

K-12 Blended Teaching: Science Edition

Whitney Keaton, Cecil R. Short, & Qi Guo

Table of Contents

Preface and About This Book	1
General Introduction to Blended Teaching	7
1. Introduction to K-12 Blended Teaching	9
2. K-12 Blended Teaching Competencies	17
3. Evaluating Blended Teaching with the 4Es and PICRAT	37
Discipline Specific Blended Teaching	53
4. Science: Intro to Blended Teaching	55
5. Science: Why Blend?	61
6. Science: Online Integration & Management	73
7. Science: Online Interaction	85
8. Science: Data Practices	99
9. Science: Personalization	111
Appendices	123
Appendix B: Research	125



EdTech Books



CC BY: This work is released under a CC BY license, which means that you are free to do with it as you please as long as you properly attribute it.

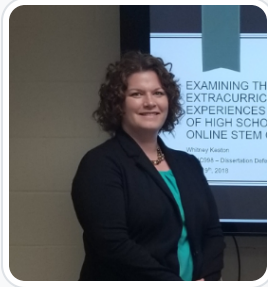
The publisher EdTech Books does not have a physical location, but its primary support staff operate out of Provo, UT, USA.

The publisher EdTech Books makes no copyright claim to any information in this publication and makes no claim as to the veracity of content. All content remains exclusively the intellectual property of its authors. Inquiries regarding use of content should be directed to the authors themselves.

URL: https://edtechbooks.org/k12blended_science

Keaton, W., Short, C. R., & Guo, Q. (2022). *K-12 Blended Teaching: Science Edition*. EdTech Books.

https://edtechbooks.org/k12blended_science



Whitney Keaton

George Mason University



Cecil R. Short

Emporia State University

Cecil R. Short is an Assistant Professor of School Leadership and Director of Secondary Education at Emporia State University. His research focuses on Personalized Learning, Blended Teaching, Open Educational Resources (OER), and OER-Enabled Practices. Before earning his Ph.D. in Instructional Psychology and Technology from Brigham Young University in 2021, Dr. Short served as a high school English teacher outside Kansas City, Missouri. More about Dr. Short and his work can be found online at www.cecilrshort.com.



Qi Guo

Brigham Young University



Like this? [Endorse it](#) and let others know.

Endorse

Preface and About This Book

Charles R. Graham, Jered Borup, Michelle Jensen, Karen T. Arnesen, & Cecil R. Short

Thank you for accessing one of the books in the *K-12 Blended Teaching (Vol. 2): A Guide to Practice Within the Disciplines* series!

The purpose of this preface is to orient you to the focus of this book, the original contributions that this book makes to blended learning, and the resources available to you within this book.



The Purpose of This Book

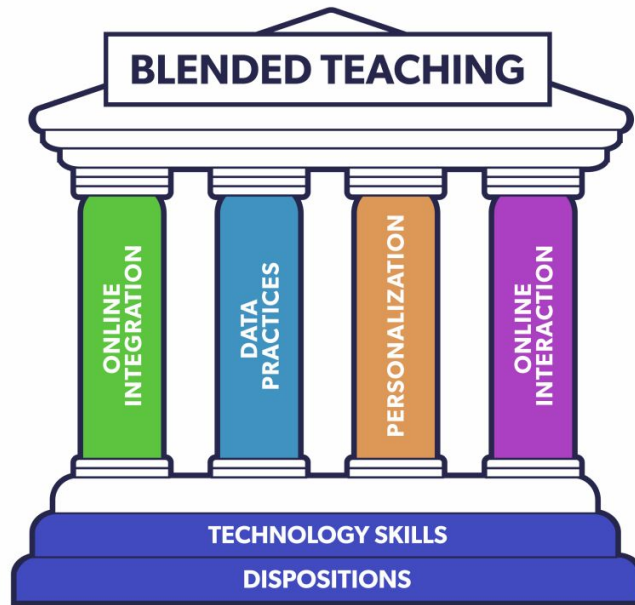
The purpose of this book is to provide rich examples of the four blended teaching competencies from a disciplinary perspective. The first three chapters of the book provide definitions and an overview of the blended teaching framework. Subsequent chapters are organized into sections that focus on blended teaching in a specific discipline. Each section has the following chapters:

- **Introductions**—Video introductions to the model teachers who will share written and video examples throughout the section.
- **Why Blend?**—Descriptions from the model teachers about why they chose to try blended learning in their classrooms.
- **Online Integration and Management**—Examples of how to effectively combine online instruction with in-person instruction.
- **Online Interaction**—Examples of how to facilitate online interactions with and between students.
- **Data Practices**—Examples of how to use digital tools to monitor student activity and performance in order to guide student growth.
- **Personalizing Instruction**—Examples of how to implement a learning environment that allows for student customization of goals, pace, and/or learning path.



What is This Book?

