my colleagues have. I, like many of the respondents, have found that if I am presenting I have a better chance of getting the conference paid for by my employer, but that typically I can only get 1–2 conferences paid for each year because there simply are not enough funds to attend more.

I like to attend conferences that are respected by my employer and give me a chance to network with old and new friends (hence one of the reasons I continue to attend AECT and AERA). And, finally, while location isn’t everything, the

location of the conference can often heavily influence if I attend a conference in a given year. For instance, if a conference is in my hometown (which doesn't happen often now that I live in Boise, Idaho but did when I lived in Denver) or is a short drive away, I am more likely to attend and convince my employer to cover the registration cost. In fact, a couple of years ago, I was able to attend the PIDT annual gathering as a graduate student because it was in Colorado and just a short drive away; to date PIDT offers perhaps the best networking opportunities of any conference I have ever attended. Further, if a conference is too far away (e.g., outside of the U.S.) and cost-prohibitive or in a less appealing city or a city I have been to too many times (e.g., Orlando), I am also not likely to attend.

This article started with a simple question, "which conferences do my colleagues attend?" While I was hoping that there might be a clear "winner," it appears that one size doesn't fit all. We are a diverse group of individuals who often do similar yet very different things day-to-day, which is likely why we have so many different conferences available to attend.

For the unforeseeable future (or as long as I can get funding), I will continue to attend AECT and AERA. However, I hope to continue to branch out every few years and check out other conferences—Sloan-C, the Annual Conference on Distance Teaching and Learning, and the International Conference on Computer-Supported Collaborative Learning are tops on my list—while also finding time to attend PIDT. It is through branching out that I can continue to broaden my circles.

Application Exercise

- Take some time to think about your future career plans. Then, do some research and discover which of the conferences listed in this article would best support the skills for your career. Look up the location and cost of the conference. Reflect on possible presentations you could make at the conference. Where possible, make plans to attend.

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* In the spirit of full disclosure, I serve as the communications officer for the Division of Distance Learning for AECT. However, even before taking on this service role, AECT has remained in my mind as the most important conference to attend each year, given my professional roles, responsibilities, and career goals.

Please complete this short survey to provide feedback on this chapter: http://bit.ly/LIDTConferences

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47

Networking at Conferences

Jered Borup, Abby Hawkins, & Tanya Gheen

Editor's Note

The following chapter is a combination of two ect Cornerstone articles written for *TechTrends:* "An Academic Experience of a Lifetime!" by Jered Borup and "Internship Reflection" by Abigail Hawkins.

Borup, J. (2013). An academic experience of a lifetime! *TechTrends*, *57*(5), 4–5. doi: 10.1007/s11528-013-0682-9
Hawkins, A. (2010). Internship reflection. *TechTrends*, *54*(4), 10. doi:10.1007/s11528-010-0410-7

Charles Graham (faculty member at Brigham Young University) once stated that what happens in conference hallways is often more valuable than what happens in the sessions. When attending a conference, you can meet amazing people and form relationships you never thought possible. The following networking strategies are for other graduates who may have felt peripheral and out of place at academic conferences. Our advice is simple: insert yourself into the scene. We would like to share three ways that any and all graduate students can do just that and make the most of their time at a conference: stand tall, shake hands, and get organized.

Stand Tall

This isn't an encouragement to improve your posture but to make the most of your opportunities. There are four ways for graduate students to stand tall at conferences.

Be confident. The former Saturday Night Live comedian Al Franken had a recurring character named Stuart Smalley. In every sketch, Stuart would look in the mirror and confidently say, "I'm good enough, I'm smart enough, and doggone it, people like me!" While we don't advocate that you chant this affirmation while at a conference, you wouldn't be wrong if you did. It will not take you long before you realize that the organization values graduate students and there is no reason not to confidently stand tall as a graduate student knowing that "You're good enough, you're smart enough, and doggone it, people like you!" Having that knowledge is critical to making the most of your time there.

Participate. It is easy for new graduate students to feel that they are not able to make a meaningful contribution. This simply is not true. If possible, you should submit a research proposal and present your work. If your research is not developed enough for a full-paper presentation, submit it as a roundtable or poster presentation. If you don't have anything to present, you can still ask questions or make comments at the sessions you attend.

Apply for awards. Look for awards supported by the organizations that sponsor the conference you are attending. There are likely several. We would recommend applying first for the ones that are specifically for graduate students. You can also ask your advisor or another faculty member familiar with the conference for advice on what awards you should apply for.

Give service. There are lots of ways that graduate students can give service. You may want to consider volunteering at the conference. It can be a good way to become familiar with the organization and meet new people. You should also try to attend one or two division meetings. At the division meeting, they will look for volunteers to help the division. Reviewing presentation submissions can be a great way to serve the division and learn what makes a good proposal.

Shake Hands and Network

We have all heard about the importance of networking. Probably the best networking advice Jered ever received was to "shake as many hands as possible." Although networking obviously involves more than a handshake, it's a good place to start. We've compiled a list of the five primary opportunities to shake hands and network at the conference (sessions, receptions, activities, meals, and the job board) and the three main resources for doing so (faculty, peers, and yourself).

Sessions. Researchers love to talk about their research. After attending a session, stick around and talk with those who are still buzzing. Listen. Ask questions. Share ideas. Exchange cards. Become a part of the larger conversation and your research community. You'll find that some of the best conversations happen after the formal presentations are over. Poster sessions and roundtables are also great opportunities to actively discuss interesting topics.

Receptions. Each conference is different, but some organize receptions that are specifically designed to help people get to know each other and network. Don't miss them! If this is your first time at the conference, it may be helpful if you went with an advisor or another faculty member from your department. They will be able to introduce you to new people until you feel comfortable branching out on your own.

Activities. There are several planned activities to help you get out there and shake some hands. Some are free with your registration, and others cost a little extra but are worth the money. For instance, Jered made some of his best memories on a riverboat cruise.

Meals. It's not uncommon for graduate students to try to eat cheap and save money during their time at a conference. Money can be tight for graduate students, but being too frugal can cost you. Worry more about who you are eating with than the cost of the meal. For example, attend that pricey division luncheon. You'll sit at a table with eight other people interested in an area of research similar to your own. You will make friends, comment on how horrible the food is, and learn the inner workings of the division. Remember the service advice from earlier? After the lunch would be a great time to ask one of the division leaders if there is any volunteer division work you could participate in during the year.

The job board. If you are on the job hunt, you should take a look at the job board. You can post your vitae and see the jobs that are available. Typically the postings will have a contact number. Don't hesitate to call, text, or email the contacts for the jobs that you are interested in to set up a time to talk at the conference.

Faculty. Don't be afraid to ask for help from your faculty. They are, not surprisingly, more familiar with the conference and other attendees and can introduce you to people they know. After her second day at the conference, Abigail pinged Dr. David Wiley asking if he would introduce her to people the next morning. He was more than accommodating and introduced her to several individuals and potential employers. Similarly, Dr. Rick West introduced her to several faculty members who were looking to hire.

Peers. While you're making bold moves and shaking hands with big names in the field, be inclusive by inviting other graduate students to join you for lunch. Introduce one another to people you know. Fellow participants in the conference that Abigail attended, Heather Leary, Eunjung Oh, and Nari Kim, all introduced Abigail to faculty from their departments.

Similarly, she introduced them to faculty from hers. It was a simple, kind, and easy way to meet others through the use of a peer network.

Yourself. Do the uncomfortable. For instance, would you be horrified if we told you to invite yourself to lunch with someone? It is a common mindset that one waits for an invitation. However, it is completely normal at a conference to ask if people have lunch plans and if you could join them (or if they would join you). So after lingering at a session and meeting people with similar research interests, be bold and ask if they have lunch plans. Make the first move. You'll be surprised by the outcome.

Get Organized

Being unorganized is a sure way to miss great opportunities. We'll look at three phases of organization: before, during, and after.

Before the conference. Plan before you go. You should start organizing and preparing long before the conference actually starts. First, identify the sessions that you would like to attend. Remember, who is presenting is just as important as what they are presenting. Ideally, you would be familiar with the presenters' work and their ideas relevant to your research. You can also contact individuals you would like to meet in advance and ask if you could take them out for coffee or chat with them during a session break. If you are not sure whom to meet, ask your advisor. Have questions prepared to ask about their research and how it relates to your own. Second, clear your plate of your other responsibilities. You want to avoid grading assignments or working on class assignments during the conference. Third, get some business cards. You are probably thinking, "But I'm just a graduate student." And? If you are teaching or a research assistant, ask your department secretary if you can get cards made with the university logo. Also, print some copies of your vitae and sample publications. These are especially important if you are on the job hunt. Lastly, join the Facebook groups for the assemblies and divisions that you care most about (especially any that are for graduate students). It will help you get a pulse for the community and be aware of important events.

During the conference. It can be easy to get a little disorganized at the conference. Two strategies may help. First, when you receive a business card (and pass out one of your own at the same time), write on the back the person's research area or employment, what you were talking about, and anything that you would like to follow up on. It would also be helpful to jot down one personal fact you can recall from the conversation. Second, carry a pocket-sized notebook for note-keeping. If you don't write down your ideas, you may forget them.

After the conference. Don't just put the business cards you collected or the notes that you took in a drawer and forget about them. Instead follow up on the conversations that you had, invite people to join your LinkedIn and other social networks, and actually read the articles that you told yourself you would. It's also a good idea to email those who helped you at the conference and thank them.

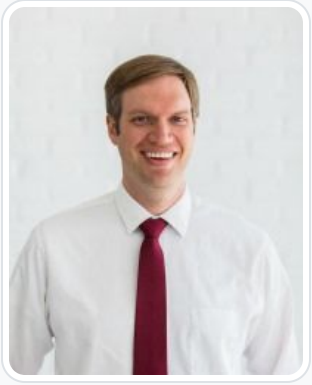
Conclusion

If you are a graduate student who is considering attending a conference—do it! And remember to stand tall, shake hands, and be organized.

Application Exercises

- After reading this article, find a professor or another graduate student who has attended a conference. Ask them about their advice for attending conferences.
- Reflect on how you would or will prepare to make the most of a conference. What would you bring. Who would you want to talk to?

Please complete this short survey to provide feedback on this chapter:
http://bit.ly/LIDTConferenceNetworking



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Jered Borup is the professor-in-charge of George Mason University's Blended and Online Learning in Schools Master's and Certificate programs that are devoted to improving teacher practices in online and blended learning environments. Previous to earning his Ph.D. at Brigham Young University, Jered taught history at a junior high school for six years. He has also taught online and blended courses since 2008. His current research interests include developing online learning communities and identifying support systems that adolescent learners require to be successful in online environments. A full list of his publications can be found at https://sites.google.com/site/jeredborup/

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48

PIDT, the Important Unconference for Academics

Richard E. West

Editor's Note

A version of the following was originally published in Educational Technology. *The full citation is:*

West, R. E. (2012). PIDT: The "unconference" for discussion of ideas and professional networking. Educational Technology*, 52(5), 45-47.*

For more information on upcoming PIDT conferences, see the active Facebook page or the official website.

PIDT is an annual meeting that has become a favorite for many faculty to discuss issues related to curriculum, doctoral student advising and teaching, research, professional service, and emerging theories and technologies. By design a small conference, focused on networking, discussion, informality, and professional growth, but still a conference from which a large number of initiatives and defining publications have emerged. The following is a brief history of this unique and important conference in our field.

PIDT History

In 2004, Wineburg poetically lamented the state of presentations at the American Educational Research Association (AERA) conference. He described his first AERA conference in 1985, and his excitement to attend a session where four "luminaries" in his field would be presenting. Enthusiastically, he squeezed into the packed room, only to hear one esteemed professor read her notes verbatim. The second speaker did have visuals, but after "firing slides like an Uzi fires rounds," Wineburg realized few were actually paying attention or learning from the presentation. He asked, "Must it be this way?" (p. 13).

That same year, 1985, a group of instructional systems technology professors quietly answered, "No!" and formed a unique, new conference, which was really more of a professional meeting than a conference. This "unconference" emphasized everything traditional conferences were not, including a priority on discussion, interaction, networking, mentoring, and action. "The main focus was primarily social and professional interaction on an individual/small group basis. The remote, rural settings provided opportunities for much more conversation and interaction than would be available at larger, more structured conferences," Mike Moore of Virginia Tech said. A focus on balancing structure with informal conversations is a tradition that lives on in the PIDT meetings, which have been held annually except for 1997. The group originally called themselves Professors of Instructional Systems Technology, which reflected the direction of

the field at the time, but which formed an awkward acronym that only persisted for a few years before becoming PIDT. Sleeping in cabins that for the first few years did not have indoor plumbing or heating, and meeting at a rustic retreat at Shawnee Bluffs in Indiana, on the banks of Lake Monroe, the original group (led by Dr. Thomas Schwen of Indiana University) met to discuss curriculum, research, and the emerging directions of the field.

“We were a new enough field that maybe people wanted to share information,” Rhonda Robinson, of Northern Illinois, said. Robinson added that PIDT especially provided a way for female professors, who were fewer at the time, to associate and mentor each other.

The meeting was so successful that they continued meeting annually in Indiana. Eventually, the conference was moved to a rotation system, typically held at either Estes Park, Colorado, or Smith Mountain Lake, Virginia, while occasionally being held at other locations. Wherever the meeting is held, the emphasis has always been on locations where recreation merges with business, allowing participants to begin conversations in classrooms and continue them on a hike or in a canoe.

After a few years, the group decided to expand and allow faculty attendees to bring one advanced doctoral student each, as a way to introduce the students to additional faculty mentors. “Many of us were graduating and did not know how to get into the professoriate. I had three courses and no ideas what to do!” Sharon Smaldino of Northern Illinois said. “We were finding that a lot of the newbies were getting lost. They weren’t understanding the big picture. . . . We tried to make a way to ensure their success. That’s something unique about this meeting. It’s very nurturing.” Eventually attending PIDT became an honor for many graduate students lucky enough to be chosen to attend with their adviser.

Professional Development

Despite an emphasis on informality and recreation, PIDT has a tradition of providing key opportunities for professional development where participants can explore new technologies, develop new theories and ideas, receive feedback on new initiatives, and collaborate on new publishing opportunities. Many PIDT attendees remember learning about emerging technologies for the first time at PIDT, such as Twitter, Second Life, Nvivo, and even the World Wide Web when it was still a radically new innovation. “I get to listen to what the doc students are talking about these days and check what I’m teaching,” Robert Branch, of the University of Georgia, said. “I first heard about Twitter here, and OER (Open Educational Resources). Things that I could not ‘not know.’”

In addition to strands about new technologies, PIDT typically has a curriculum strand, where participants bring syllabi and teaching materials to share. In years past this has included sessions on classes common to most departments (such as a pre-service educational technology course) to new courses being developed (such as a course on ethics and instructional technology) to other, larger proposed changes within academic departments. “The established faculty have a forum if they need it. When we moved to LDT (Learning, Design, and Technology as a new name for their academic program), it was here we tried it out,” Branch said.

Other topics commonly discussed at PIDT include the following:

- Strategies for mentoring and advising graduate students
- “Big” ideas that are being developed for publication but which need a venue for preliminary exploration
- Writing projects needing collaboration
- Advice for students who are job hunting or for new faculty seeking tenure. These sessions have often been very practical, with students bringing vitas/cover letters for critique or senior faculty providing mock job interviews
- Sessions more relevant to the needs of mid-career or late-career faculty

Typically, only about half of these sessions are scheduled ahead of time, with the rest emerging at the conference as attendees discuss topics of interest to all of them. However, most participants feel the greatest value of PIDT is the professional development that occurs in between sessions. “I learned a lot from watching the senior people in the field,”

Smaldino remembered. “I think . . . people like to get together to have these informal conversations that you can’t have inside your program [where you can] sit down and talk about how do you do I.T.?”

These opportunities for networking in a relaxed atmosphere also are beneficial for graduate students. “It’s a lot of fun. We get so serious as professors and forget to have fun. It’s important for students,” Robinson said, before adding that “A theory in parenting is that it’s important for kids to see parents play” and doctoral students get the same benefit from networking with professors in a relaxed, recreational event.

Where Publications Are Born

Traditionally, PIDT has been a place where collaborators could meet and discuss ideas for publications. Perhaps most well known was when David Jonassen was selected to edit the first edition of the *Handbook of Educational Communications Technology* and used PIDT to brainstorm the list of chapters/topics and to recruit many of the authors. Numerous other articles and book chapters have similarly emerged from PIDT collaborations, including at least one edition of the AECT definitions and terminology book, with many of the definitions hotly discussed at PIDT sessions.