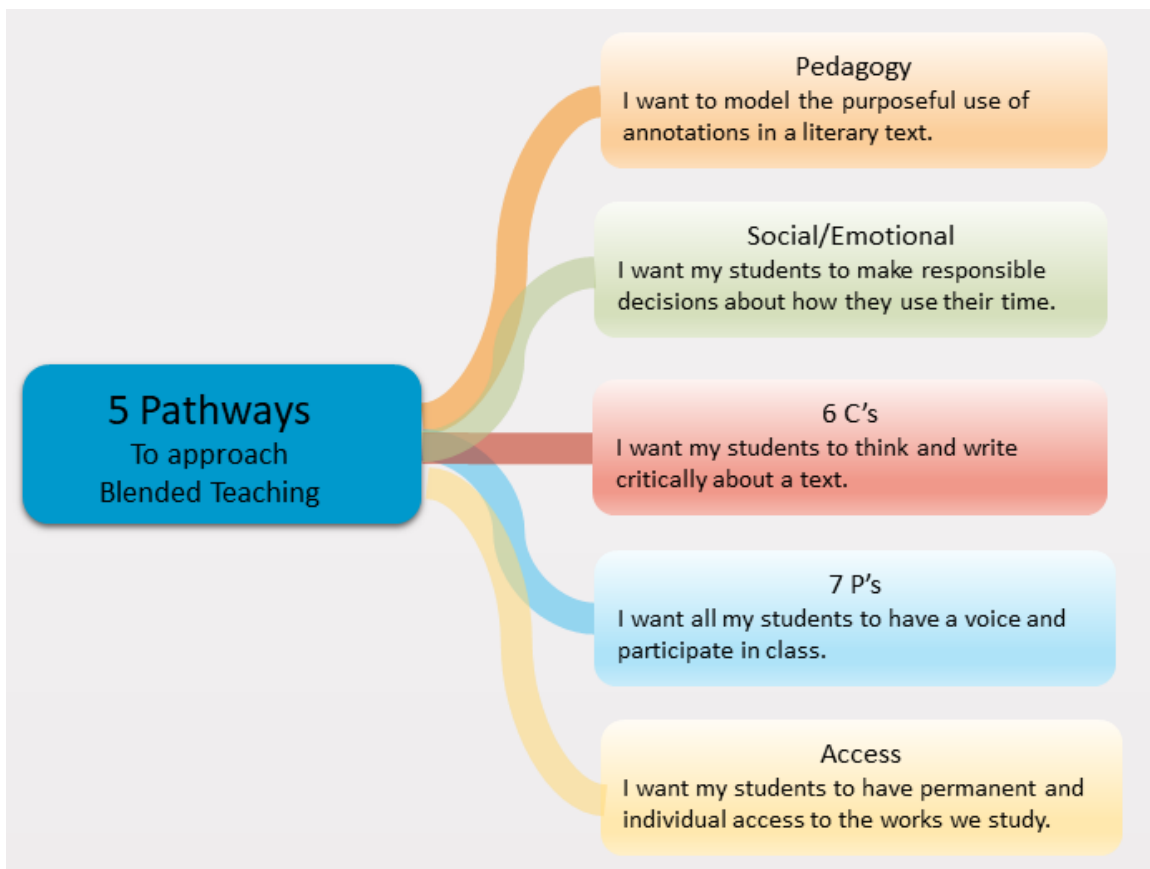
This book is a follow-up to [K-12 Blended Teaching: A Guide to Personalized Learning and Online Integration \(Volume 1\)](#). Volume 1 took a competency-based approach to planning and implementing blended learning. The competencies in Volume 1 were organized into the following areas: Online Integration, Data Practices, Personalization, and Online Interaction, with a final chapter that discussed how all of these areas come together to design blended learning. These competencies are built upon a solid foundation of blended learning dispositions and technology skills.



You can read more about these ideas by following these links to Volume 1:

- Cover - [K-12 Blended Teaching \(Vol. 1\): A Guide to Online Integration and Personalized Learning](#)
- Chapter 1 - [Blended Teaching Foundations](#)
- Chapter 2 - [Online Integration](#)
- Chapter 3 - [Data Practices](#)
- Chapter 4 - [Personalizing Instruction](#)
- Chapter 5 - [Online Interaction](#)
- Chapter 6 - [Blended Design in Practice](#)

Instead of using the competency-based approach from Volume 1, Volume 2 explores blended learning within various K-12 contexts through a problems of practice approach. These problems of practice are organized into the areas of Pedagogy, Social/Emotional Learning, the 6 C's of 21st-century learning, the 7 P's of transformational blended learning, and Access. Examples of these problems of practice are illustrated in this volume's [Chapter 1: Introduction to K-12 Blended Teaching](#). Below is an image from the English Language Arts chapter that demonstrates some possible problems of practice.

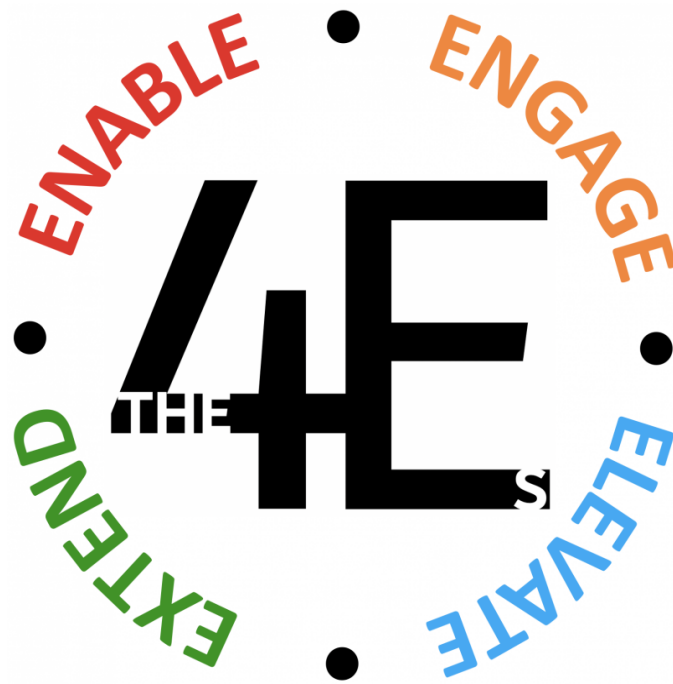


New Content in Volume 2

While Volume 2 understandably builds on the content of Volume 1 and offers new examples of blended teaching across K-12 contexts, it also offers some new insights that are generally applicable to blended teaching.

First, [Chapter 2: K-12 Blended Teaching Competencies](#) offers an overview of the competencies from Volume 1, but also provides new understandings of what some of these competencies look like in practice. Worth specific exploration are new understandings of what personalized learning looks like in K-12. Chapter 2 provides a framework for designing personalized learning that examines the relationships between the data used for personalization, who or what is controlling the personalization, what is being personalized, and the extent to which learners are practicing agency and ownership over their own learning. These new understandings of personalized learning come from working alongside the teachers who contributed their practices to this book.

Second, [Chapter 3: Evaluating Teaching with the 4Es and PICRAT](#) presents a new framework for evaluating blended teaching practices. Volume 1 used PICRAT to help explain some of the designing that goes into blended teaching. Volume 2 builds on Volume 1 by providing both PICRAT and a new 4E framework for evaluating blended teaching. This new framework focuses on evaluating the ways in which blended teaching Enables, Engages, Elevates, and/or Extends learning in meaningful ways.



New Resources in Volume 2

Much like Volume 1 offers resources such as blended teaching videos, artifacts, and reflection questions, the books in Volume 2 have their own resources worth referencing.

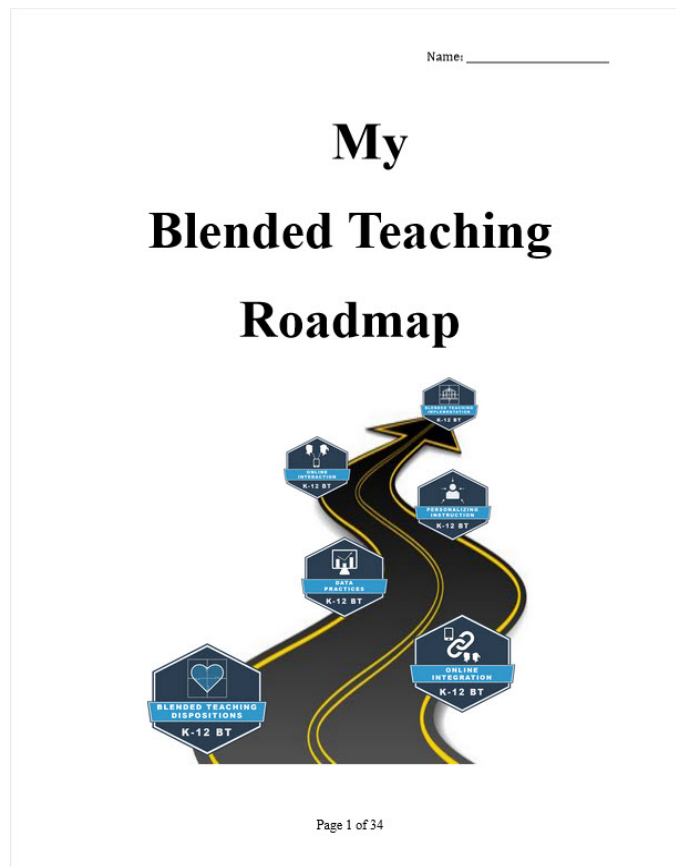
Each chapter of this book is filled with **teacher quotes and videos** about teachers' experiences with K-12 blended teaching. Chapter 4 of this book introduces the teachers who contributed practices to the book. Our hope in creating this book is that it can largely be seen as a book created through collaboration with teachers for teachers. The videos and quotes throughout this book should not be seen as optional content, but rather as the core content used to explore examples of blended teaching across content areas and grades.

The other key resources to be aware of in using this book for training, professional learning, or blended teaching implementation are the **Blended Teaching Readiness Survey**, the **Blended Teaching Roadmap**, and the **Blended Teaching Workbook**.



Each chapter of Volume I begins with a link to the **Blended Teaching Readiness Survey**, a brief readiness self-assessment survey. This survey can be helpful as you prepare for blended teaching regardless of whether you are taking a competency-based approach or a problems of practice approach. The survey takes 2-3 minutes per section of

the survey. These sections include questions about your dispositions and abilities to use online integration, data practice, personalized learning, and/or online interactions. It provides users with a sense of their current aptitude for blended teaching specific to each competency. You can learn more about the Blended Teaching Readiness instrument and use it yourself here: <http://bit.ly/K12-BTR>.



The [Blended Teaching Roadmap](#) is a resource introduced in Volume 1 for guiding teachers in designing, developing, and implementing blended teaching. Like Volume 1 itself, this resource takes a competency-based approach to help educators implement blended teaching. Appendix C of Volume 1 provides links to examples and Google Docs to reference and use in creating a plan for blended teaching. To use the Google Doc, you should make a copy of the Blended Teaching Roadmap that you can edit and own.



Blended Teaching Workbook

This is an example of what the callout boxes for the Blended Teaching Workbook look like. You will find these scattered throughout the book. You can access the Blended Teaching Workbook [here](#).

The [Blended Teaching Workbook](#) is a new resource introduced in Volume 2. Like Volume 2 itself, this resource takes a problems of practice approach to designing, developing, and implementing blended teaching. References to the Blended Teaching Workbook are scattered throughout this book with links to the Google Doc used to create the workbook. To use the Google Doc, you should make a copy of the Blended Teaching Workbook that you can edit and own.