Future Conferences

The PIDT conference is typically hosted in the East, then the West, and sometimes somewhere in the middle. Where it’s hosted is usually planned a year away, based on which universities and departments are interested in hosting. There is no formal organization or leadership, but the departments at Virginia Tech and Brigham Young University have cared for the website and Facebook group over the last decade, and hosted the majority of the conferences. To learn more about upcoming PIDT conferences, visit the Facebook page or the official website.

Application Exercise

- Look at the PIDT website and/or Facebook page. Find out more information about this “unconference,” such as where it will be held next and who usually attends.

References

Wineburg, S. (2004). Must it be this way? Ten rules for keeping your audience awake during conferences. *Educational Researcher, 33*(4), 13–14.

Please complete this short survey to provide feedback on this chapter: http://bit.ly/PIDTConference

Richard E. West

Brigham Young University

Dr. Richard E. West is an associate professor of Instructional Psychology and Technology at Brigham Young University. He teaches courses in instructional design, academic writing, qualitative research methods, program/product evaluation, psychology, creativity and innovation, technology integration skills for preservice teachers, and the foundations of the field of learning and instructional design technology.

Dr. West's research focuses on developing educational institutions that support 21st century learning. This includes teaching interdisciplinary and collaborative creativity and design thinking skills, personalizing learning through open badges, increasing access through open education, and developing social learning communities in online and blended environments. He has published over 90 articles, co-authoring with over 80 different graduate and undergraduate students, and received scholarship awards from the American Educational Research Association, Association for Educational Communications and Technology, and Brigham Young University.

He tweets @richardewest, and his research can be found on http://richardewest.com/

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VI. Preparing for an LIDT Career

Two of the most common questions students have when they enter an LIDT graduate program is what kinds of careers will be available to them after graduation, and how can they prepare for those careers? This section focuses on answering those questions. There are many more careers possible with an LIDT degree than those represented here, and additional chapters may be added in the future. The next question is for you to answer: What type of career do you want to have?

LIDT Careers

For further information about career paths in the LIDT field, including videos about different job sectors within the field, focused on BYU IPT alumni, please visit the EdTech Careers Job Sectors page.

What Are the Skills of an Instructional Designer?
Careers in Academia: The Secret Handshake
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49

What Are the Skills of an Instructional Designer?

William Sugar, Abbie Brown, Lee Daniels, & Brent Hoard

Editor's Note

The Following Article Was Originally Published in the *Journal of Applied Instructional Design*

Sugar, W., Brown, A., Daniels, L., & Hoard, B. (2011). Instructional design and technology professionals in higher education: Multimedia production knowledge and skills identified from a Delphi study. *Journal of Applied Instructional Design, 1*(2), 30–46. Retrieved from https://edtechbooks.org/-PD

As Instructional Design and Technology (ID&T) educators, we have made considerable effort in understanding the specific multimedia production knowledge and skills required of entry-level professionals. Our previous studies (Sugar, Brown, & Daniels, 2009) documented specific multimedia production skills, knowledge and software applications (e.g., Flash) that ID&T students and subsequent graduates need to exhibit. As a result of these efforts, differences can be readily distinguished between instructional designers working in corporate settings and those working in higher education settings (Sugar, Hoard,Brown, & Daniels, 2011). Kirschner, van Merrienboer, Sloep, and Carr (2002) observed that instructional designers at higher education settings focus on identifying alternative solutions for a particular course whereas instructional designers within a corporate training setting are more customer-oriented. Larson and Lockee (2009) concurred with this assessment by noting "differences in the requirements listed for business and industry versus higher education jobs" (p. 2). Essentially, the organizational culture (e.g., shared beliefs and values) within a corporation is radically different than that which is found within a college or university setting. Since over 89% of our initial survey respondents (e.g., Sugar, Brown, & Daniels, 2009) worked in colleges or universities, we decided to concentrate our efforts exclusively on the multimedia production knowledge and skills of instructional designers working within higher education.

The role of the instructional designer, instructional technologist, and instructional technology consultant within a higher education setting has been well established. Recent studies have documented several quality instructional technology-related projects within higher education settings (e.g., Renes & Strange, 2011). As one might expect, teaching online has been emphasized during the past fifteen years (e.g., Barczyk, Buckenmeyer, & Feldman, 2010), as well as mobile learning technologies (e.g., El-Hussein & Cronje, 2010) and online student response systems (e.g., Stav, Nielsen, Hansen-Nygård & Thorseth, 2010). Other innovative technologies, such as interactive white boards (e.g., Al-Qirim, 2011), social networking (e.g., Conole, Galley, & Culver, 2011), Web 2.0 tools (e.g., Kear, Woodthorpe, Robertson, & Hutchison, 2010), and 21st century tools for teacher educators (e.g., Archambault, Wetzel, Foulger, & Williams, 2010) have been integrated in higher education classrooms. Several case studies document the inclusion of instructional technologies

into content-specific higher education courses, such as art and design education (e.g., Delacruz, 2009), engineering (e.g., Dinsmore, Alexander, & Loughlin, 2008), and nursing (e.g., Donato, Hudyma, & Carter, 2010). “Soft” technologies, such as mentoring circles (Darwin & Palmer, 2009) also have been successfully integrated in higher education settings.

The prominence of the instructional designer within higher education settings also has been well documented (Shibley, Amaral, Shank, & Shibley, 2011). Incorporating a continuous improvement process (Wolf, 2007), encouraging higher education faculty with innovative reward and recognition structures (Bluteau & Krumins, 2008), and the importance of interacting with faculty peers (Nicolle & Lou, 2008) are examples of current best practices in facilitating successful technology adoption and integration. Considerable effort in understanding how higher education faculty adopt e-Learning activities (e.g., MacKeogh &Fox, 2009), Web 2.0 technologies (e.g., Samarawickrema, Benson, & Brack, 2010), as well as faculty members’ perceptions of roles of Learning Content Management Systems (LCMS) (e.g., Steel, 2009) have been recently initiated as well.

Purpose of Study

The intent of this study is to better comprehend the instructional designer’s role in higher education settings. Specifically, we sought to interpret multimedia production knowledge and skills required of Instructional Design and Technology professionals working in higher education. In addition, since we noted a definite interrelationship between multimedia production and instructional design skills in earlier studies (Sugar, Brown, & Daniels, 2009), we also sought to understand the relationship between these two skill sets. To accomplish this goal, we conducted a Delphi study, seeking the opinions and consensus of experienced instructional designers who work in higher education.

Method

We determined that a Delphi research methodology was the best approach to address our questions. In the early 1950’s, “Project Delphi” was developed from an Air Force-sponsored Rand Corporation study. This study sought to “obtain the most reliable consensus of opinion of a group of experts . . . by a series of intensive questionnaires interspersed with controlled opinion feedback” (Linstone & Turoff, 2002, p. 10). Delphi panelists remain anonymous to each other in order to avoid the “bandwagon effect” and ensure individual panelists do not dominate a particular decision (Linstone & Turoff, 2002). Ideally, the Delphi panel is heterogeneous; clearly representing a wide selection of the targeted group. Since the inception of Project Delphi, the Delphi technique has been a prescribed methodology for a wide variety of content areas, including government planning, medical issues, and drug abuse-related policy making (Linstone & Turoff, 2002). Several existing Instructional Design and Technology research studies utilized the Delphi method to examine phenomena such as: determining constructivist-based distance learning strategies for school teachers (Herring, 2004); understanding strategies that promote social connectedness in online learning environments (Slagter van Tryon & Bishop, 2006); best practices for using technology in high schools (Clark, 2006); optimal technology integration in adult literacy classrooms (Dillon-Marable & Valentine, 2006); and forecasting how blended learning approaches can be used in computer-supported collaborative learning environments (So & Bonk, 2010). The Delphi method has also been used to identify priorities from a select group of experts on topics that include K–12 distance education research, policies, and practices (Rice, 2009); mobile learning technologies (Kurubacak, 2007); and educational technology research needs (Pollard & Pollard, 2004).

Standards have also been determined from Delphi studies. Researchers used this method to ascertain effective project manager competencies (Brill, Bishop, & Walker, 2006), biotechnology knowledge and skills for technology education teachers (Scott, Washer, & Wright, 2006), and assistive technology knowledge and skills for special education teachers (Smith, Kelley, Maushak, Griffin-Shirley, & Lan, 2009).

This Delphi research method is an established technique to collect a consensus decision among experts about a topic that involves examination of a broad and complex problem that could be potentially subjective (Linstone & Turoff, 1975; Linstone & Turoff, 2002). The question of which multimedia production knowledge and skills are important among

entry-level instructional designers is both complex and subjective; the answer depends on decisions made within organizations and the learner population the organization services.

The Delphi method provides researchers with the ability to systematically evaluate the expert decision-making process within a prescribed set of phases. This process is particularly advantageous for those participants or Delphi panelists who are in separate physical locations (Linstone & Turoff, 1975), as our participants were.

Delphi Panel

For our Delphi study, fourteen Instructional Design and Technology professionals originally agreed to participate. Ultimately, eleven of the fourteen original panelists completed all three data collection phases of the study; three individuals stopped participating for various personal reasons. The overall goal was to gather responses from a heterogeneous grouping of panelists (see Table 1) representing higher education work environments in general. The seven female and four male panelists work in a variety of higher education settings, including two-year colleges, four-year universities, public institutions, and private institutions. Eight of our panelists represent public institutions and three represent private institutions. In addition, two panelists represent two-year community colleges and four represent undergraduate-only institutions. Nine of our panelists work in administrative positions (e.g., Director) and two of our panelists work as instructional designers for their respective institutions. Ten panelists have worked in higher education setting for more than ten years. The average amount of higher education work experience was over sixteen years. The panelists are geographically diverse, representing western, mountain west, mid-west, south, southeast, mid-Atlantic, and northeast regions of the United States. One panelist works at a higher education institution in Switzerland.

Table 1. Demographic information of Delphi panelists

Gender	Position	Years in higher education setting	Region	Type of institution
Female	Instructional Designer	10	West	Public; 4-year degree; Undergraduate & graduate
Female	Instructional Designer	12	Mountain West	Public; 4-year degree; Undergraduate & graduate
Female	Coordinator	4	Northeast	Public; 4-year degree; Undergraduate & graduate
Female	Coordinator	27	Southeast	Public; 2-year degree; Undergraduate
Female	Vice Provost	25	South	Public; 4-year degree; Undergraduate & graduate
Male	Director	29	Midwest	Private; 4-year degree; Undergraduate
Male	Chief Academic Officer	20	South	Public; 2-year degree; Undergraduate
Male	Director	19	Southeast	Private; 4-year degree; Undergraduate & graduate
Female	Director	14	Mid-Atlantic	Public; 4-year degree; Undergraduate & graduate
Male	Director	11	Switzerland	Public; 3-year degree; Undergraduate & graduate

Female	Team Leader	13	Northeast	Private; 4-year degree; Undergraduate & graduate

Overview of Delphi Data Collection Phases

Three Delphi data collection phases were completed during this study. During the first round, panelists responded to the following three open-ended questions:

- What multimedia production knowledge do you believe an entry-level Instructional Design and Technology professional needs to know in order to be successful?
- What multimedia production skills do you believe an entry-level Instructional Design and Technology professional must possess in order to be successful?
- What kind of overlap is there between multimedia production knowledge and skills and instructional design knowledge and skills?

The purpose of these questions was to delineate specific multimedia production knowledge and skills, required of these professionals. The questions were open-ended in order to avoid biasing our panelists' responses (Linstone & Turoff, 1975). The panelists responded to these questions via email.

With the intent of identifying emerging and reoccurring themes, three evaluators analyzed the panelists' responses using a category construction data analysis method as outlined by Merriam (2009). Questionable items and themes were discussed among the three evaluators; the evaluators reached consensus on all items. Particular themes from these responses were identified. This initial set of themes was sent to the panelists for their review. Each panelist had the opportunity to respond to the overarching group of themes and the specific themes, and to add additional categories as well. All of these themes were compiled into a summative questionnaire, and this questionnaire was then distributed during the second round.

The intent of the questionnaire was to establish a quantitative appraisal of our panelists' responses about each item and to seek a common set of responses to Instructional Design and Technology graduates' multimedia production knowledge and skills. The panelists rated each questionnaire item with regard to the importance of each identified knowledge or skill, and the panelists' responses were compiled and distributed via email to each panel member. Panelists were then given the opportunity to offer feedback about the questionnaire results and make any corrections, as necessary.

During the third round, the eleven panelists reviewed the Round #2 ratings and were given the opportunity to revise their own ratings. Five of the eleven panelists recommended minor incremental changes to their original rankings. None of the eleven panelists made any suggestions to either add another item or remove an existing item. Given this feedback, we determined that these minor modifications indicated there was an apparent consensus among the panel.

Results

During the initial Delphi phase, the eleven panelists generated 289 unique statements regarding the three aforementioned initial questions. From this first round of responses, 60 distinct multimedia knowledge and skills needed by Instructional Design and Technology graduates were identified and organized into seven primary categories. This list of categories was then sent back to our panelists for confirmation. Eight of the eleven panelists recommended ten additional knowledge and skills for a total of 70 items.

Table 2. Top-ranked items (M ≥ 1.45)

Rank	Item	Category	f	M	SD

1	Communication skills	Communication and collaboration	11	1.91	.30
2	Social skills	Communication and collaboration	11	1.73	.65
3	Web design basics	Production	11	1.64	.51
4	Visual communication	Visual and graphic design	10	1.60	.70
5	Microsoft Office Suite	Applications	11	1.55	.52
6	Online course pedagogy	Instructional design and pedagogy	11	1.55	.69
7	Knowledge of learner	Instructional design and pedagogy	11	1.55	.82
8	Screencasting	Production	11	1.45	.69
9	Pedagogical design expertise	Instructional design and pedagogy	11	1.45	1.21
10	Design multimedia content	Instructional design and pedagogy	11	1.45	.82
11	Articulate advantages & disadvantages of delivering media formats	Delivery and project management	11	1.45	.69
12	Determine delivery venue	Delivery and project management	11	1.45	.52
13	Understanding of how disabilities impact multimedia selection	Delivery and project management	11	1.45	.69
14	LCMS	Online Applicatons	11	1.45	1.21
15	Video production	Production	11	1.45	.52

Responses were rated on a scale of -2 to 2, with -2= unnecessary, -1= not important, 0= somewhat important, 1= important, 2= essential.

Table 3. Bottom-ranked items (M≥.36)

Rank	Item	Category	f	M	SD
60	XML	Online Applications	11	.36	.81
61	Online plug-ins	Online applications	11	.27	1.27
62	Online quiz tools	Online applications	11	.18	1.08
63	Contribute	Online applications	10	.10	1.10
64	Photography	Productions	11	.09	.94

65	Online survey tools	Online applications	11	.09	.94
66	Animation	Production	11	.00	.63
67	Garageband	Applications	11	.00	.63
68	Final Cut Pro Suite	Applications	11	-.09	.94
69	Programming (e.g., Action-script)	Production	10	-.10	1.10
70	Green screen	Applications	10	-.40	1.27

Responses were rated on a scale of -2 to 2, with -2= unnecessary, -1= not important, 0= somewhat important, 1= important, 2= essential.

The panelists also reacted to the seven categories. Four original categories (Visual and Graphic Design, Instructional Design and Pedagogy, Communication and Collaboration, and Delivery and Project Management) did not receive any feedback or edits and were approved. The panelists commented on the three original categories: Basic Production, Specific Software Tool and Online. Upon review of these comments, these categories were renamed Production, Applications, and Online Applications respectively. We distinguished between applications (e.g., Flash) that can create instruction for online settings as well as non-online settings, and applications (e.g., Dreamweaver) that exclusively create instruction for online settings.

In summary, Delphi panelists' responses were organized into seven categories: Production (10 items), Applications (12 items), Online Applications (15 items), Visual and Graphic Design (6 items), Instructional Design and Pedagogy (15 items), Communication and Collaboration (4 items), and Delivery and Project Management (8 items). See Appendix for a listing of these categories and corresponding items.

During the next Delphi phase, our eleven panelists ranked these seventy items on the following scale: Essential, Important, Somewhat important, Not important, Unnecessary. Accordingly, we assigned a 2 to -2 Likert scale for these five items where Essential items received 2 points, Important items received 1 point, Somewhat important items received 0 points, Not important items received -1 point, and Unnecessary items received -2 points. Thus, the top score any item could receive would be 22 points (i.e., all 11 panelists deemed this item to be Essential) and the lowest score that an item could receive would be -22 points (i.e., all 11 panelists deemed this item to be Unnecessary). This rating system also provides the ability to weight and counterweight individual panelists' responses about a particular item. For example, if a panelist rated one item as Important (1 point) and another panelist rated the same item as Not important (-1 point), the item would receive a combined score of zero points and would be considered as Somewhat important.