We hope that you enjoy the book we have put together, and encourage you to share it with others! Thank you again for exploring our work!

Previous Citation(s)

Graham, C. R., Borup, J., Jensen, M. A., Arnesen, K. T., & Short, C. R. (2022). Preface and About This Book: . In K. T. Arnesen (Ed.), *K-12 Blended Teaching: English Language Arts: A Guide to Practice within the Disciplines*. EdTech Books. <https://edtechbooks.org/-QweN>

Graham, C. R., Borup, J., Jensen, M. A., Arnesen, K. T., & Short, C. R. (in progress). *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines, 2*. EdTech Books. <https://edtechbooks.org/-QNCX>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/preface.

General Introduction to Blended Teaching

Introduction to K-12 Blended Teaching
K-12 Blended Teaching Competencies
Evaluating Blended Teaching with the 4Es and PICRAT



This content is provided to you freely by EdTech Books.

Access it online or download it at

https://edtechbooks.org/k12blended_science/general_introduction.

Introduction to K-12 Blended Teaching

Charles R. Graham, Karen T. Arnesen, Jered Borup, & Michelle Jensen



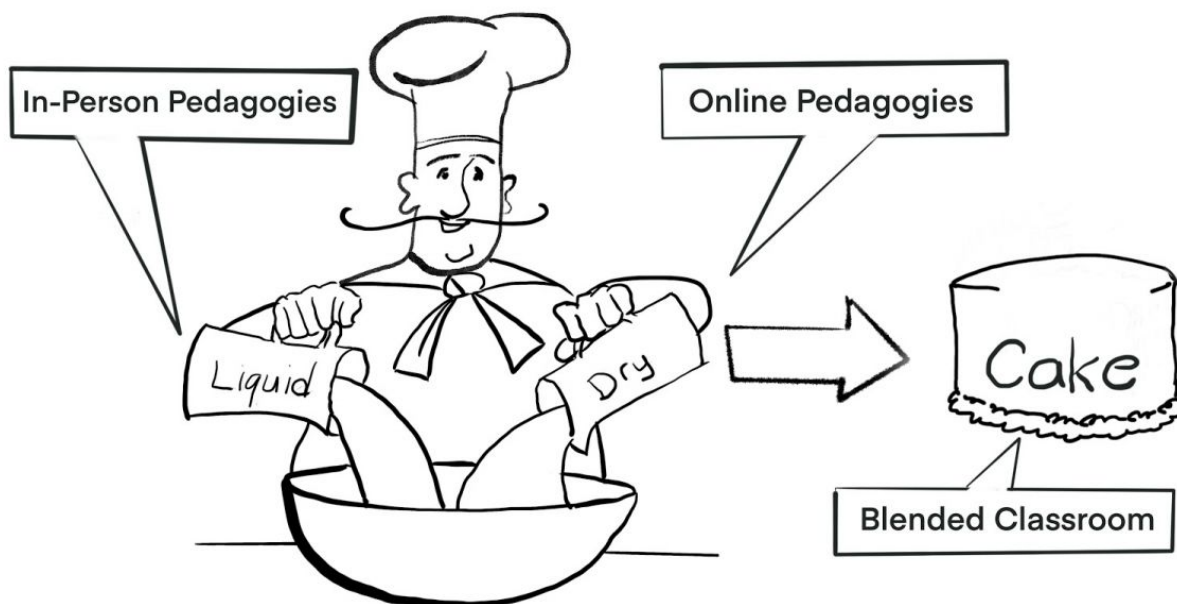
1.1 Blended Teaching

In its simplest form, blended teaching is the *strategic* combination of in-person teaching and online teaching.

Blended teaching is a general term that covers a wide range of different pedagogies, strategies, models, and practices. One teacher's blended classroom might look mostly like a traditional classroom with the addition of an occasional online discussion with students, while another classroom might be mostly online with a few strategically planned in-person activities.

Consider this simple (yet imperfect) analogy. Blended teaching is like baking a cake.

- The cook mixes the dry and liquid ingredients together to create a cake for friends/family to eat. The skill of the cook and the nature of the ingredients can create something uniquely wonderful.
- Likewise, a teacher 'mixes' pedagogies in online and in-person modalities together to create learning experiences/outcomes for students.



Consider possible lessons to take from the blended-cooking analogy:

- More dishes are possible with both dry and liquid ingredients.
- The specific ingredients matter. (You can't just have 2 cups of any dry ingredients and 1 cup of any liquid ingredients.)
- The amounts of specific ingredients also matter.
- When mixed well the outcome is different (often better) than if not mixed at all.
- When different ingredients are used, a different cake is made.
- Different cakes may have different purposes.
- There are thousands of ways to combine the dry and liquid ingredients.
- Good cooks do not follow a recipe. They make the cake to fit a specific purpose.

Like a good baker makes a cake, a skilled teacher can create a blend that promotes learning in a way that is most helpful for her own students.



1.2 Reasons for Blended Teaching

There are three primary reasons that teachers are motivated to try blended teaching: (1) Improved student learning, (2) Increased access and flexibility, and (3) Increased cost efficiency. Table 1 shares a few simple examples of each of these reasons for blending.

Table 1

Reasons for Blending

Reasons for Blending

Improved Student Learning	A teacher:
----------------------------------	------------

Reasons for Blending

	• uses the blend to give students small group instruction or one-on-one time with students in order to address specific learning needs. • uses data obtained from online tracking systems to constantly monitor learning and to make adjustments to instruction. • uses self-made videos to give instructions that students can slow down, speed up, pause, or repeat in order to understand the material or an assignment. • offers choice in assignments to increase student engagement and ownership in their learning.
Increased Access and Flexibility	A teacher: • uses the online space to incorporate into the classroom materials and information, targeted instruction, and activities that are not otherwise available. • A teacher uses technology to give students choices in learning activities. • A teacher consults with students to make learning goals.
Increased Efficiency	A teacher: • moves some science labs online, creating less need for expensive equipment in the classroom. • uses books that are online to lower the cost of books (and to have more than a classroom set for students). • uses the online space to publish assignments, teacher and student examples, writings, explanations, and questions, reducing the need for copies. • Creates videos to expand teacher presence in the class, thus multiplying her effectiveness and productivity.

In this book we will primarily focus on providing examples of blended instruction that are designed to improve student learning and/or increase access and flexibility for the learner. It is worth noting that while one of these purposes may be the primary reason that you implement a blended approach, you may also see added benefits in other areas as well, such as in ease of lesson planning or improved overall class engagement.



1.3 Identifying Your Reason for Blending

Each teacher needs to decide their own reason for blending. This is important because, like the chef with the cake, determining your purpose provides a vision for how to select appropriate blended models and strategies to achieve the purpose. Blending just because an “administrator told you to” or because “you like technology” are not good reasons for blending.

In working with teachers, we have found that one of the best ways to get started is to identify and focus on a problem of practice. A problem of practice is a current problem or challenge that you believe blended teaching could help you solve.

As you consider problems of practice that are meaningful to your teaching context, these five pathways may help you identify them (Table 2).

Table 2

Problem of Practice Pathways

Problems of Practice Pathways

Signature Pedagogies	Signature pedagogies are the teaching strategies that are commonly used in your discipline. They are often unique to your content discipline and shared within your professional organization. A problem of practice could be recognizing and trying to address limitations in your implementation of one or more signature pedagogies in your discipline. Examples: • Language Arts: I want to find more effective ways to engage my students in collaborative writing. • Math: I want to increase the quality of mathematical discourse in my classroom. • Science: I want to create opportunities for my students to use technology to analyze and interpret data and then create a scientific argument from this evidence.
Social Emotional Learning	Students may struggle in areas of social emotional learning, such as self-management, self-awareness, responsible decision making, social awareness, and relationship skills. A problem of practice could be recognizing and addressing areas of growth in students' social and emotional learning. Examples: • I want to create structures to help my students to make rational decisions. • I want my students to engage in activities that help them develop empathy for each other. • I want to introduce self-regulation challenges into my students' assignments.
6 C's of Deep Learning	The 6 Cs of Deep Learning are character, citizenship, collaboration, communication, creativity, and critical thinking. A problem of practice could entail trying to increase one or more of these C's in your instruction. Examples: • I want to increase my students' ability to communicate effectively about their learning. • I want to help my students develop better collaboration skills. • I want to students to think critically about current world events. • i want to allow my students to demonstrate their learning in creative ways. • I want to help my students practice appropriate digital citizenship. • I want my students to develop good character as they prepare to enter the real world.
7 P's of Quality Blended Teaching	The 7 Ps of Quality Blended Teaching are participation, pacing, personalization, place, personal interaction, preparation, and practice with feedback A problem of practice could be recognizing and addressing a challenge in one of these areas. Examples:

Problems of Practice Pathways

- I want to enable 100% participation in class discussions.
- I want my students to pace themselves to learn as quickly as they are able or as slowly as they need to.
- I want my students to personalize their learning by selecting learning activities that will help them the most.
- I want to open up learning experiences that take place outside of my classroom.
- I want to create additional opportunities for students to personally interact with me and with one another.
- I want to increase students' out-of-class preparation before classroom activities.
- I want my students to receive timely, effective feedback to their practice.

Student Access

Students may have challenges with access to traditional learning opportunities because of disabilities, illness, and/or participation in extracurricular activities like sports or the arts. They may also have limited access to materials that are necessary for improving their understanding of the subject. Such materials may include books, primary resources, lab equipment and resources, art supplies, concert or theatrical performances, etc.

A problem of practice could try to address challenges of access for students in your class.

Examples:

- **Student Absence from Class:** I want to make it easy for students who miss class for illness or extra curricular activities to stay caught up.
- **Transient Students:** I want to make it possible for students who move between schools regularly to quickly assess what they know and do what is needed to participate with the class.
- **Resources:** I want students to have access to the educational materials used as part of our learning in class.



1.4 Examples of Problems of Practice

Here are some examples of teachers who used blended teaching to solve a problem of practice. As you read through them, see if some resonate with desires you have for your classroom.

Scenario 1

Problem of Practice: A teacher wants students to take more ownership for their educational practices and attitudes.

Blended Approach: Students set weekly and daily goals which are recorded online, where the teacher has immediate access to them. Goals can include completion goals (setting a certain number of assignments and assessments to complete), performance goals (setting a specific standard of how well the assignments are done), or a mindset goal (setting a goal for asking for help or focusing better), for example. Students share their goals with their team and teacher online. At the end of the week, they reflect online about their experience. The teacher can respond online or in-person to areas of concern as needed.

Setting: LPS (Leadership Public Schools) Richmond in Richmond, CA

Site: [Daily and Weekly Goal Setting](#)

Scenario 2

Problem of Practice: A chemistry teacher wants his students to “learn for themselves and by themselves.”