The average scores for all of the seventy items ranged from M = 1.91 to M = -.4 (see Appendix). The 15 top-ranked items that received a 1.45 average or higher are found in Table 2. The top two items, Communication (M = 1.91, SD = .30) and Social skills (M= 1.73, SD = .65) were within the Communication and Collaboration category. Three production items, Web Design Basics (M = 1.64, SD = .51), Video Production (M = 1.45, SD = .52), and Screencasting (M = 1.45, SD = .69) were including in this top-ranked list. The item, Visual communication and visualization theories (M = 1.60, SD = .70), was the fourth highest-ranked item and Microsoft Office Suite (M = 1.55, SD = .52) was the fifth highest-ranked item. Four of the fifteen Instructional Design and Pedagogy items and three of the eight Delivery and Project Management items also were distributed in this top-ranked listing. Learning Content Management Systems (LCMS) (M = 1.45, SD = 1.21) also was in this top ranking list. The eleven bottom-ranked items that received a .36 average or lower are found in Table 3. Five Online applications (XML, Online quiz tools, Online plug-ins, Contribute, and Google Forms/Survey Monkey) were located in this list of items. Three Production items (Photography, Animation, and Programming) and three Applications items (Garageband, Final Cut Pro, and Green screen) received an average of 0 or lower.

Table 4. Percentage of importance within each category

Category (n)	Unnecessary to Not important -2 ≤ M < -1 %	Not important to Somewhat important -1≤ M < 0 %	Somewhat important to Important 0 ≤ M < 0 %	Important to Essential 1 ≤ M ≤ 2 %
Communication and collaboration (n=4)	0.0	0.0	25.0	75.0
Visual and graphic design (n=6)	0.0	0.0	0.0	100.0
Delivery and project management (n=8)	0.0	0.0	12.0	88.0
Instructional design and pedagogy (n=15)	0.0	0.0	20.0	80.0
Production (n=10)	0.0	10.0	30.0	60.0
Online applications (n=15)	0.0	0.0	66.7	33.3
Applications (n=12)	0.0	16.67	66.66	16.67
Totals (n=70)	0.0	4.3	37.1	58.6

In Table 4, the percentage of importance ratings is listed for each category. Over sixty percent of the items (63.8%) from each of the seven categories received an “Important” (M > 1) to “Essential” (M < 2) ranking. All theVisual and Graphic Design (n=6) items were within this range. Fourteen of the fifteen Instructional Design and Pedagogy items received “Important to Essential” ratings; SCORM received an average score lower than 1 (M = .73, SD = .91). Three of the four Communication and Collaboration items also received “Important to Essential” ratings. Public presentation skills received an average score lower than 1 (M = .91, SD = .94). All but one Delivery and Project Management item (n=7) also received an “Important to Essential” rating; Understanding of budget constraints & funding issues received an average score lower than 1 (M = .64, SD = .81).

Sixty percent of the Production items (n=6) received an “Important” (M > 1) to “Essential” (M < 2) rating (see Table 4). A majority of the Delphi panelists categorized Web design basics (M = 1.64, SD = .51), Video production (M = 1.45, SD = .52), Screencasting (M = 1.45, SD = .69), Audio production (M = 1.36, SD = .67), Images production (M = 1.36, SD = .67), and Basic HTML commands (M = 1.09, SD = 1.10), as “Important” to “Essential” items. (see Table 5). The remaining four Production items either received a “Somewhat important” (M < 0) to “Important” (M < 1) ranking (i.e., Desktop publishing and Photography) or received a “Not important” (M < -1) to “Somewhat important” (M < 0) ranking (i.e., Animation and Programming skills).

Table 5. Production category items

Rank	Production category items	f	M	SD
3	Web design basics	11	1.64	.51
8	Screencasting	11	1.45	.69
15	Video production	11	1.45	.52
16	Audio production	11	1.36	.67

26	Images production	11	1.36	.67
38	Basic HTML commands	11	1.00	1.10
48	Desktop publication	11	.91	.75
64	Photography	11	.09	.94
66	Animation	11	.00	.63
68	Programming skills (e.g., Actionscript)	10	-.10	1.10

Responses were rated on a scale of -2 to 2, with -2= unnecessary, -1= not important, 0= somewhat important, 1= important, 2= essential.

Table 6. Application category items

Rank	Application category items	f	M	SD
5	Microsoft Office suite	11	1.55	.52
33	Adobe software suite	11	1.09	.94
47	Major operating systems	11	.85	1.08
49	Photoshop	11	.82	.87
51	Audacity	11	.73	.79
56	Adobe Flash	11	.64	.93
57	Adobe Acrobat	11	.55	1.04
58	iMovie	11	.55	.82
59	Fireworks	11	.55	.93
67	Garageband	11	.00	.63
68	Final Cut Pro Suite	11	-.09	.94
70	Green screen	10	-.40	1.27

Responses were rated on a scale of -2 to 2, with -2= unnecessary, -1= not important, 0= somewhat important, 1= important, 2= essential.

Only 25% of the Application items (n=3) received an “Important” (M > 1) to “Essential” (M < 2) rating (see Table 6). Two of these three applications are generic applications with regard to multimedia production items. These applications are Microsoft Office suite (M = 1.55, SD = .52) and Major operating systems (M = 1.00, SD = 1.08). The other Application item is the overall Adobe software suite (M = 1.09, SD = .94). The remaining nine Application items either received a “Somewhat important” (M < 0) to “Important” (M < 1) ranking (i.e., Audacity, Flash, Photoshop, Acrobat, iMovie, Fireworks, and Garageband) or received a “Not important” (M < -1) to “Somewhat important” (M < 0) ranking (i.e., Final Cut Pro and Green screen).

There is disagreement among the panelists regarding the importance of specific applications. As depicted in Figure 1, at least 45% of the panelists perceived the importance of the following three applications: Flash, Photoshop, and Fireworks. Six panelists perceived Flash as either an Important or an Essential multimedia production item whereas five panelists perceived Flash as either Somewhat important or Not important. Five panelists perceived both Photoshop and Fireworks as either an Important or an Essential multimedia production item whereas six panelists perceived both Photoshop and Fireworks as either Somewhat important or Not important.

Table 7. Online application category items

Rank	Online application category items		M	SD
14	LCMS	11	1.45	1.21
29	Web 2.0 applications	11	1.27	.79
34	Knowledge of online file structures	11	1.09	.94
39	Camtasia	10	1.00	.82
40	Web page editors	11	1.00	.78
44	Dreamweaver	11	.91	.83
45	CSS	11	.91	.70
50	Wikis	11	.82	.75
53	Captivate	11	.64	.67
55	Blogs	11	.64	.67
60	XML	11	.36	.81
61	Online plug-ins	11	.27	1.27
62	Online quiz tools	11	.18	1.08
63	Contribute	10	.10	1.10
65	Online survey tools	11	.09	.94

Responses were rated on a scale of -2 to 2, with -2= unnecessary, -1= not important, 0= somewhat important, 1= important, 2= essential.

Thirty-three percent of the Online application items (n=5) received an “Important” (M ≥ 1) to “Essential” (M ≤ 2) rating (see Table 7). Four of these five applications are generic applications with regard to multimedia production items. These applications are LCMS (M= 1.36, SD= 1.21), Web 2.0 applications (M= 1.27, SD= .79), Knowledge of online file structures (M= 1.09, SD= .94), and Web page editors (M= 1.00, SD= .78). The other Online application item is Camtasia (M= 1.00, SD= .82). The remaining 10 Application items received a “Somewhat important” (M < 0) to “Important” (M < 1) ranking.

Similar to the Application items, there is disagreement among the panelists regarding the importance of particular online applications. As shown in Figure 2, at least 45% of the panelists perceived the importance of the following two applications: Camtasia and Online plugins. Six panelists perceived Camtasia as either an Important or an Essential multimedia production item whereas five panelists perceived Camtasia as either Somewhat important or Not important.

Five panelists perceived Online plugins as either an Important or an Essential multimedia production item whereas six panelists perceived these tools as either Somewhat important, Not important or Unnecessary.

Discussion

In considering these results, the Delphi panelists identified specific multimedia production skills and knowledge needed by entry-level Instructional Design and Technology (ID&T) professionals who work in higher education settings. These skills and knowledge include the following: generalized multimedia production knowledge and skills, emphasis of online learning skills, and the interrelationship between multimedia production and instructional design skills. After describing these skills and knowledge, we discuss how these results have influenced our own respective curricular practices, as well as anticipate future research studies that would provide additional understanding on how best to educate instructional designers working in higher education settings.

The Delphi panelists undoubtedly came to consensus that ID&T graduates need to be well-versed with a number of general multimedia production skills. Visual design principles, video production and audio production skills all were ranked high and were considered Essential by a majority of the panelists. Conversely, more advanced and specialized technologies (e.g., programming and green screen technology) are not as important and were ranked as Unnecessary. Also, there is a conclusive preference among the panelists regarding online learning applications and skills. Web design basics, online course pedagogy, screen-casting, and LCMS skills all were ranked as Essential. It is interesting to note that no specific computer-based instruction application besides Camtasia and Dreamweaver received an Essential or Important ranking. In fact, Delphi panelists were divided on the importance of specific software applications, including: Flash, Photoshop, Audacity, Fireworks, and Captivate.

In addition to these essential multimedia production skills, the panelists' rankings indicate an inter-relationship between instructional design skills and multimedia production skills. Even though panelists were asked about ID&T graduates' multimedia production knowledge and skills, eighty percent of the items from the Instructional design and pedagogy category (e.g., Knowledge of learner characteristics, Determining the appropriate delivery venue for particular content area, etc.) were ranked as Essential. Furthermore, Communication skills and Social skills were ranked first and second, respectively. This finding implies that ID&T entry-level professionals need a robust combination of general multimedia production skills and knowledge and overall instructional design skills and knowledge.

Implications

As Instructional Design and Technology faculty members, we were intrigued to receive these results from our panelists and are now considering curricular revisions for our respective courses. The results from our study indicate that multimedia production items cannot be taught in isolation and should not be linked to a particular software application. In previous semesters, our respective multimedia production courses were the default software application course (e.g., Flash, Authorware, Director, etc.). Currently, our students now use "lowest common denominator," computer-based instruction applications (e.g., PowerPoint) to teach particular computer-based instruction methodologies (e.g., tutorial). Our respective students are introduced to innovative technologies (e.g., Prezi), but the emphasis is not solely on the particular authoring tool, but on how to integrate this tool into overall, existing instructional modules. To highlight the interrelationship between multimedia production and instructional design skills, our students are now required to complete instructional design reports when creating a multimedia production project. We view these projects as instructional design "experiments" and students complete "lab reports" with each project.

The panelists' respective rankings and results also indicate additional areas to explore with regards to ID&T graduates' overall multimedia production and instructional design skills and knowledge. Inquiry into the changing role of the instructional designer with respect to these two skill sets, such as Schwier and Wilson's (2010) recent study should take place. A more in-depth understanding of what Willis (2009) refers to as process instructional design, such as a study on the best practices involving collaboration between instructional designer and client is encouraged as well. In addition,

case studies on how instructional designers effectively balance multimedia production and instructional design skills should be developed. These case studies could be used as instructional tools to teach novice instructional designers best practices in integrating multimedia production skills within an overall instructional design project.

In summary, the results from this Delphi study indicate that Instructional Design and Technology professionals working in higher education settings need to be educated about overall multimedia production skills and how these skills interrelate to their set of instructional design skills. As Instructional Design and Technology educators, we look forward to considering innovative and effective approaches to our respective curricula and to continuing this dialogue with other Instructional Design and Technology educators.

Application Exercises

- If you were to design a course for students in an instructional design program, what 3-4 areas would you focus on, based on the results of this study?
- Look at the list of skills that were ranked as Important-Essential by the Delphi panelists. Think of one or two of those skills that you could personally develop more in your life, and make plans to do so.
- After seeing the results of the study in this article, evaluate your own progress towards becoming an instructional designer. Do you feel like you are learning the soft and hard skills required for the job? How would you adjust your current plan to better align with what is required in the field?

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50

Careers in Academia: The Secret Handshake

Ana Donaldson & Sharon E. Smaldino

Much of a doctoral academic program is targeted toward finishing the dissertation and not enough time spent on what to do once you have climbed to the top of that mountain. Too often programs place emphasis on research as the singular most important element for faculty lives (Adams, 2002; Tierney & Rhodes, 1993). Many programs excel in preparing young professionals to engage in quality research endeavors, which is embodied within the excellent dissertation preparation these students receive. However, doctoral programs that are focused on preparing future faculty must consider the multiple responsibilities these young professionals will encounter as they enter the professoriate.

Many of the multiple lessons learned on the backward side of becoming a viable member of the faculty are learned through experience and an occasional troublesome journey off the accepted path. The guidelines for this journey have been termed as sharing the secret handshake; known only to those who have already found themselves comfortably situated in a secure academic position.

The following is intended to offer some guidelines and suggestions from our own experiences both on and sometimes off the path and from guiding others as they traverse this challenging terrain. Each journey is unique but here are some common obstacles and shortcuts that might assist you as you venture into your academic trek.

The Journey Begins: the Job Search

So, you've made the decision to enter the academic life of a professor. To embark on this type of endeavor requires you to consider several things including the selection of potential academic settings and locations, expectations – theirs and yours, and your qualifications for an academic position.

One of the choices you will be making early in your search is whether you will be looking toward a research-oriented or teaching-focused institution. Each one has it advantages and challenges. Whichever one catches your eye, remember for the majority of universities, scholarship is always emphasized. Also, the push for external grant funding also may differ from one institution to another. Your pre-visit research will help you to determine in which ocean you will chose to swim.

Let's begin with the "look." You are about to graduate from a quality doctoral program with a vast array of learning experiences and research opportunities to avail you of the potential for a great job as a professor. Think of it as your first day of Kindergarten. The big yellow bus pulls up in front of your house, you have to make a huge step up to get onto the bus (sometimes you falter), and then you have to walk down the long aisle (which seems like walking the gauntlet) to find a seat. All this before you get to the classroom. It seems nearly impossible, but if you are organized and have done your homework, you should find the process of fitting into an academic setting can be an exciting adventure. During your graduate program you have actually been socialized in terms of the academic setting and are better prepared for the job search than you may think (Austin & McDaniels, 2006).

As you have progressed through your program you have had many opportunities to learn about various college and university settings. Your efforts to learn about the array of programs and their course offerings in the field has led you to consider the type of institution you might prefer. It's always wise to spend time considering the differences in programs as each has its own unique culture and dynamics (some are known to be nurturing, others to "eat their young"). And, as you learn of position openings you begin to think about how you might fit into their program. Do remember they are seeking someone who will match their needs, so while you might think you are a "fit" you may find they don't agree. Don't be disappointed if you don't get the call to interview. They just had someone else in mind. It's ok, you've probably applied to several positions, so you'll be fine.

Selecting the institution to which to apply requires a bit of work on your part. First you should spend some time looking over the university and program websites to learn more about their dynamics and philosophy. Learn about the cost of living for that area and information about the community in terms of available housing, schools, support services, and social opportunities. You might find a great place but it is a 5-hour drive to the nearest airport and that might cause you problems when it comes to any travel expectations you might have. You might make a list of the things you need or want in a location, identifying what you are really looking for in terms of a location for working and living.

The Cover Letter

The job search commences with the cover letter to announce your interest in their open position. Do not assume anything as you prepare this letter. You may have met some faculty from the program, but you may not know who is serving on the search committee nor who is screening the letters. A single position announcement can elicit hundreds of letters of application (Adams, 2002). Your cover letter will mean the difference between being placed in the "consider" or "don't bother" piles. A carefully crafted cover letter can assure you of the first step in the process for being invited to an interview. In this very competitive world, it is always wise to have someone else proof-read the letter since a single error might automatically banish you to the wrong pile. The best advice we can offer is write to the identified qualifications and how your strengths align with those well. Also, it doesn't hurt to "stroke" their allegiance to their institution either. If someone in the faculty just received a noteworthy award, mention it. It shows that you've done your homework about them, which is often what impresses the committee. You've made the effort to consider them, now you are asking them to consider you. Sequence and terminology is also important. Address each of the the requirements in order using the same terms that are stated in the posting for the position. This allows the screeners to quickly complete a checklist to make sure you are included in the right stack for further consideration. And, include all the relevant materials they request, e.g. reference names or letters, transcripts, writing samples.

The Interview

Congratulations, you got the call to go to the campus for an interview. How exciting. This is getting your foot in the door. Be as flexible as you can in terms of arranging your visit. Most likely it will involve 2-3 days on campus. You'll probably be asked to present some aspect of your research agenda. You just finished that dissertation study, surely there is something there you can present to the faculty and students that will be meaningful and about which you have a vast knowledge. But, don't overdo that part; you want to appear prepared and knowledgeable, but comfortable as well. You'll be invited to have several meals with faculty and students. Be prepared to eat "simple foods" because your time there is not to eat well, but rather to continue the interviewing. Do request an opportunity to spend time with the students, perhaps over pizza. Much of your time will be spent socializing and talking about why you wish to be part of that institution and community.