Blended Approach: The teacher employs a flipped classroom. He creates videos of content the students need to know as well as tutorials on how to do certain chemistry operations. The students watch these videos at home. In class, the students apply what they learn at home in a variety of activities. The teacher walks around the class, answering questions, giving guidance, tutoring as needed, and “putting out fires.”

Setting: Woodland Park High, Colorado

Site: [Flipped Chemistry Course](#)

Scenario 3

Problem of Practice: A writing teacher wants her students to receive immediate feedback and to value the writing and feedback processes.

Blended Approach: The teacher has students write a specific type of paragraph online in a shareable document. While the students write, the teacher opens the students’ documents on her computer and gives feedback on them. Later the teacher and students discuss how to give good feedback. The students are then paired with another student to give each other online feedback. The teacher chooses five feedback comments and shares them in an in-person whole class discussion about the strengths and weaknesses of the feedback comments.

Site: [Learning to Give Feedback](#)

Scenario 4

Problem of Practice: A middle school teacher wants parents to be better informed and involved in their child’s education.

Blended Approach: Students use an app called Seesaw to record their work. Anything recorded on Seesaw is immediately available to parents who are connected to their child’s profile. Students can add video and audio components to explain their work.

Setting: Trailblazer Elementary School in Colorado Springs, CO

Site: [Seesaw Record](#)

Scenario 5

Problem of Practice: Students hurry through math assignments without really learning how to approach math problems and do them correctly.

Blended Approach: Students have individualized online learning agendas with standards, instructional videos, and text exercises. Students check off each objective within a standard as they complete them and pass an online mastery quiz. Teachers use the agendas to track student progress. When the students have finished each objective, the teacher reviews the progress and assigns them to create a mastery video, in which the students show how they work an easy, medium, and difficult problem within the standard. Teachers review the video to determine if the student is ready for the final mastery assessment.

Setting: ReNEW DTA, a charter school for pre-K through 8th grade in New Orleans, LA.

Site: [Thinking Mathematically](#)

Creatively addressing problems of practice with a blended approach can transform your classroom and help you create a strong, effective learning environment.



1.5 Pedagogy Centered, Technology Supported

The power of the blend is that it opens a whole new set of pedagogical possibilities for teachers. Although blends can improve outcomes for students, they can also make things worse for them. As with traditional teaching, the teacher's strategic planning and skill will make all the difference in the quality of the blend.

One way to begin thinking strategically about a blend is to consider the 3 M's—media, modality, and method.

Definitions: Media, Modality, Method

Media: The physical tools or technology used in the classroom. They can be digital media, such as tablets, computers, or cameras, or they can be non-digital, such as whiteboards, books, or science equipment.

Modality: The environment, where learning takes place. Modalities are generally the in-person classroom, the online classroom, and the blended classroom.

Method: The strategies and pedagogies of the teacher. They may be general methods (such as discussions) or discipline specific pedagogies such as experimental labs in chemistry.

See [Media, Modality, and Methods](#) video for a more full explanation.

Although all three M's impact learning, they are not equal in importance. No media or modality will be effective if it is not used as part of meaningful and strategic methods or pedagogies. Modality and media have an indirect effect on learning outcomes because they influence the *types* of strategies and methods that a teacher can use. But the teacher's methods directly influence student learning and outcomes. Table 3 shows good and bad examples of blended learning strategies and pedagogies. Evaluate each and see what made the difference: media, modality, or method.

Table 3

Good and Poor Examples of Blended Learning

Good Example of Blended Learning	Poor Example of Blended Learning
A math teacher uses adaptive software. She allows students to progress at their own pace and has one-on-one or small group sessions for students who struggle with a particular concept.	A math teacher has students who finish their math assignment early uses apps on a classroom set of tablets to play math games.
A history teacher sends students links to two different viewpoints of a historical event. Students read/watch the content at home. In class, the teacher puts students in groups of four and has them summarize each viewpoint and discuss why they are different. How does the creator's viewpoint affect the depiction of what happened? How can people really know what happened and why?	A history teacher records a lecture and has students view it before class at home. In class they do a worksheet with questions about the lecture.
A foreign language teacher utilizes station rotations in his classroom. At one station students choose from a list of writing assignments and write using google docs. Another student at that station reads the document online and gives suggestions or asks questions.	A foreign language teacher uses a video streaming service to show his students a weekly video in the target language. This enhances listening skills and allows

Good Example of Blended Learning

At the next rotation students meet online with a native speaker and have a short conversation, which uses new vocabulary.

Finally, at the last station students meet with the teacher to discuss and practice new grammar rules and language structure.

Poor Example of Blended Learning

students to hear the language spoken by native speakers.

These examples illustrate that blended teaching is powerful only when the modality and the media are used to support, not replace, pedagogy or method. As in any teaching setting, good blended teaching does not depend on technology but on the teachers' understanding of her students, her knowledge of the content, and her ability to plan strategies that will use technology to meaningfully combine online and in-person spaces, increase the number and quality of student interactions, use data to effectively meet students' needs, and personalize instruction in order to increase student ownership of their education, their engagement, and their ability to develop and use 21st century skills.

The chapters in this book will help you get started.

Previous Citation(s)

Graham, C. R., Arnesen, K. T., Borup, J., & Jensen, M. A. (2022). Introduction to K-12 Blended Teaching. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines*, Vol. 2. EdTech Books. <https://edtechbooks.org/-Cipt>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/intro.

K-12 Blended Teaching Competencies

Charles R. Graham, Jered Borup, Michelle Jensen, Karen T. Arnesen, & Cecil R. Short

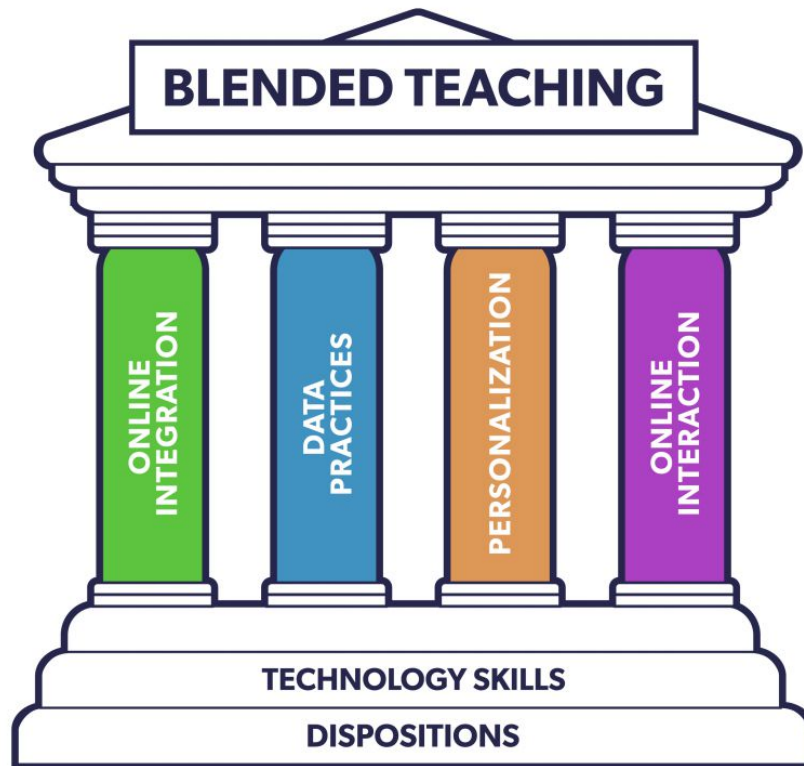


2.1 Blended Teaching Competencies

In [Volume 1 of K-12 Blended Teaching](#) we introduced four competencies shown in Figure 1, with each competency represented by a pillar built on a solid foundation of blended dispositions and technology skills. The four core blended teaching competencies—(1) Online integration, (2) Data practices, (3) Personalization, and (4) Online interaction—can be mastered by any teacher in any subject area. These competencies are built on a foundation of positive dispositions and basic technology skills.

Figure 1

Blended Teaching Foundations and Core Competencies



We will provide a brief introduction to these competencies in this chapter with more in-depth coverage in each of the subject-specific sections. Check out your readiness for blended teaching in each of these areas by taking this [Blended Teaching Readiness Self-evaluation](#).

Test Your Blended Teaching Readiness: <http://bit.ly/K12-BTR>

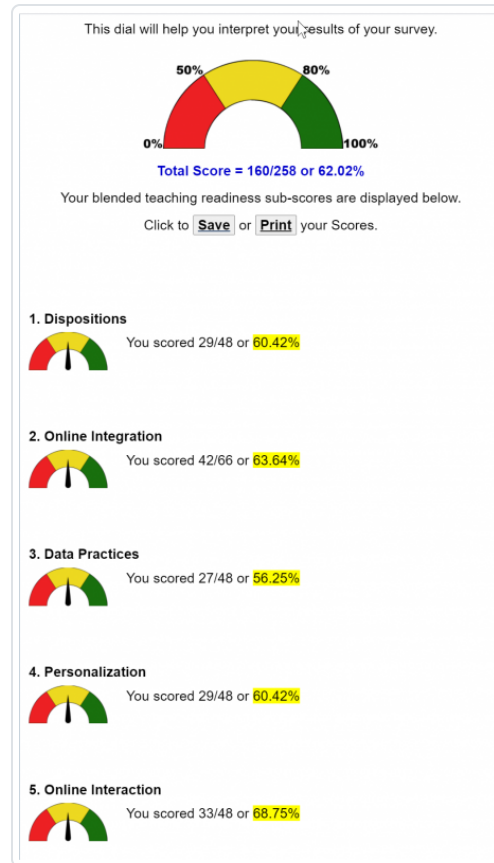


Check out how ready you are for blended teaching?

As shown in Figure 2, the results of the blended teaching readiness instrument will give you a score in each of the competency areas. The scores will help you to understand which competency areas you might want to start with as you build your personal skillset with blended teaching.

Figure 2

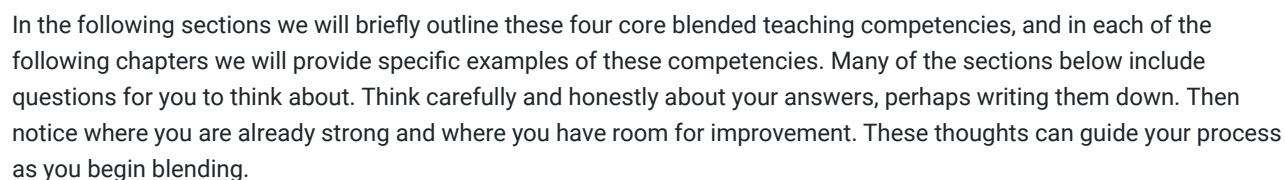
Example results from the Blended Teaching Readiness Survey



This volume differs from Volume 1 of the K-12 Blended Teaching series in that it focuses on examples of blended teaching in a specific content area. The four competencies of online integration, data practices, personalization, and online interaction are still key skills for successful blended teaching. However, those skills may look distinct when practiced in different content areas. We have represented this idea on the cover of this book with the blended teaching tree as shown in Figure 3. The individual branches represent blended teaching in the many distinct educational disciplines all of which are nourished by the common core set of teacher competencies.