One piece of advice is to arrange to arrive on campus earlier than the start of your interview process. It might help to have a whole day to wander around the campus, visiting the area, and learning a bit about the environment. If you are considering a position at an institution in a northerly location, you might wish to visit in January or February to get a feel for winter, especially if you're from the south and have never ventured to a place where there is an annual average of 10

feet of snow! You will want to see if you fit into the culture of the institution by doing a walk-about and getting a better feel for the place.

You should also consider questions you might ask while there. You've done your homework and know a lot about the institution and the program. But, you'll want to know more details about the work-load (what courses you'll be asked to teach), the responsibilities of a first year faculty member (advising, committee work), and options that might be available (research settings, resources, tenure-track travel support). Even as you are asking your own questions, the program faculty are considering how well you match with their interests and program needs.

There are a few cautions when you are interviewing that can affect how well you are received. It is very unwise to suggest that you'd like to work at that institution because it moves you closer to your family or your significant other just took a position in a nearby location. A large city nearby is also not a good reason for selecting that institution. It's good to be honest, but don't suggest you are considering their program because it is convenient for you. What is important is that you emphasize how well you believe you fit into their program and the asset you will be if invited to join their faculty team.

It is suggested to not mention salary or question benefits until you have gotten past the initial interview stage. It is a good idea to let them bring up the topic. When asked about salary, a safe reply might be: "I would expect my starting salary to reflect my level of experience and expected job duties." If the salary seems low, inquire about a six month review of your performance for an adjustment if waranteed. For public institutions, salary ranges are usually available on the university website that you have already reviewed in preparation for the visit. Sometimes the schedule includes a visit to the Human Resources office, which is where you can learn about the benefits that are included in the hiring package. Be sure to get materials about their health and retirement programs. While, yes, you may be still very young, it doesn't hurt to think about the day when you'll be one of the gray-haired senior faculty.

Tenure and promotion are part of the ritual of becoming a member of the faculty. And, the process largely starts on your first day at the university. The university search process costs a lot in terms of money and time and you were the one selected. That's great news! You're first step on the way to becoming a professor has been actualized. And, in that process, there are considerations that you should keep in mind. You need to be well informed as to the actual institutional expectations and how they are managed within the program/department and the university. It's best to get started as soon as you get the key to your office, find it, and figure out where to find the office resources you will need (like a stapler). It is also wise to be cordial to the individuals with the true power (Administrative Secretaries) who make sure all paperwork is handled efficiently and that you are advised of any office policies that need to be followed.

Pre-tenure Warnings

Sometimes the most important lessons are learned through the most difficult circumstances. A very applicable example is when the president of the university asked the faculty members if there were any questions during a faculty-wide beginning of the semester meeting. Not realizing that this was a rhetorical question for non-tenured faculty, I [Ana] asked why the university was not supporting minority recruitment for the coming semester. The question was met with silence and then a mumbled reply about investigating the question further. I had just left the auditorium when the provost came leaping over tables and faculty to grab me by the shoulders and ask "who the hell are you?" Fortunately the local press was not at the meeting and this was not the year I applied for tenure. When I returned to the department and shared my question, my mentors [Sharon and Mary] very patiently and firmly explained that: "I was to keep my non-tenured hand in my lap, my non-tenured mouth shut, and my non-tenured bottom in my chair." Up to this point, in my four years at the university, I had innocently believed that I had a voice as a faculty member. For the next year, I learned to keep my mouth firmly shut when asked for faculty input. The awarding of tenure and promotion to Associate Professor the following year, finally gave me the voice that I thought I had all along.

Rick West shared with us that his experience as a new faculty member at BYU was just of opposite of the above example. He was encouraged to have a voice and contribute to the faculty decisions prior to T&P. This is why it is so critical to know the players on the field and to make sure that you all are wearing the same uniform on the playing field.

In addition, it is advisable to be seen in your office and to regularly attend department meetings. Your effort to make time to be part of the faculty is also an essential element to being a member of the team. If you are absent, make sure someone knows that you are attending another meeting or going out of town to a conference. And, when you do attend program and department meetings, don't bring your knitting or model airplane kits, and please don't do your email. You want to demonstrate your interest in learning more about how you can be an active member of the institution.

And, finally, don't volunteer for everything. Your time is valuable. I [Sharon] was advised that I was probably not born with my right hand raised high in the air, nor that my first words were most likely "pick me." It's a challenging. year, don't make it worse for yourself by taking on too much or alienating the people who wish to make you an integral part of their program.

How to Work With the Tenured Faculty

Huber (1992) wrote a book entitled *How Professors Play the Cat Guarding the Cream* in which he suggested that you need to be cautious about balancing your responsibilities between teaching, research, and service. He offers that it's not all about the research, that there is importance to considering your teaching and service. But, you will hear from those sharp-clawed cats (tenured professors) that teaching and service have little value. In truth teaching takes up a huge portion of your time those first few years. You have to prepare the courses, grade papers, meet with students, and perhaps work with the curriculum team to be sure that what you are doing is a good fit to the program. The critical piece of advice from Huber is to keep your responsibilities balanced.

The Role of Mentoring

If possible, a buddy or mentor within the program can help you make some good decisions about what types of things you might take on that first year. "Effective mentoring relationships enrich the professional world. They bring joy and benefit to all concerned" (Cates, 2016, p. 186). You might join a program that assigns someone to serve as your mentor. That can be a valuable way for you to learn about the program and your colleagues.

Cates (2016) advised that "effective mentees come to their mentors well prepared. They have done their homework: reflected on their wants, needs and strengths; investigated their options; and explored what is available" (p. 186). This is very true within a formal mentoring relationship. But, it is wise to consider finding someone on your own as well. My [Sharon] informal mentor was a gal who always kept the teapot handy and the water warm. She was a member of a different department within the college, but we struck a chord in our discussions which led us to understand that whenever one of us needed an ear to hear our tale or a hand to shake us awake, the tea would be ready in 5 minutes. Either one of us could call the other and in 5 minutes we met in a little out-of-the-way room where we could sit and talk. In that time I learned to listen and to think about how to make the best of something that seemed insurmountable at the time. What I learned from her guided me to become a mentor to others, with some who became my best friends. In fact, it lead to the creation of the Sisterhood of the Traveling Bus… ahh, but that is another story for another day.

Setting the Plan in Motion

A valuable AECT Tenure and Promotion Guide is free to all AECT members: https://edtechbooks.org/-Lr

We recommend that you review it for a diverse perspective of what we and others have suggested for your own success.

It is customary to create a four-binder (or digital folder) approach to keeping your materials for the tenure and promotion process organized. One binder should hold general information that will include you teaching philosophy, current CV, and other general items. The second one will be for scholarship, which you have listed on your CV, but you

do need to keep the actual publications. These two are followed by one for teaching and another for service. It is critical to update these each year as if this was the year you were going up for consideration.

During your years prior to the T&P major hurdle, remember It is important to be balanced in the three key areas:

1. Scholarship: be publishing each year. It is helpful to determine the expectations for publications for T&P and always publish one more. Keep a copy of the published article in the binder along with information about the peer-reviewed journal or publication. A good idea is to get a publication out of each presentation at a conference. As a reminder of your visibility in the field, hang each conference name badge in a visible area of your office. Sometimes it surprises new faculty to learn that a peer-refereed journal counts more than a book in most institutions. If you are invited to co-author a book, suggest that you are honored, but that your focus is to continue your research agenda before advancing into the book preparation phase of your academic career. You may well be invited later by the original author.
2. Teaching: Keep track of all teaching evaluations and the little notes of appreciation from students. Include an explanation of how you have used evaluations and suggestions to improve your instruction over time. As part of your general statement and philosophy, add reflective comments on how your teaching has evolved over time with an emphasis on student learning.
3. Service: Show service at the program, department, college, and university levels as well as for local, national, and international organizations. AECT is a great place in which to demonstrate active international service since the door is always open at the division and leadership levels. The best university services options are those with high visibility and low time commitments. Many times new faculty are asked to take roles that might detract from primary responsibilities. If you find yourself having difficulty saying NO, then you might ask yourself if the added task directly leads to tenure. If not, consider thanking the requesting individual for the thought, but then explaining that you need to focus your efforts at the present on tenure and promotion. Always leave the door open for these added duties once you have achieved your professional advancement goals.

Your T & P package needs to reflect not only who you are as a scholar, instructor, and professional member currently but also as a reflective road map of how you got to this place in the your journey. Leave no question in the minds of the T&P Review Committee that you are ready for this professional advancement and continued commitment to the university.

Preparing Your Tenure Package

The creation of the T&P package usually occurs after the fifth full year at an institution. Most universities do not encourage early consideration due to cross campus politics that may be out of your and the department's control. Prior to the 6th year application, a 3rd year review is usually held to make sure you are on track. The results of this review are critical as an indicator of shortcomings or balance concerns.

The traditional 3rd year review can be very illuminating. Take the advice offered in order to strengthen your package. If the letter suggests you need to focus on something more, e.g. less service and more scholarly publications, then cut back on the number of committees or find ways to increase your publications through collaborations and advancing students' engagement in research. Remember that those conference presentations can often be turned into a publication with a little effort. Also, be aware that you want your publications to reflect the priorities of the program and university. For example, if you are in an institution where research is emphasized, then you will want more referred publications. If you are in a teaching-centered institution then more application types of journals may be applicable. It's wise to ask your colleagues about where the emphasis is and what journals are recognized.

One key concept that many new faculty miss is that you do not truly have a secure position until you have achieved the initial tenure and promotion advancement. You will spend the first five to six years holding your breath and working as hard as possible to be recognized as a valued permanent member of the team. Balance is the magic formula to help make this happen. Not only balance between the three areas of evaluation but also balance between your professional and personal lives.

Applying for Tenure and Promotion

Generally you will be asked for a list of potential external reviewers when you start the actual T&P consideration stage. Keep networking at conferences and meetings to gather ideas of who might be good choices for external reviewers. Select people who are engaged in similar types of research or have similar types of positions (although of higher rank, e.g. associate or full professors). Keep in mind that your program people will also offer names. Most institutions will not allow you to offer the names of those with whom you have had direct work experience, e.g. your major professor, a co-author, a co-presenter. You will not know who got the invitation to prepare an external review, but like your job application, put your best foot forward with the materials you prepare for the reviewers. You will not see the letters that these reviewers write either; just get over it.

Find an advocate to guide you through the T&P process. This person goes beyond the role of mentor because the person speaks for you and contributes to guiding T&P committee decision process. Your advocate becomes your voice during the T&P committee deliberations. Many times your program is within a larger department with multiple programs represented. Your advocate helps to identify the importance of your work both within the department and university as well as those "outside" organizations and agencies you serve.

Learning the Secret Handshake

As stated before, often we receive mixed messages in the academic setting. It is important to make sure everyone is on the same playing field and wearing the same uniforms before starting the game in earnest. Prepare yourself by gaining an understanding of how to fit into the program/department/college culture in order to be successful. Sometimes this takes an initial period of lurking. Getting involved in office politics as a newbie is never a wise choice. When the dust settles, you might find yourself cheering for the wrong team.

The one thing never taught in many doctoral program is how to navigate the politics of academia. It is important to remember the faculty dynamics that exist in even the most nurturing of environments. Traditional faculty members have always been the best at whatever they have done: best grades, top honors, and the center of attention in the classroom. This can lead to a bit of a diva-syndrome. When you have a gaggle of divas trying to direct policies it can become a bit daunting. You want to make sure that you keep yourself steady and to keep focused on what is important to you, getting through tenure!

Choose Your Battles Carefully

There are numerous examples of how many times you will encounter resistance to new ideas. You need to take stock of why you consider the new option as a better way. And, then you need to think about the potential for alienating yourself from your colleagues. Some ideas might be benign and won't affect the others very much, which makes it possible for you to make the change within your class with little interference to the overall picture. For example, if you have a special opportunity to do research in another state, but need to have about four weeks to be in that setting, it might be possible to offer your evening course over 12 weeks rather than the traditional 15 by extending the class meeting times a little each week. You can be certain that you've met the demands of the institution in terms of contact hours, and you can assure the students that they are not short-changed in terms of the content. Thus, you can "end" the semester a little early for you and keep that research opportunity viable.

However, when you decide that a creative schedule of multiple sections of a course would be beneficial to meet your needs (and you assume the students' as well), but that schedule reeks havoc with the entire college schedule, then you might want to scale it back a bit to be sure that your idea does not affect colleagues, especially in other departments. It was Sharon's creative idea to have all day Wednesday serve as "edmedia day" so that all 6 sections of the educational media course for all teacher education candidates could be completed in one day. After answering the call from the Registrar's Office about how that could be done, I had to go to the Dean's office to explain my idea. It was not so much the idea of an all-day edmedia day, it was that my idea affected six other departments and many faculty and courses. Good thing I had tenure then!

Final Considerations

Balance your life between faculty responsibilities and your personal life. The first two years are going to be daunting due to many new course preps and having to establish your research agenda in earnest. Your personal life does not have to be put on a shelf, but you need to figure out how to make it work for you. Some people have done such simple things as getting up an hour early to spend time leisure reading or exercising to be able to be with family for a short time before the "rat race" begins. Others have learned to take time in the middle of the day to go swimming in the community pool to meet people beyond the department faculty. Others have joined a community group, social or religious, that offers opportunities to meet people outside the university entirely. One of us [Ana] also found it important to schedule time with her retired spouse during her last two years at the university. My shared calendar was marked off as personal development for every Thursday afternoon. This was my special together time with my husband. Many days found us together on a local river in a canoe. I found this to be extremely important while I was working primarily online with the expected 24/7 access for students and other faculty. .

The idea is do not find yourself having to wear a name tag stating, "Hello, my name is _____." You want to be sure you can find ways to continue to engage in social activities. And, don't forget that hobby or musical instrument. You need to block off time that is for you to decide how you want to make use of it. Do not do work. Oh, you'll block off time for research, that's true, but this is that special "me time" that so many of us forget to set aside in our early careers. Make the time, you won't regret it.

Summary

Ours is not the first attempt to provide guidance to others on this professional and personal journey. Each list of recommendations provides another perspective on each individual's challenges and triumphs. In summary, the following is a list of 19 lessons offered by Dr. Bob Reiser from his own journey and his extensive work with students. The lessons bridge both academia and business instructional design positions but many are shared between the two areas. Some are stated as reinforcement to what has been shared and others offer an additional contribution:

1. Use a wide variety of sources that list instructional design job openings.
2. Most instructional design positions are in business and industry.
3. Most high-paying instructional design positions are in business and industry (also known as "the faculty members' lament).
4. Learn how business operates.
5. Acquire a strong set of skills in the production of instructional media.
6. Acquire a strong set of design (and analysis) skills.
7. Acquire some management skills.
8. Develop a strong set of communication skills.
9. Don't be discouraged if you don't get the first job you apply for.
10. Don't be discouraged if you don't get the second job you apply for.
11. Become active in professional organizations.
12. Publish, don't cherish [share what you have learned].
13. Don't be dejected if your manuscript is rejected.
14. Develop an area of expertise.
15. When preparing for a job interview, find out as much as you can about your potential employers.
16. Keep up with the literature in your area of interest.
17. Let your professors know you are looking for a job.
18. (Prerequisite for Lesson 17) Demonstrate to your professors that you do good work.
19. If the job doesn't fit, revise it; apply for jobs that interest you, even if you don't have the exact qualifications advertised. (Reiser, 2012, pp. 257-261)

Even though Bob Reiser's list seems more focused on the corporate side of the professional field, many of his ideas can be adjusted to the academic side of the profession. We have offered our ideas and suggestions of how to leap over those hurdles you may encounter. But, we can also state that all of this is worth your efforts. You have much to offer, but to be able to move forward, you must follow a path that gives you the voice that will be heard by others. Your path might be different than the one we described, but if you are wise and thoughtful, you will be successful in your endeavors.

Application Exercises

If you are interested in a career in academia, search for several faculty positions and look at the job description. Pay attention to the job responsibilities and qualifications. What do you learn from this experience?

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51

Careers in K-12 Education

Drew Polly & Kay Persichitte

Never in the history of K-12 education in America has the access to and demand for using technology to support and extend learning and improve teaching been greater. That said, all indications are that these expectations will increase for teachers to effectively model, use, and integrate technologies in their classrooms and in their own professional development. The 2017 NMC Horizon Report (available at https://edtechbooks.org/-nN) cites these key trends (pp. 10-20):

- Long-term (5 or more years): advancing cultures of innovation and deeper learning approaches;
- Mid-term (next 3 to 5 years): growing focus on measuring learning and redesigning learning spaces;
- Short-term (next 1 to 2 years): blended learning designs and collaborative learning.

Getting and succeeding at a job in K-12 already requires K-12 teachers to have experience with contemporary technologies, a desire to maintain their technology skills through continuous professional development, and a willingness to become leaders in the integration of educational technologies to improve student outcomes. These trends specifically focus attention on key areas of the field of educational/instructional technology including instructional design (e.g., learner assessment, media use, instructional strategies), distance learning, digital technologies, and affecting change in the K-12 setting.

In particular, these short-term and mid-term trends will require instructional personnel in schools to model, use, and integrate technologies in ways that teachers may not have experienced in their teacher preparation program. Examples include contemporary shifts to flexible learning environments, active or experiential learning pedagogies, supplementing face-to-face instruction with online (blended) instruction, flipped classrooms, virtual learning, cognitive tutors, maker spaces, and incorporating mobile technologies within all kinds of learning settings.

So, what are the employment prospects in K-12 for the near future? The National Center for Statistics (NCES) offers insights based on the latest available school data (Fall 2016) for both public and private K–12 schools. The report (available at https://edtechbooks.org/-yZ) documented increasing public school enrollment in Fall 2016, with public school systems employing about 3.1 million full-time-equivalent (FTE) teachers resulting in a pupil/teacher ratio of 16.1 to 1, close to the 2000 ratio of 16.0 to 1. Private schools were projected to employ .4 million FTE teachers with a pupil/teacher ratio of 12.2 to 1, compared to a ratio of 14.5 to 1 in 2000. The NCES continued with these projections:

- The number of K-12 teachers needed is projected to increase 8% between 2011 and 2023.
- Pupil/teacher ratios for K-12 are projected to decrease to 14.9 to 1 by 2023.
- New teacher hires in public schools are projected to increase 32% between 2011 and 2023.
- New teacher hires in public schools are projected to increase 32% between 2011 and 2023.
- New teacher hires in private schools are projected to increase 19% between 2011 and 2023.

Indeed, the opportunity for employment remains strong for the classroom teacher who is ready for the challenges of the 21st Century learner.

In this chapter, we will explore how to get and succeed at a job in K-12 including the skills, knowledge, and roles of school personnel related to the field of educational/instructional technology, suggestions for professional development, and developing a professional community of support.

Skills Knowledge, and Roles

In today's school districts, there are technology skills required of every person, and the number of specialized positions continues to increase over the last couple of decades. Depending on the position assignment, those skills and the requisite knowledge to demonstrate those skills will be very unique.

Classroom Teacher

Most states in the United States require a K-12 classroom teacher to obtain a teaching license from an accredited teacher education program. The skills and knowledge related to technology integration in K-12 settings for classroom teachers are heavily related to the design of instructional activities and learning environments that actively engage learners with content and the appropriate integration of educational technologies. There are numerous resources that elaborate on the effective design of instruction and integration of technology (e.g., Puentedura, 2014;Smaldino, Lowther, Mims, & Russell, 2014). The intended audience of this chapter is most likely not classroom teachers, but those professional roles below who will be working with classroom teachers.

Building-level Technology Specialist/facilitator

Building-level technology specialists and facilitators work in schools to oversee and provide support to school personnel about the use of technology. Most of these jobs involve basic technology support with hardware, software, and connectivity, which require individuals to troubleshoot and be the first line of technology support. These jobs in some states and school districts may also involve teaching courses (for instance, media use or technological literacy).

In elementary schools (typically Grades K-5), students typically spend 45-50 minutes every 5 or 6 days in a computer lab for dedicated technology time. The building-level technology specialist, in these cases, serves as the technology teacher, working with students on technology-rich projects, or other technology-based activities. In middle and secondary schools (typically Grades 6-12), the building-level technology specialist/facilitator works with classroom teachers to provide consultation about using various technologies to support teaching and learning. In all of these cases, opportunities for these building-level technology experts to work with teachers on the design of technology-rich instructional activities varies greatly; in some cases these individuals are expected to be well- versed and knowledgeable of only specific technology(ies), and in other cases they are expected to be experts in both instruction and other topics related to technology use.

Individuals who work in this role typically hold, or are in the process of earning, their state's technology specialist endorsement. Earning this endorsement usually includes taking courses in a graduate certificate or master's degree program. Some of these programs also require the completion of a successful internship in a school setting. Since these requirements differ in various states and in some cases districts, those interested in this role should make inquiries about specific requirements for this role. Some districts offer part-time assignments as technology facilitators combined with the classroom teacher role.

Media Specialist

The contemporary media specialist (aka the library media specialist) typically has a Masters degree either in the field of educational/instructional technology or in a post-baccalaureate program that has emphasis in technology integration, multimedia development, or school media. Some states require a special license or certificate for these positions and some allow a bachelor's degree with other academic coursework. Media specialists generally must document prior experience in elementary or secondary education and knowledge of technology use and integration. Because they serve

the entire school community, they must have good oral and written communication skills and they must demonstrate effective interpersonal relationships with students, staff, and parents.

Media specialists must have basic librarianship skills such as the ability to select and provide access to a wide variety of materials which meet the needs of various learning situations as they interact to support teachers, as well as the knowledge and ability to teach information and technology literacy. The most common requirement is the knowledge and ability to work with technology and assist integration in the classroom. The media specialist does not typically serve in a technical or trouble-shooting role for technologies used in the school, but this may be an additional expectation in smaller or rural settings. In this era of mobile devices, media specialists may be called upon to develop policy statements regarding use of and access to mobile devices, student computer use, digital privacy, internet safety, student or faculty access to and use of copyrighted materials, and/or other topics related to technology in schools.

Media specialists are usually hired on a faculty contract that includes tenure and some additional days of responsibility at the start and end of the school year. Success as a media specialist requires frequent professional updates related to emerging technologies and their potential for supporting or extending instruction. One such area that has grown significantly in the last decade is blended learning. As the flipped classroom model has become more popular, the expansion of student access to classroom materials and the teacher through a combination of online, face-to-face, and/or synchronous computer-mediated technology has proliferated. The media specialist may be the bridge to these innovative instructional environments for faculty and parents. Many states have a state level professional organization for media specialists to share and collaborate on a regular basis.

District Level Technology Leader

Almost all districts now have at least one person in an administrative technology leadership role. These people often have extensive classroom and technology integration experience with graduate preparation that included both the academic and the technical aspects of the field of educational/instructional technology. They are usually responsible for developing, implementing, and updating a district-level technology plan. These administrators will also be responsible for managing budgets, purchases (e.g., comparing options, contractual agreements, user plans), installments, warranties, service and/or upgrade agreements, insurance coverage, and safety for all technology in the district. They may play a major role in the development of district level policies related to technology and, at a minimum, they have the administrative responsibility for the fair and legal implementation of all such policies. They have supervisory responsibility that varies but often includes district “technicians”: personnel who have technology maintenance and installation roles not related to students or faculty. District Technology Leaders usually interact closely with the local school board, superintendent, other academic administrators (including principals), and sometimes the media specialists.

District technology leaders are typically hired on “at will” administrative contracts that are year-round and may stipulate a term set for review and renewal. They are often members of the Council of Chief State School Officers (CCSSO) (see http://ccsso.org/). The CCSSO offers regular workshops and professional development opportunities related to contemporary and emerging technology use and integration issues. These individuals typically have served as a school-based technology specialist before taking on this larger role.

State Technology Leader

State technology leaders are typically entrenched in the communities of both K-12 education and educational policy. Like district-level technology leaders, these individuals have to manage and work with budgets and contracts, and help to make sense of federal or state policies related to technology access or technology tools that influence the work of school districts and personnel in K-12 settings.

In many cases these state technology leaders work closely with other state leaders from curriculum and instruction, assessment and accountability, school performance, accreditation, and other divisions within state departments of education. In the past decade one of the larger issues has been the increase in administering high-stakes state assessments via the internet on laptops and desktops. In many cases, state assessment and accountability leaders

must work with state departments of education to make these decisions and to set policy and implementation guidelines. State technology leaders also advise and consult with state department of education personnel and other state leaders to ensure that adequate connectivity and infrastructure are in place for high-stakes assessments to be administered online.

State technology leaders also have potential to influence and drive policy and initiatives that influence the entire state. For example, many states who have endorsed and implemented initiatives to turn classrooms into 1-to-1 technology-rich environments do so only through funding and political support driven by the state department of education and other state technology leaders. Another example is the growing demand for blended classroom options in K-12 settings, which also relies on extensive internet access, strong infrastructure, and personal access for students to computer-based technologies outside the classroom. Most state technology leaders have served as district technology leaders prior to taking on this expanded role and they often rely on their colleagues in surrounding states for sharing ideas about new opportunities or state-wide initiatives.

Professional Development Facilitator

Professional development facilitators support the integration of technology in K-12 settings by working directly with teachers, school-based technology specialists, media specialists, and district technology leaders. Professional development facilitators either work in this role full-time or serve primarily in another role and facilitate professional development as an additional or secondary responsibility. These individuals are well versed at working with district and state leaders to identify teachers' needs, and then designing and implementing learning experiences to support teachers' use of educational/instructional technologies.

Individuals in this role are usually members of the International Society for Technology in Education (ISTE) as well as the state affiliates of ISTE. In some cases, these individuals are also a member of Learning Forward (formerly known as the National Staff Development Council), which focuses on issues related to teacher professional development.

For those interested in this work, a good starting point is to initially facilitate sessions at district, state, and national educational technology conferences. This initial work will give professional development facilitators experience about planning a short professional learning experience for teachers and allow them to work with teachers in a lower-risk environment. Partnering with other professional development facilitators may also provide experience with the development and delivery of professional development workshops that extend or enhance introductory professional development activities.

Developing A Professional Learning Network (PLN)

For those seeking jobs in K-12 settings as an educational technology leader in any of the roles described in this chapter, it is essential to develop ayour professional learning network (PLN) through the use of social media, especially Twitter and Facebook at this time. Occasionally educational organizations or bloggers will post a list of recommendations on who to follow. Here are two recent ones to check out: https://edtechbooks.org/-Qs and https://edtechbooks.org/-tF. The development of a PLN is recommended for a few reasons:

1. A well-rounded PLN that includes teachers, educational technology leaders, and educational technology organizations increases the likelihood that professionals will stay abreast of technologies and innovations that are being used in K-12 classrooms.
2. Educational bloggers typically tweet out or post on Facebook their recent blog posts. It is more efficient to read social media posts and click on longer blogs and articles for those topics that are of interest instead of subscribing or reading several blogs weekly.
3. Twitter Chats have gained popularity over the last few years. These occur when an individual or organization hosts a Twitter chat by posting a series of questions to which others respond, creating an asynchronous, open conversation. Twitter Chats are a great way to learn a lot of information about a topic, exchange many ideas in a short period of time, and expand a PLN by engaging with others.
4. Networking leads to professional relationships. By being active on social media and participating (reading, posting, and responding to others), educators are forming a professional network that leads to professional relationships with others who share your interests and offer greater variety of experiences and supports.

As educators think about their social media presence and the development of a PLN, they need to be very cognizant of what they post Educon social media and how others may interpret posts on accounts that are not related to education. They might want to consider keeping a social media account for professional use and a separate one for social personal use. If the same social media accounts for both professional and personal accounts are used, users should be responsible about what they post or photos that they are tagged in or associated with. Many employers, especially in K-12 settings, are very sensitive to the social media presence of potential employees. Also, remember that in this era of "Googling" everything, a current or future employer, the students' parents, and/or the students, themselves, may choose to "Google" the educator and find all his or her social media activity. Educators must always remember that they have a professional reputation to protect!

Success as a K-12 Teacher

In order to be a successful educational technologist in K-12 settings, the skills and knowledge needed are detailed above and vary by position. However, regardless of what position(s) educators are seeking in K-12 settings, there are a few recommended dispositions that will likely contribute to success.

Collaborate

K-12 settings are collaborative environments that require all school personnel to work together for the common goal of supporting student learning. The path of an educational technologist in K-12 settings (regardless of specific role) is likely to intersect with administrators, teachers, building-level instructional leaders, as well as district and state leaders who focus on administration, curriculum, and testing/accountability.

Typical work with people in these various roles will be to problem solve, troubleshoot, and plan technology-related efforts to support teaching and learning. Since these different roles represent different interests and each requires a unique niche of expertise related to K-12 settings, successful K-12 educational technologists must be adept at listening to and working with others from different backgrounds, both professionally and culturally. In preparation for this work, educators' knowing as much as possible about the roles, responsibilities, and backgrounds of the individuals they interact with increases the likelihood that their interactions will be positive and beneficial.

Embrace Flexibility

The world of educational/instructional technology is ever changing, as new tools are developed and new devices are proliferating. K-12 settings may change rapidly too, as initiatives from district and state boards of education and superintendents serve as a catalyst for new projects. As individuals in these leadership positions change, it is important to maintain a perspective of flexibility, and cope with these changes with an attitude of, "How can I positively contribute to these new efforts?"

The ability to be flexible is also important when working in school settings with administrators and classroom teachers. Research indicates that technology is likely to be used by teachers who feel supported to use technology and who have access to onsite help in their school building (Glazer, Hannafin, Polly, & Rich, 2009). Since school-based technology leaders work closely with classroom teachers, they should be ready to roll with the punches and be flexible if teachers change their minds and modify planned technology-related lessons and projects. Educational technology leader in a K-12 setting often your job is to provide consultation and brainstorm ideas with teachers and other school personnel to help them make decisions that they feel are most likely to support success for their students.

Maintain a Learner-centered Perspective

In technology leadership roles, learners include educators the leader is working with, as well as K-12 students. A learner-centered perspective includes knowing the background, interests, and needs of learners, and then ensuring that learning opportunities support the development of related skills and knowledge, regardless of the age or context of the learner. In the case of a building-level educational technology leader, this could include doing a survey of teachers' technology interests and needs and planning professional learning opportunities and resources to support teachers. It may also include working with administrators and curriculum leaders to identify topics and concepts that are difficult to learn and then developing technology-rich experiences to support the learning of these concepts.

For district and state educational technology leaders who are more removed from K-12 students but who work closely with other district leaders, the idea of learner-centered work may include analyzing the needs of districts and schools in terms of technology access, technology professional development or interests, and working on developing and refining initiatives to help meet those needs. Without a doubt,: learner-centered work is not the roll out of canned and one-size-fits-all professional development, projects, or new technological tools. Further, learner-centered work is also not a one-time experience that assumes implementation without follow-up and support. Research shows the benefit of ongoing, comprehensive support that is relevant to the daily work of learners (Lawless & Pellegrino, 2007; Polly & Orrill, 2012).

Be a Lifelong Learning Learner

As stated earlier, educational technology work in K-12 settings requires keeping up with changing infrastructure, technologies, audience demands/needs, and approaches to teaching and learning in classrooms. To be successful in K-12 settings, being a lifelong learner who seeks out new information is essential. Most school districts and state departments of education mandate professional learning experiences for all employers. These may include workshops, courses, and conferences. Such opportunities to stay on the cutting edge of K-12 uses of technology are invaluable and should definitely be taken advantage of.

Summary

The potential for educational/instructional technologies to support, enhance, and extend effective teaching and improved student learning is documented in the research and literature over many decades now BUT there continue to be examples of the misuse or inappropriate use of technology in our schools, as well. The need for all instructional personnel to understand and implement basic instructional design skills with technologies cannot be overemphasized. The proliferation of blended learning options in K-12 is a global phenomenon. Instructional personnel may also find the chapter by Persichitte, Young, and Dousay (2016) useful. In it, the authors distinguish blended and online learning settings, discuss a variety of types of learner assessment, and describe contemporary trends, challenges, and recommendations for the effective assessment of learning in blended and online courses. The content targets teachers, instructional designers, administrators, and program managers of K-12 blended and online learning settings. Suggestions are included for using web-based communication tools for feedback and assessment and the authors conclude with a discussion of implementation topics associated with assessment in these learning environments that deserve additional attention and consideration.

The jobs described in this chapter have great opportunity to influence improved technology integration in K-12 settings and improve learner outcomes. Though this MIT report (Willcox, Sarma, & Lippel, 2016) was focused on reforms in

higher education, we think this idea of a dynamic digital scaffold is relevant to instructional personnel in K-12 schools, as well:

> *…dynamic digital scaffold—a model for blended learning that leverages technology and online programs to help teachers improve instruction at scale by personalizing the students' learning experiences. Technology will not replace the unique contributions teachers make to education through their perception, judgment, creativity, expertise, situational awareness, and personality. But it can increase the scale at which they can operate effectively (p. 39).*

Examples of such personalized learning are being documented in technologically-rich, face-to-face classrooms and in the emerging K-12 virtual learning classrooms. So this comment from the National Education Policy Center (NEPC) press release for Virtual Schools Expand Despite Poor Performance, Lack of Research Support, and Inadequate Policies reminds us of the system-wide nature of the work of educational technology professionals in K-12 settings:

> *An analysis of state policies suggests that policymakers continue to struggle to reconcile traditional funding structures, governance and accountability systems, instructional quality, and staffing demands with the unique organizational models and instructional methods associated with virtual schooling (Molnar, 2017).*

Final Advice

We close this chapter with a few suggestions for those looking at career options related to educational technology in K-12 systems today, knowing that technology integration skills and instructional design knowledge can be the "edge" that gives job seekers the advantage in a K-12 search for any of the positions described in this chapter.

- Take advantage of as many opportunities as possible to expand professional and personal uses of technology.
- Take care of your social media presence in all situations and in all media.
- Take active steps to develop a PLN and nurture its growth as a career progresses.
- Expect that the future will include expectations that educators use technologies to connect and communicate with parents, learners, and others in ways not yet anticipated.
- Consider career options that blend instructional expertise with interest and experience with technology.

Additional Learning

These organizations are helpful for learning more about careers in this area.

- Edutopia - https://www.edutopia.org/
- Gates Foundation - https://www.gatesfoundation.org/
- International Society for Technology in Education - http://www.iste.org
- Learning Forward - https://learningforward.org/
- Lumen Learning - https://www.lumenlearning.com/

Application Exercises

1. Talk to a district K-12 administrator. What is he/she looking for in a potential new employee to fill one of the positions listed in this chapter
2. Look online at the faculty/administration at a school/district or state office of education and identify which positions may fit the descriptions in the chapter. For example, the a school district employs an Educational Technology Specialist, an E-School Coordinator, and a Tech Integration Specialist, though it isn't clear if these are real LIDT positions or not.

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Please complete this short survey to provide feedback on this chapter: http://bit.ly/K12Careers

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52

Careers in Museum Learning

Making a Difference in Museums Through Instructional Design

Stephen Ashton, Kari Ross Nelson, & Lorie Millward

Museums have a long and storied place in communities around the world. From the smallest hamlet to the largest metropolitan city, museums are places where people go to understand the past, to inform their present, and to gain insight into and even influence the future. Many principles of instructional design allow museum professionals to create visitor-centric organizations, spaces, and programs that help museums become embedded within their communities as trusted places of learning.

In this chapter we will address why and how a museum may use instructional design principles to understand its purpose, hone its mission, and create environments and programs that matter to their visitors. We will discuss the role of informal learning and design thinking in a museum context and will discuss museum careers that are relevant to instructional designers and how one might prepare for them.

The range of museum types is as diverse as people, and each museum has, or should have, a clear purpose guided by a focused mission. Some museums are collections-based, meaning they exist to collect and care for objects, artwork, or scientific specimens, while other museums are experience-based, meaning they exist to engage visitors in some type of activity to fulfill their purpose.

For example, a natural history museum's purpose may be to collect specimens and conduct and share research on the plants, animals, and geology of a particular area. To support this purpose, this museum might have a mission to interpret ongoing research through engaging exhibits and programs that feature their collections so that visitors may gain a better understanding of the natural history of the area.

On the other hand, the purpose of a children's museum may be to promote healthy physical and cognitive development in early childhood. To support this purpose, this museum might have a mission to engage the whole child through imaginative play, storytelling, and hands-on investigations, using interactive exhibits and immersive spaces that invite children to participate in playful learning.

As community needs, demographics, and/or understandings change, so must a museum's purpose and mission. Without adapting, the museum will likely lose its relevancy, and potentially its funding. This is why principles of design thinking, are vital for a museum in developing a purpose and mission that matters to its constituents.

Informal Learning in Museums

According to research conducted by museum researchers John Falk and Lynn Dierking, only 5% of learning happens in a classroom setting, which suggests that the bulk of it happens outside of the school environment and extends over a

lifetime. Informal, lifelong learning experiences include pursuing a hobby, discussions with family and friends, watching television, surfing the internet, reading, exploring the outdoors, and visits to museums and similar organizations (Falk and Dierking, 2013; see also Boileau, 2018, in this book).

Museum environments are designed to promote free choice, meaningful learning. Their galleries, exhibits, and programs present multifaceted, dynamic portrayals of science, art, history, and other topics, and allow visitors significant choice and control over what and how they learn. They encourage direct and/or facilitated experiences with content, phenomena, and objects; engage visitors physically, emotionally, and cognitively; and provide opportunities to connect new information to prior knowledge and personal interests (NRC, 2000).

Free choice learning in museums is powerful because, unlike school, with a set curriculum and progression, people choose to visit the institutions that hold collections or offer experiences that appeal to them personally. While in the museum, visitors can engage in exhibits and activities of their choosing, which essentially allows them to curate their own learning experiences. For this reason, museums often present differing levels or complexity of content, multiple perspectives, and personal facilitation.

Design Thinking in Museums

In this section we will discuss design thinking in a museum context. Rather than go into great detail about the history and varieties of design thinking, as was thoroughly done by Vanessa Svihla in the "Design Thinking and Agile Design" chapter of this book, we will highlight how museums are incorporating different aspects of design thinking into their practice.

Understanding the Museum Context

The use of design thinking in museums is a relatively new trend in the museum field. Traditionally, museums were established as object-oriented facilities with the role to preserve precious objects (Educational Facilities Laboratories, 1975). Museums were seen as the authoritative source of knowledge about these objects. Curators decided what was important for the museum visitors to learn. However, in the mid 1900s some museums, particularly children's museums and science centers, made the shift to become hands-on, experience-oriented institutions (ibid.). Over time many other genres of museums also made this transition from a "look but don't touch" approach to providing engaging learning experiences. Museums started to embrace a constructivist view of learning, which meant museum visitors could draw their own conclusions about museum objects rather than being dictated by the museum curators. More emphasis was placed on the visitor and less on the collection.

For example, in the late 1990s the Exploratorium, an industry leading hands-on science center in San Francisco, introduced exhibits that encouraged Active Prolonged Engagement (APE) (Humphrey & Gutwill, 2005). The open-ended nature of the exhibits allowed the visitors to test their own theories, build their own models, and lead their own scientific experiments. These put the visitors at the center of the experience rather than the exhibits. Additionally, Pekarik (2010) emphasized the importance of centering the experience on the visitors rather than on the exhibits. He stated,

> *To see the museum as a field of potential for human growth is to see it as a place that serves others…Its task—from this perspective—is to provide a setting that is as rich with opportunities, as alive and intriguing, as is humanly possible. The museum becomes, in a sense, a hyper-reality—a trackless realm to play in . . . that offers opportunity for engagement in multiple ways, with the capacity to be intense and powerful (p. 110).*

With this in mind, human-centered design, and design thinking in general, has naturally become an increasingly important and effective tool for museum professionals.

What Does Design Thinking Look Like in Museums?

In this section we will briefly discuss the use of design teams in a museum setting and then will detail a specific design case in the building of the Museum of Natural Curiosity at Thanksgiving Point in Lehi, Utah.

Projects that incorporate design thinking or human-centered design are most successfully accomplished with a team. In museums, these teams are commonly composed of individuals from across the organization from several different departments. For example, in larger museums where there are designated staff members for each area of expertise, an instructional designer may be on or lead a team with individuals from the following departments:

- Education and programming
- Exhibits and fabrication
- Audience research and evaluation
- Visitor/Guest services
- Content matter experts (curators)

To successfully lead or participate on a museum design team, an instructional designer will need to understand the role of each of these departments. Similar to an instructional designer who works at a computer company and has to "speak the language" of the software developers, testers, graphic designers, etc., an instructional designer on a museum design team needs to "speak the language" of the various departments. It is not expected that an instructional designer be a content expert on the project being considered; rather, an instructional designer is a facilitator of the design process.

The Case of the Museum of Natural Curiosity

To illustrate how design thinking can be used in a museum setting, we will describe how the different components of the design thinking process were used in the building of the Museum of Natural Curiosity at Thanksgiving Point Institute in Lehi, Utah. The Museum of Natural Curiosity opened to the public in May 2014. Many years before it opened, Thanksgiving Point, a multi-museum complex, began the process of design in preparation for the new venue experience. The team at Thanksgiving Point closely followed the following design cycle, although you will see that the steps were not exactly linear:

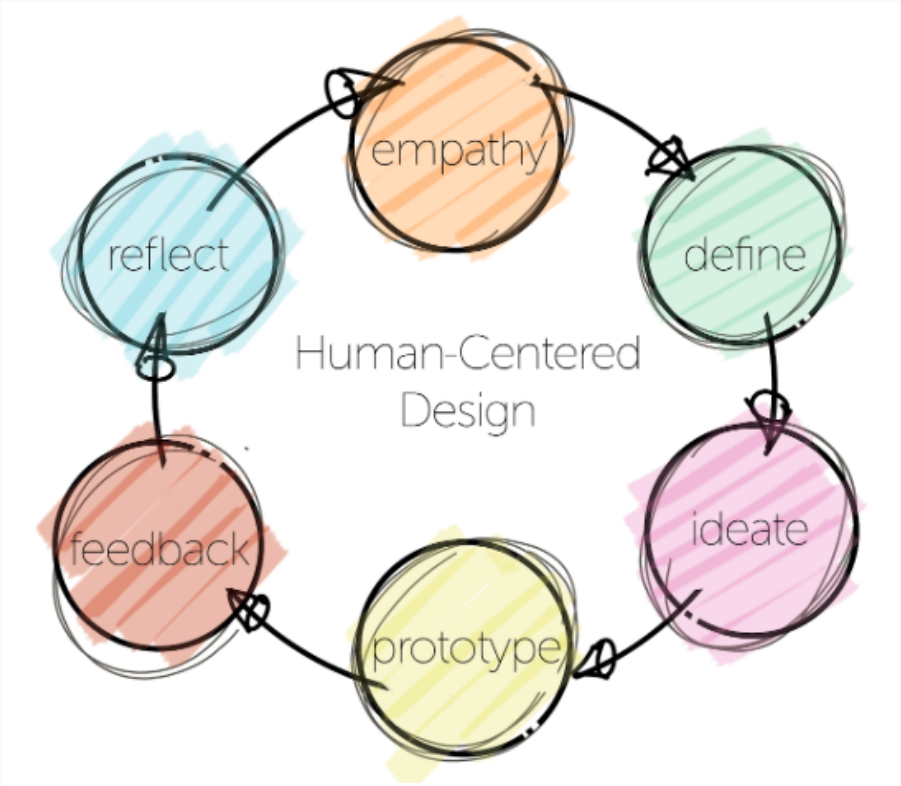

Figure 1. Human-centered design

Empathy Mapping

The Thanksgiving Point design team learned from visitor feedback—through surveys, observations, and informal interviews—that the visitors wanted to have a children's museum built at Thanksgiving Point. After deciding to move forward with the decision to build one, the design team, along with board members and senior managers, visited some of the most reputable children's museums and science centers throughout the United States. Our purpose was to gather ideas and best practices and to understand how these museums were meeting their visitors' needs.

Define

Originally, we intended to build a children's museum. However, we realized we wanted a museum that was focused on the entire family, as families were our primary audience at Thanksgiving Point, rather than just children. Also, when we visited science museums around the country, we realized we wanted to have elements of hands-on science centers as well. The Museum of Natural Curiosity was then defined as a family museum. It was to be a hybrid of a children's museum and science center. Defining this clearly gave us specific direction as we moved forward with the design of the museum.

Ideate

The Thanksgiving Point design team ideated many times throughout the process of designing the experience for the Museum of Natural Curiosity. Thanksgiving Point also contracted with an outside design firm to help develop ideas and fabricate the exhibits. The design team and outside design firm held many brainstorming activities together and at times included other key stakeholders, including visiting families and board members. As ideas were generated, favorite

ideas rose to the top, and then those ideas went through additional stretches of ideation. In a way, each exhibit idea went through its own design process.

Prototype

Because Thanksgiving Point is a multi-museum complex, we already had a museum with space for testing our ideas. The Thanksgiving Point exhibits team developed a prototyping space in a traveling exhibit gallery that they called the Try It! Lab. The lab was a design space behind a plexiglass wall. When the exhibit developers wanted to try out a new idea, they would build a mockup of the idea, take it out to visiting guests on the other side of the plexiglass, and get their feedback on it. The prototype was enhanced or adjusted to incorporate the feedback from the guests. All of the exhibits in the Museum of Natural Curiosity went through an extensive amount of prototyping.

Feedback

The Thanksgiving Point design team used the Audience Research and Evaluation Team to help measure guest feedback throughout the entire process. They helped measure guest feedback on the exhibits and programs. Additionally, before the museum was opened to the public, there were three months set aside for testing. During these three months, many outside groups, including schools, special needs groups, and families were invited to attend. The entire three months was spent getting their feedback and incorporating it to improve the overall experience.

Reflect

The Thanksgiving Point design team reflected often on the process and project throughout the design process. It was helpful to regularly check our progress toward accomplishing our goals. Additionally, we have reflected on the design of the Museum of the Natural Curiosity as we have designed additional exhibits and experiences. The design team is now designing for Thanksgiving Point's fifth and newest venue, the Butterfly Biosphere. The team is reflecting on and taking lessons from the Museum of Natural Curiosity experience to help ensure the Butterfly Biosphere also meets the needs of visiting guests.

The Museum of Natural Curiosity opened with high commendation from the community and Thanksgiving Point visitors. The revenue budgeted for that fiscal year was far exceeded, especially the Thanksgiving Point membership budget. The increase in revenue was attributed to the success of the Museum of Natural Curiosity. Many museum professionals also visited and gave very positive critiques of the new museum. One museum and design professional said, "I could tell as soon as I walked in that this museum was built with design thinking at its core."

Instructional Design Careers in Museums

Careers in museums are as varied as museums themselves, and the study of learning and instructional design is a great preparation for many museum jobs. If you land work in a small museum, be prepared to wear multiple hats! In a larger museum, your work may be more specialized, but collaboration with other departments will be important for cohesive and effective learning experiences for your visitors.

Below are some common positions in museums that practice learning and instructional design in their work. Many of the descriptions include real-word perspectives on the work in call-out boxes labelled "From the Field." These quotes come from anonymous responses to a survey we distributed to practitioners in January, 2018.

Educational Programming

Museum educators design, develop, and deliver programs that enhance a visit to the museum for visitors of all ages. Programs may take the form of guided tours, facilitated gallery activities, lecture series, outreach materials for classroom teachers, digital applications, summer camps, maker spaces, and more. Educators play an important role on exhibit teams to strengthen the educational soundness of an exhibit. They work with curators/content experts to ensure the accuracy of educational programs. While there are no report cards, tests, or required curriculum, don't think this isn't

serious work! It is important for a museum educator to systematically apply an understanding of development stages, learning theory, learning objectives and outcomes, and learner-centered design to the experiences they create. Organizational, budgeting, and "people" skills are also vital.

From the Field:

"Informal learning closely parallels the methods of traditional learning, with a special emphasis on visitor motivation and experience design. Intended learning outcomes are just as important to keep an exhibition or program focused as they are in any learning context. Often we are more focused on affective outcomes (vs. cognitive). For both of these reasons, evaluation needs to be rigorous yet creative. Museum work is fascinating!"

"One thing that is difficult sometimes is that learning and instructional design theory/methods are fairly new to my museum (and, I would guess, most museums except for the very large ones), and consequently haven't been incorporated into most existing processes and development. It is often only requested at the end of a project to evaluate learning outcomes. Because of this, I think it is important to be ready to advocate and educate coworkers/bosses on the important role that learning and instructional design can play throughout the whole product/curricula design and development process."

Research and Evaluation

As informal learning environments, we don't give our visitors tests as they leave the museum, so how do we know visitors are learning from the exhibits and programs we design? This is the role of museum evaluators. Evaluators work with designers and educators to explore the effectiveness of their exhibits and programs. In addition to surveys and interviews, museum evaluators use prototype testing, observations, and a variety of other creative methods to explore how the museum is meeting its goals.

Researchers take on the additional responsibility to study the nature of learning in museums to add to the body of knowledge that helps us optimize what we do in them. Museum evaluators should have competency in both quantitative and qualitative research methods, data analysis, evaluation planning, and research ethics. It's also helpful to be familiar with the process of design and the role of evaluation within that process.

Exhibit Design and Fabrication

Exhibit designers craft compelling stories to share with museum visitors. Working with curators, content experts, and other museum staff, exhibit designers select topics, develop concept plans, write labels and interpretive text, and build and install components – both physical and digital. You might think of museum exhibitions as a kind asynchronous learning – with the exhibit designer being the instructor, the museum visitor the learner, and the exhibit as the medium. With this in mind, learner-centered design thinking, conceptual planning, spatial planning, project management, and storytelling are all important skills in this job. While not traditionally taught in instructional design class settings, physical construction and design skills such as technical drawing, material building, woodworking, and other basic carpentry skills are also marketable skills for an exhibit designer.

From the Field:

"Multiple learning levels and individual options for more depth of information are essential because the definition of the learner is so broad. It's like the outstanding movie that has humor understood by kids yet has layers that relate to adults, too."

Leadership Team

Depending on the size of the museum, the leadership team may include an executive director, senior management, the board of directors, grant administrators, development directors, and others who set the vision and evaluate opportunities through the filter of the museum purpose and mission. A museum's leadership team oversees all aspects of the visitor experience by managing the staff that works to offer unique experiences for visitors every day. This may even include overall venue design and construction! An instructional designer in a leadership position will help set the overall goals of the museum. The mission he or she helps draft will greatly determine the trajectory of learning that occurs within the museum. In these leadership positions, management and budgeting skills, along with the ability to think long-term, are especially important.

From the Field:

"That there is a great deal of internal education necessary to bring colleagues into the awareness that learning and instructional design is a highly developed specialty field (every bit as deeply theoretical as art history, etc.), and that approaches that include a sophisticated understanding of learning theory and content delivery are more effective than going by the gut or following unquestioned conventional beliefs about what museums do."

Consultant / Design Firms

As non-profit organizations, many museums hire consultants and contractors on a project by project basis to save the cost of a permanent employee or when the scope/nature of the project is fixed. This work may be in any of the above areas and allows you the flexibility that comes with self-employment. Generally there are not entry-level positions as a contractor. You will likely need extensive experience in your chosen field for credibility.

From the Field:

"Get museum experience and "street cred" in the museum setting — even better if you can build some expertise in a subject matter. It's important that your museum colleagues respect your abilities early on so that you can bring convincing authority to your learning/ID work."

Getting Started

For any museum job, a great place to start is volunteering and internships. Find a museum or museum professional whose work interests you and reach out. Take the initiative to offer your time, ask questions, and expand your network. Be prepared to get this initial experience (even internships) without being paid – remember that non-profit status? But the sacrifice will pay off – most museum professionals really enjoy what they do!

There are other things you can do in grad school to prepare for a museum career. Consider taking classes about informal education or the principles of learning. Museums will be interested in hiring people that have previous, practical experience with design projects, research, and evaluation. If you are interested in going into museum management, taking financial and other business strategy classes will also be very helpful. Museums value employees that can think independently but can also work well on a team.

We have seen some graduate and even undergraduate students find success in getting hired at a museum by first offering their services. For example, you might contact a museum professional and say something like, "I am conducting a project on how families learn together in informal learning settings. Is there a way I could partner with your museum to study this more closely? I have the support of my advisor, Dr. X, and I would love to be able to share more with you about this project." Or another approach would be to keep things more open and to ask the museum what they are currently working on. For example, you might say, "I am a graduate student that is very interested in the museum field. Are there any projects occurring right now at your museum related to exhibit design that I could help with? I have the following expertise."

You will find that museums are generally very open to working with and sharing their ideas with others, including college students. It is not uncommon for museum professionals in one museum to ask museum professionals from other museums for ideas on increasing revenue, increasing visitor satisfaction, improving exhibits and educational programming, etc. The museum field is very collaborative.

Lastly, attending one of the professional associations listed below will provide you with some great exposure to the museum field. Many of the associations listed below offer student scholarships for free registration, travel, and lodging.

From the Field:

"Having a career related to learning and instructional design in a museum setting is very rewarding for me. I get the opportunity to learn about so many diverse topics and to work with scientists from a range of fields. I also appreciate that I get to work on products from the very beginning, brainstorming ideas, to the "end," when students and museum visitors are using, learning from, and enjoying the products that I've worked on."

Professional Associations

There are several museum-related professional associations, each with their own informative websites (great places to check out museum job listings), listservs, peer-reviewed journals, and conferences. For starters, explore these, but also search for state and regional museum associations for opportunities close to home.

American Alliance of Museums (aam-us.org). Established in 1906, AAM represents more than 35,000 individual museum professionals, volunteers, and institutions. They help to develop standards and best practices, gather and share knowledge, and provide advocacy on issues of concern to the entire museum community.

Association of Children's Museums (childrensmuseums.org). Started in 1962, and with more than 400 members in 48 states and 20 countries, ACM seeks to leverage the collective knowledge of children's museums through convening, sharing, and dissemination.

Association of Science-Technology Centers (astc.org). ASTC is a global organization for science centers, museums, and related institutions. ASTC strives to increase awareness of the valuable contributions its members make to their communities and the field of informal STEM learning. Founded in 1973, ASTC represents over 600 members, including science centers and museums, nature centers, aquariums, planetariums, zoos, botanical gardens, and natural history

and children's museums, as well as companies, consultants, and other organizations that share an interest in informal science education.

Visitor Studies Association (visitorstudies.org). VSA is dedicated to understanding and enhancing learning experiences in informal settings through research, evaluation, and dialogue.

Museum Education Roundtable (museumedu.org). Museum Education Roundtable provides scholarship and professional learning for museum educators.

Relevant Journals and Other Publications

There are several relevant, peer-reviewed journals and other publications we would recommend to those that are new to the museum field. The following list is not comprehensive, but it at least gives a starting point for those who want to know what topics are being discussed in the field. This list includes both research-based and practitioner-based publications.

Curator: The Museum Journal (curatorjournal.org). Curator is a research-based, peer-reviewed journal intended for museum professionals, researchers, and students that focuses on general and urgent issues that museums face.

Journal of Museum Education (museumedu.org). The Journal of Museum Education is a peer-reviewed journal that focuses on issues and ideas related to museum education. It is intended for museum, research, and education professionals. Topics include learning theory, visitor research and evaluation, strategies, and responsibilities of museums as public institutions.

Visitor Studies Journal (visitorstudies.org/journal-and-archive). Visitor Studies Journal is a research-based, peer-reviewed journal published by the Visitor Studies Association that focuses on issues related to visitor research and evaluation. The journal publishes theoretical ideas and practical solutions and is intended for both researchers and practitioners.

Museums & Social Issues: A Journal of Reflective Discourse (tandfonline.com/toc/ymsi20/current). Museums & Social Issues is a peer-reviewed journal that focuses on the way museums respond to, become engaged with, or highlight social issues. Topics include race, immigration, religion, gender equality, and other contemporary issues.

Museum Magazine (aam-us.org/programs/museum-magazine). Museum is published by the American Alliance of Museums. This practitioner-based publication addresses general issues that museums face today.

Dimensions (astc.org/publications/dimensions). Dimensions is a magazine published by the Association of Science-Technology Centers. This practitioner-based publication addresses issues and discusses solutions relevant to science and technology centers.

Hand to Hand (childrensmuseums.org/members/publications). Hand to Hand is an editor-reviewed journal published by the Association of Children's Museums. This publication includes articles and discussions related to major trends in the children's museum field and also features interviews with children's museum professionals.

Conclusion

Many principles of instructional design, when applied in a museum context, can help museum professionals create venues, exhibits, programs, and experiences that are informed by and reflect the needs of their visitors. The museum field offers a wide range of fulfilling careers for those interested in applying aspects of instructional design to these diverse, public-serving institutions.

The museum field is in constant need of bright, committed individuals who are passionate about improving the museum experience. Those with a background in instructional design have the ability to make unique contributions in

many museum professions, including exhibit design, education, research and evaluation, and administration, thus influencing the overall experience for visitors. In turn, the museums can have a lasting impact on the patrons who visit them.

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Feedback

Please complete this short survey to provide feedback on this chapter: http://bit.ly/CareersMusuem

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Thanksgiving Point

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53

Careers in Consulting

Barbara M. Hall & Yvonne Earnshaw

The definition of a consultant means different things to different people, but it is especially important to answer this question for yourself. The most obvious answer is “to consult,” or seek someone’s opinion, advice, or guidance; or, seen from the other side, to consult is to offer someone your opinion, advice, or guidance. Think of the many ways you have already been a consultant either giving or receiving advice, guidance, and opinions. You are likely to have already been a consultant in some way today. Being an instructional design consultant is not much different than the other kinds of formal and informal consulting you have probably already done. Simply, a professional consultant offers considered opinions related to tailored solutions for specific clients and their needs.

In this chapter, we’ll introduce you to the world of consulting and discuss how to prepare for and find a job as a consultant, write proposals and contracts, and succeed as a consultant. We will also provide tips along the way that we discovered as consultants and hope you find this information beneficial.

Preparing for a Job as a Consultant

As you prepare for a job as a consultant, it is important to establish how a consultant is different from other employment types. In this section, you will read about what sectors consultants work in, why firms use consultants, what skills you will need, where you will physically work, and whether or not consulting is a good fit based on your individual circumstances.

What’s the Difference Between a Consultant and Contractor?

As a consultant, you are more likely to work directly with your client rather than through an intermediary organization. If you work for yourself or with other consultants, you will need to choose a business structure, such as a sole proprietorship or limited liability corporation (LLC). You are more likely to work under an IRS Form 1099, which means that you will be paid a gross amount and you’ll need to pay for your own taxes and medical insurance.

A contractor is often perceived as someone who is working for a limited amount of time in a narrow role with specific tasks on a larger project within a formal organization. A contractor might work directly for an agency as a W-2 employee (the taxes will be paid by the agency) but work on-site at the client’s organization.

There are different tax and legal implications and business license requirements for owning a business, so be sure to consult professionals such as tax lawyers and CPAs.

Where Do Consultants Work?

Instructional design is a field of expertise that is used across all economic sectors to work on projects from industry to non-profit organizations to the military to PK-12 education to corporations to higher education and government. The best source of information for employment across economic sectors, as well as information about specific

occupations, is the United States Department of Labor. Be sure to review the Department's Occupational Outlook Handbook and O*Net Online.

You may need additional or specialized skills, depending on the specific sector. For example, if you consult for PK-12, you willll most likely need teaching experience. If you want to consult for the military and often in government positions, you will need to have a security clearance. It may be easier to work directly with an agency who is already set-up to work in these areas.

Why Do Firms Use Consultants?

Firms use consultants for a variety of reasons. Perhaps the firm is looking for someone with specialized skills to work on a short-term (or longer-term) project, or perhaps the firm is looking for someone with an outside or new perspective. While consultants can provide objectivity in their evaluation and advice, note that consultants sometimes have pre-existing relationships with members of an organization's leadership who may want the consultant to offer an "objective" stamp of approval for a specific direction already identified. There are other challenges to objectivity, such as wanting to please leadership for the benefit of future contracts or some other perk. Of course, some firms hire consultants to be a genuine change catalyst; for example, a consultant could identify current or potential problems as well as potential solutions. A firm might hire consultants to leverage their networks, supplement the capacity of internal personnel, or just do the dirty work of budget and/or personnel cuts (think about the role of George Clooney in the movie, Up in the Air). Asking a firm why they are hiring a consultant may offer additional information to help you tailor your approach.

What Skills Do I Need?

The list of skills may seem short, but it takes a good deal of self-reflection to determine if you have the skills required to become a successful consultant. Whether or not you will make a career out of consulting or continue to work full-time and consult on the side, the skills are the same.

The following list will help guide you through some of the questions you should ask yourself:

- Initiative and self-motivation/discipline – Are you a self-starter? Are you motivated to work even when no one is managing you?
- Self-awareness – Do you know what you are good at? Are you a generalist or a specialist?
- Adaptability – How do you feel when schedules change, someone makes an unexpected demand on you, or opportunities and constraints shift? Can you adapt to working on time-limited projects at different benchmarks with different clients across multiple sectors requiring different aspects of your expertise?
- Structure – What is your method or practice for working? Are you more laid back or hyper-organized?
- Communication – How will you deal with difficult situations with a client?
- Project management – Are you able to juggle multiple tasks and deadlines?
- Basic business acumen – Can you budget effectively?
- Technological skills – Are you able to fix your own IT issues? Are you familiar with hardware and software?
- Networking – Do you have a list of professional contacts? Are you comfortable talking to strangers about your business?

The Most Important Skill

The most important skill as a consultant in the field of LIDT is communication.

What Kind of Work Environment Will I Have?

As a consultant, you will need a place to work. This space will vary depending on your particular needs. There are benefits and challenges to every work environment, whether you work at home or an off-site space or have a workspace at the client's office.

Working at home. There are many benefits to working at home. You will not be sitting in traffic every day and you will have a lot more flexibility if you need to tend to your family's needs. You also will not be spending money on lunches, gas, snacks from the vending machine, or dry-cleaning.

However, you will need to treat it like a job outside of the home. It's important to have a dedicated space at home where you can work. Ideally this is in a separate room that isn't your bedroom or family room. This dedicated space should have the appropriate office equipment for your job. You may find it beneficial to get ready for work each day and schedule a lunch break.

There are some challenges to working at home: isolation and distractions. In a traditional work environment, people are all around you all day long. You may only interact with some people in passing at the water cooler, but it's enough to feel connected to others. "Working" at home may mean that you have more flexibility, but this can distract you from doing your actual work. Try to limit these and other distractions (TV, pets, and kids).

I Work in a Closet

I (Barbara) have worked in a literal closet —the walk-in closet of the master bedroom, to be exact. The room that was going to be my office was needed as an actual bedroom. I had been considering a standing desk, and my husband and I joked that I could just stand in the closet and put my computer on the wire shelf. Voila! My new home office was born.

Renting office space. If working at home is challenging because of the distractions, there is also the option of renting a dedicated office space. One benefit is that you have a place to go to, so it feels like you are going to work. These dedicated office spaces offer a variety of services, such as having a physical mailing address or P.O. Box, standard office equipment (photocopier, printer, and fax machine), Internet, a receptionist, kitchenette, and a conference room to meet with clients. Prices will vary depending on size of the space and services included.

There are also shared co-working spaces in several markets around the country. You have the flexibility of renting a desk only when you need it, as opposed to renting an entire office on a more permanent basis. It may also be helpful to have other freelancers/contractors around you. However, you have to consider the distractions again. Will you be able to focus on your own work and not be distracted by the projects going on around you?

If an office space is outside of your budget, find another place you can go to like a library, a community center, an apartment clubhouse, or your local (quiet) coffee shop.

Working on-site. As a consultant, you may also be working at the client's location. Your workspace may be anything from a cubicle or desk to a shared conference room. The client knows you're there for a short-term project, so you may not have a permanent workspace. If there is a specific dress code or core business hours or work at home policy, you will need to abide by the house rules.

You will have more direct access to the client, so you may feel like you are more of a member of a team. However, in this case, it is important to remember that you are not an employee of that company, so you may not be able to enjoy the same benefits as an employee, such as use of the gym or discounts. At some companies, you may need to have an

employee escort you into the building each day. You may not have access to the same systems or be able to contact people directly (e.g. the off-site LMS administrator).

Using technology. Regardless of the physical space in which you choose to work, you will also need to consider what technology you'll need such as a lightweight laptop, a reliable phone, and an Internet connection. Depending on the quality of service at home and your cell phone plan, you may need a home phone with a dedicated line.

You may be required to purchase your own software to work on projects. Instructional designers use a variety of software for development and more general business software for word processing, spreadsheet creation, and presentations. Tracking your invoices and business expenses will require financial software. You will also need to consider how you will be connecting with clients if you need to host video and audio conferencing. There are many options available, so look at what best serves your needs.

Working From Home… or Not

When I (Yvonne) was consulting on the east coast, I was working with a team in Europe and a team in California. Working at home gave me the flexibility to get up early to work a few hours with Europe, take a couple of hours to run errands or head to the gym, and then be back before my meetings started with California. I really enjoy working at home. My husband, on the other hand, found working at home to be difficult. He prefers to be in the office. Oddly enough, he actually enjoyed his hour-long commute because it gave him time to listen to his podcasts.

Is Consulting Right for Me?

As mentioned before, consulting requires a particular skillset. It also requires that you have the time, financial ability, and support system to be a successful consultant.

Time. How do you know if you have the time to be a consultant? Only you can make that decision. Do you really know how much time you spend performing tasks in the many areas of your busy life? Do you really know how much time you have for a consulting career or even side job?

There are several time trackers available such as Toggl, MyHours, TimeCamp, Klok, ManicTime, RescueTime, and good ole fashioned paper templates. Be sure to set a specific time and deadline for exploring and deciding, though, or you might end up wasting time learning about how you spend your time.

Risk tolerance. As a consultant, you will not be receiving a steady salaried paycheck so there is financial risk involved. Consulting income has a lot of ebbs and flows depending on how many hours you are billing. It's important to know that you probably will not be billing 100% of your work hours. Every hour that you're "working" you may not be able to bill to a client. In fact, you may only be able to bill 50% of your hours to a client. The other part of the time you'll be networking or finding new opportunities. This may seem like it will not take a lot of time, but it is critical to your success as a consultant to spend a lot of time doing these two tasks.

There may be less busy times of the year. Toward the beginning of the year, businesses may be trying to determine their budgets for the year and you will not have any billable hours. Toward the end of the year, businesses may have run out of consulting budgets and again, you will not have any billable hours.

Think about how many weeks of vacation you want to take during the year. As a consultant, you will not be paid for your vacation time so you may want to have money set aside for the leaner times. You may even want to get your feet wet initially by keeping your full-time job and start your consulting business on the side. Only you can determine your own personal level of risk.

Supporters and distractors. You will encounter people and circumstances who will support your efforts and those who will distract you. You will need to consider your individual situation and ask yourself if your partner or spouse, family, and friends will support your work as a consultant that may require you to work long hours or travel frequently. Will those individuals support you when your income may be scarce? Will you have to say no to that long-awaited vacation because you have a project deadline?

Is Consulting Right for Me?

Consulting was really like a roller coaster in terms of hours for me. One year I (Yvonne) didn't have a paycheck in January and February because I was waiting for the client to approve the budget for that year. After the budget was approved, the work quickly ramped up to 60-80 hour work weeks. I remember scheduling a vacation months in advance and, due to project delays on the client's end, I still tried to work while travelling cross-country during an auto-racing event (with very limited Internet at the tracks). The work finally calmed down to a steady 40 hours a week for several months before tapering off again at the end of the year.

Finding a Job in Consulting

Finding a job as a consultant has a lot to do with your goals. Based on those goals, you need to set the pace of the transition from your present state into your future state as a consultant. You may need to start slowly, tackling a few tasks each week and "poking around" for opportunities.

Where Do I Find Opportunities?

There are different ways to find consulting opportunities and the process closely mimics a traditional job search. Searching online job sites, having a social media presence, and networking are the main ways to find an opportunity. You may also have more advantages than you even know. Be sure to check out the U.S. Small Business Administration's set-asides for small businesses, such as those owned by women, veterans with service-connected disabilities, and those who are socially and/or economically disadvantaged. Some state governments offer similar set-asides, so be sure to check with offices in your particular state. You may find it easier to secure subcontracting opportunities with larger organizations that can tackle large government contracts that are likely beyond the capacity of most small businesses, especially if you do qualify for special status with the Small Business Administration or other federal or state programs.

Sites that collate jobs. Essentially, you are looking for a job in the traditional sense. Check out various websites like SimplyHired, Indeed, Monster, or USAJOBS.

You Are Who Google Says You Are

Have you ever "Googled" yourself, especially from someone else's computer? You might be surprised at who turns up. Is it you? By simply adding my middle initial to my name wherever possible, I distinguished myself from a popular Hollywood producer. Now, when someone uses my middle initial in a Google search, the top ten or so results are all me and my work.

Social media presence. Social media can be beneficial to look for opportunities and to announce that you are looking for opportunities. Many companies have LinkedIn, Facebook, and Twitter accounts through which they may post opportunities.

Companies will be looking at your web presence, so be strategic in what you're posting. You may want to have a Twitter account where you post best practices or articles that you find that are related to your business. Creating a LinkedIn account is also a good idea. Using specific keywords and a targeted headline will help guide people (including recruiters) to you. Be sure to add a skills section. Don't just create an account and not be active. Use the tool to your advantage and post on the feed.

As a consultant, it's important to create your own brand to differentiate yourself from the competition. Make sure you create a strong digital portfolio to showcase your work. You can use templates in Google Sites, Weebly, or Wix to build your site and then pay to personalize your website's URL.

Local groups. Speaking at local events in your community is a good way to network. As noted in the skills section, effective communication and marketing yourself is a key skill as a consultant. Joining a public speaking group, such as your local chapter of Toastmasters International, will help build your confidence as a public speaker and you will also be networking with other professionals. You never know when and where you will find a consulting opportunity. Check out your local chamber of commerce for networking events.

Networking at the Chamber

My local chamber of commerce has a weekly coffee connection hosted at a different partner's business. It's an opportunity to meet and greet 60-75 people and provide a 30-second commercial about myself. I always, always come prepared with business cards.

Professional organizations. Joining a professional organization and meeting other professionals is a great way to find opportunities through the online job boards and network at the events. Some suggestions are ATD, ISPI, USDLA, AECT, Quality Matters, or OLC, depending on what meets your needs. Remember that many organizations offer less expensive student rates for membership.

Career services office. Do not be afraid to head to your current or former university. Career services may have mailing lists to join or networking events to attend.

Targeting specific firms. You can always reverse roles and search for consulting companies as if you were a potential client to find less-known firms.

Cold-calling. Cold-calling is a lot like dating. You will need to make a lot of phone calls to get your foot in the door. Be brief and say that you will follow up with an email. If you do not feel comfortable calling, you can also send an email to the company or organization. In either case, have a script ready to sell your services and know that not every meeting will result in work.

Converting job/internship posting to consulting gig. Another option is to apply to a traditional job or internship posting and sell your consulting services. Be sure to include the benefits of using a consultant for this type of position. However, it's helpful to know who the decision-maker is instead of sending your resume and cover letter through an electronic system.

Writing Proposals or Contracts

Now that you have been able to find an opportunity, you are at the proposal and/or contract stage. Depending on the size of the firm, the proposal and contract may be combined. The proposal/contract will be very detailed and will need to be thought out carefully.

Scope and Capacity

You need to know two “big picture” items to convert a call for proposals (CFP), request for proposals (RFP), or request for quote (RFQ) into a contract. You need to know the scope of the work being sought and your capacity for meeting the scope of that work. Read the scope carefully and ask questions of the point of contact listed for additional information. You need to completely understand the scope of the work required in order to accurately gauge your capacity to take on the work.

What I Learned From the Contract I Didn’t Get

When I learned that I did not win the contract, I felt relieved. As I reflected on my feeling of relief instead of disappointment, I realized that the scope of work was too much of a stretch for both my area of expertise and my capacity to manage the project. What did I learn? I learned that my capacity is not always as large as my enthusiasm.

Respond as Requested

The “call” for a proposal or quote is likely to be quite detailed and prescriptive in the way that you should submit your proposal. Be very careful to follow the precise requirements of the call. Answer every question and respond to every section with the requested information – no more, no less. Do not assume details; clarify any questions you have. Even in clarifying the details, reach out to only the point of contact listed and in only the way(s) listed in the call.

The components of your proposal should match precisely the questions and sections stated in the call. Use the exact same language and titles. Do not add sections or attachments unless those are requested. If the call neither explicitly accepts nor declines such additional information, ask the listed point of contact if the additional information you think will be useful would be accepted by the organization. Remember the adage that less is more; too much information or too many examples could make your proposal look unfocused and unprofessional.

Many calls, especially for larger contracts, will specify the timeline after proposals are submitted. While it may be okay to follow-up with smaller organizations, especially those with whom you already know a point of contact, you do not want to breach an established protocol by pestering employees or becoming a nuisance with overt or veiled attempts at follow-up. If you cannot follow the steps outlined in the call, then an organization might assume that you cannot complete the project within established guidelines either.

How Much Do I Charge?

Determining cost is always tricky. There are pros and cons to using an hourly rate versus a fixed rate. When you’re first starting off you may want to use an hourly rate until you get a feel for scoping projects. You can charge a different hourly rate for managing the project versus production work. If you charge an hourly rate, you run the risk of not calculating enough hours to complete the project or not charging enough to cover your overhead (taxes, business expenses, travel, etc.). That being said, it might be better to use fixed-rate billing rather than an hourly rate. Remember that you are selling your value so think of your cost in terms of a set value, not by how many hours it takes to complete a job. With a flat rate, your clients will know exactly what they will be paying. There are benefits to both sides. It’s really dependent on how financially comfortable you are.

As a guide, The Learning Guild's Degrees for L&D Professionals: What, Why, and Worth? provides salary information and degree expectations. https://edtechbooks.org/-zpqpThis may provide a starting point for you to determine where you should be salary wise. Another great resource is from Harold Jarche. Although his information is from 2007, the ranges are still very much in-line with what instructional design consultants charge today. You will notice that business tasks

cost more than production work. Overall, the range for consulting may be from $25-$200/hr depending on what type of work you will be doing.

What Are the Standard Contract Components?

A contract between you and your client will ensure that your interests are protected, that the work is clearly defined, and that you have established communication and compensation expectations. These contracts typically have a standard set of components. Consider developing your own template for the components of a contract that you want to use. Even if the firm may has a standard contract, having your own template can help you ensure that your important points are included.

Some of the components are rather obvious, like the names of the parties involved. The contract should include directly or reference as an attachment or appendix the specific scope of work to which both parties agreed. You and a representative of the organization should initial each page of the contract as well as fully sign the last page. Ensure that the scope of work is signed separately if it is not included as an embedded component of the contract.

Another important component of the contract is the list of deliverables and the timeline on which those deliverables are due. Remember that deliverables occur on both sides of the project, not just from you to the firm. For example, what access to resources like key individuals and documents will you need to be successful? Make sure there is written confirmation that such access will be granted and include such permission and access as part of the detailed timeline. Client approvals of different stages of a project, especially a large project, should also be included. How long after you share a design plan or set of storyboards should the client offer feedback and approval? Include the specific dates or time range (for example, “within five business days”). For your planning purposes, be sure that you know all of the tasks that need to occur to reach each benchmark along your timeline, and that the timeline is approved by both parties.

Finally, communication expectations and information for both primary and secondary points of contacts should be listed in the contract. In terms of communication, how often are status reports expected, and to whom should those reports be submitted? Are there different individuals who grant permissions, answer questions, and receive status updates? What are acceptable ways to communicate (in person, email, telephone, postal mail)? The approved or preferred methods of communication should include the names of specific individuals (at least one main, primary point of contact and one secondary, backup point of contact) and their direct contact information, such as individual email addresses, room numbers, or telephone numbers.

Costs, payments, and penalties. You will need to determine the costs, payments, and penalties involved when billing a client. You’ll also need to identify when you want to be paid and your cashflow. Let’s think about this situation: You state that you will invoice bi-weekly, net 30. What does this mean? It means you’ll start working on day 1, submit an invoice around day 15 (bi-weekly is every other week), and then the 30-day clock starts. The client will have 30 days to pay the invoice. What does this mean for you? You will not see a check until 45 days after you have started the work. How will you pay your bills if you don’t have income for six weeks? Unfortunately, that first check may be delayed by the mail and the client’s accounting department. So, in reality, you may not see a check for nearly two months. You may want to change your payment terms to net 15. You can also include a penalty for late payments. A typical charge is 1.5% compounded monthly for a late payment.

Non-disclosure and non-compete agreement. Both of these provisions protect the client. Non-disclosure prevents the consultant from discussing trade secrets, client lists, and other pertinent information. Non-compete prevents you, as the consultant, from starting up your own business after consulting at a company for a designated time period, which could be from six months to two years (any more than that and you should consider whether or not you want to take the position), and within a certain geographic area (which should be focused and not broad like “East Coast”). It may also include information about not soliciting clients or employees from that company.

An important note is that not all states allow non-compete agreements. They are governed by state laws, so check with your state to determine whether or not you can include one in your contract.

Early termination of contract. Unfortunately, contracts may need to be terminated early. This could be for a variety of reasons, but it really should be reserved for really serious issues such as non-payment. You can include a timeframe for written notification for termination and an early termination fee.

Terms of use. Having access to work samples to place in a portfolio or listing the client on your website should be discussed on a case-by-case basis and either be included in the contract or discussed at project completion.

Succeeding as a Consultant

After you have finished your first project (and subsequent projects), a good tip is to think about the lessons learned of what worked, what did not work, and how you can move forward. Take what you have learned to the next opportunity.

How Do I Adapt to Changing Needs?

As a consultant, you will be juggling both your personal life and your professional life. You may need to move to a different city or state, or your kids may need you to have a more flexible schedule to be more involved with their extracurricular activities. You will also have to balance the consulting side, which requires you to be more adaptable. You may need to hire additional resources to assist you to keep working on multiple projects. Clients may change depending on their needs and budget. As the economy changes over time, your focus on a particular industry may change. Who knew the high-tech industry was going to take a hit in the early 2000s or the mortgage industry was going to have a crisis in 2008? Be prepared as much as you can, and have a safety net for the leaner times.

What Do I Do When Things Go Wrong?

As with anything in life, there may be times when something goes wrong at the company, in your personal life, within the client/consultant relationship, or with something outside of either's control. You have resources available to you. Ask for help from a mentor when you need it. You can find mentors through the SBA (check out SCORE) or your network.

How Do I Maintain and Grow My Client List?

The best way to maintain and grow your client list is to keep working. Be careful of relying on a single client. While the work may be steady and lucrative for a while, that client's needs or budgets may change. One way to grow your client list is to look at other firms that do work similar to the work of your current clients. However, remember your non-compete or other agreements before investigating if those firms have similar needs.

Another way to grow your client list is to reconsider some of the decisions you made at the beginning of your consulting journey. Do you want to broaden the kinds of consulting work you are willing to do or perhaps the kinds of clients for which you are willing to work? Maybe new opportunities have popped up since the last time you did an environmental scan of your area; there might be new firms or changing needs. Repeat some of the steps in the Finding a Job section to see what might be new.

Meanwhile, the best way to maintain your client list is simple relationship management. Always do a good job with your work. Reach out occasionally to offer casual greetings or an article you know is relevant to your client's work without seeking anything in return. You might even consider sending seasonal cards small fruit baskets, or offer free webinars to the firm's employees or associated organizations. Always remember to maintain the relationship in ways other than just soliciting work.

How Do I Stay Current?

Staying current is an important part of being a successful consultant and it requires some introspection. Think about your reputation as a consultant. Do you perform quality work and deliver the materials on time? Are you still networking with others in the field by speaking at local events and conferences? Do you need to update or refocus your skills? Are

you using the most up-to-date software? Are there gaps in your knowledge? These are all things you should consider in order to stay current.

Conclusion

Now that you have been introduced to consulting, we hope that you are walking away with some information that will help you decide whether or not consulting is a good fit for you. Consulting can definitely be an exciting, yet challenging, job. It can force you out of your comfort zone and provide many great opportunities to hone your craft within LIDT.

Please complete this short survey to provide feedback on this chapter:
http://bit.ly/LIDTConsultingCareers

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Barbara M. Hall has served for about two decades as an instructional and training consultant in multiple sectors, including the military, non-profits, and elementary, secondary, and post-secondary education. Barbara currently serves as the Director of Curriculum at Northcentral University's School of Education and as an ad hoc instructional designer for Southern New Hampshire University. Previously, she worked as an Assistant Professor and Chair of the instructional design program in the College of Education at Ashford University and the Director of Community Development for a federally funded project at the University of North Carolina at Chapel Hill. Barbara earned her PhD in instructional design from Capella University; she is a certified peer reviewer with Quality Matters and a reviewer for multiple conferences and journals, including her appointment as an Assistant Editor for the *Online Learning Journal*. She has earned awards including best collaborative assignment (2017), second best quantitative journal article (2016), and outstanding faculty scholar (2015).

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Final Reading Assignment

Now that you are concluding this book, you should know . . . that you still know very little about the field of Learning and Instructional Design Technology. This is a "meta" field after all! One of the best pieces of advice I received as a student was to "read everything." As you progress in your studies, you will need to focus your reading specifically on the body of literature influencing your own work. However, take time to also read broadly, because often we need to step outside of our narrow research and design agendas to spark our creativity. The following are some recommended readings for you (with link addresses provided for those reading this book in pdf form), although any person in the field will have a different list—so ask them what they have read that influenced them, and you will be led down a fruitful path.

Open-access

- The Design of Everyday Things by Donald Norman
- Surviving Change: A Survey of Educational Change Models: http://files.eric.ed.gov/fulltext/ED443417.pdf
- LIDT open access books available on https://edtechbooks.org/-ycR.
- An Open Education Reader: https://opened.pressbooks.com
- Teaching in a Digital Age (https://edtechbooks.org/-qL)
- Seminal Papers in Educational Psychology: https://3starlearningexperiences.wordpress.com/2017/02/28/seminal-papers-in-educational-psychology/
- Psychological Science by Mikle South (an open text for Psychology 101, but also useful for revisiting classic psychological ideas) https://edtechbooks.org/-Rz
- Trends and Issues Podcast (http://trendsandissues.com/) by Abbie Brown and Tim Green, and their accompanying Flipboard magazine.
- Interaction and User Experience Design articles from interaction-design.org. This is an excellent collection of openly available articles by leading scholars in the areas of user experience design, research methods, and innovation research.
- Video Interviews with senior "legends" within AECT. http://aectlegends.org
- Learning-theories.com — brief summaries of many different theories
- *How People Learn* — grant-funded summary of learning theories by leading learning scientists
- The Cathedral and the Bazaar — Famous essay by Eric Steven Raymond that is widely regarded as the essay that launched the Mozilla foundation and open source movement.

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