Figure 3

Core Competencies in the Content Areas



You will need to develop basic technology skills and positive dispositions in order to be successful in blended teaching.

Dispositions focus on the teacher's attitudes and beliefs towards blended learning and teaching. Positive attitudes, even excitement, in each of these areas will determine how willing you are to experiment with and grow in a blended learning context.

Learn more about dispositions and skills in K-12 Blended Teaching (Volume 1): [What Competencies are Needed?](#)

Successful blended learning classrooms shift from teacher led pedagogy to student driven pedagogies. Students begin to take more control of and responsibility for their learning, often making decisions for what, how, and when they learn. Teachers become a facilitator in such decisions and in helping students succeed in their new roles.

- 20

2.2.2 Mastery Learning Orientation

Blended classrooms lend themselves to mastery-based learning instead of time-based learning. Students advance in their learning as they master skills and content, not as they spend a certain amount of time on them. This approach significantly reduces the amount of whole-class direct instruction. Technology is a helpful tool for managing mastery learning.

- How do I feel about students learning at different paces in my classroom?
- Do I value students having enough time to master a learning objective before they move to the next one?
- Do I think I could develop the flexibility to manage such a classroom?

2.2.3 Value of Data-Driven Decisions

A reliance on data (Figure 4) to make decisions about instruction and individual pathways to learning is at the heart of a blended classroom. This data may include formative and summative assessment results, attendance, student goals, demographics, and measures of engagement. It can help teachers recognize strengths and weaknesses, progression, and reasons for students' lack of progress.

- How do you feel about using technology to keep track of various aspects of student learning?
- Do you feel data could help you not only understand your students better but also help them progress and become better learners?

Figure 4

Example of a Mastery Tracker Showing Student Progress

Students  		 1	 1	 1	 1
SORT: Last, First  A - Z 		Obj1.1 	Obj1.2 	Obj1.3 	Obj1.4 
Student 1	3 0 1	MASTERY	MASTERY	MASTERY	REMEDIATION
Student 2	2 2 0	MASTERY	NEAR MASTERY	MASTERY	NEAR MASTERY
Student 3	3 0 1	MASTERY	MASTERY	REMEDIATION	MASTERY
Student 4	2 1 1	REMEDIATION	NEAR MASTERY	MASTERY	MASTERY
Student 5	2 2 0	MASTERY	NEAR MASTERY	NEAR MASTERY	MASTERY
Student 6	4 0 0	MASTERY	MASTERY	MASTERY	MASTERY

2.2.4. Growth Orientation

Becoming a successful blended teacher will require you to take risks. You may fail at times, but these failures can help you learn and improve.

- How eager are you to learn new things and try innovative ways to do things?
- Are you willing to take risks that may temporarily leave you feeling inadequate? (Are you willing for your cake to fail now and then?)
- Do you enjoy learning and trying new things?

2.2.5 Emphasis on Life Skills

In a blended learning environment, technology can be used to develop real life skills such as communication, collaboration, creativity, and critical thinking.

- Do you currently use pedagogies that help your students develop life skills? If not, how can you start?
- Do you believe these life skills are part of your responsibility as a teacher?
- Are you willing to consider using technology to develop these skills?

2.2.6 Value of Online Learning

Because blended learning is “the strategic combination of in-person with online teaching,” valuing online learning is as important as valuing in-person learning.

- Do you believe online activities can enhance the way children learn?
- Do you feel online activities can give students opportunities to learn they can not get in the traditional classroom?
- Can you see ways online learning can help you personalize or individualize curriculum?

It is natural to feel a little uneasy about some of these dispositions. Maybe you are suspicious of online learning, or perhaps giving students more control makes you feel uneasy or out of control. Perhaps you worry that if you emphasize life skills, you won't be able to teach the content you are mandated to teach. Any new venture may feel risky; however, the fact that you are reading this book shows that you are ready to learn! And learning can change dispositions.

You can begin to see yourself as a teacher in new ways and to grow and learn along with your students, adding an excitement to learning that will enhance any methods you learn and choose to use. The key is just to begin. Beginning is the basis for personal growth—you have to start somewhere!



2.3 Basic Technology Skills

If you feel uncomfortable with all the technology tools out there, you are not alone. However, it is important to note that technology is not ultimately the focus of blended learning. *It is about helping students learn.* Once you start applying blended teaching, you will find that technology will become as invaluable and comfortable a tool to use in improving the learning experience of your students as a whiteboard, a book, or a worksheet is.

Here are some of the important knowledge and skills you can develop as a blended teacher.

2.3.1 Basic Literacy

You will need to become familiar with and use technologies on your own, troubleshoot issues that may arise, and find quality online content for use in your classroom.

- What technologies do you currently feel comfortable with? How did you learn to use them?
- Make a list of technologies you know of but that you don't use. Which one would you like to learn? How can you do so?

2.3.2 Digital Citizenship

Digital citizenship consists of modeling and teaching copyright laws and fair use, ensuring privacy and protection (passwords, no bullying, etc.), ensuring honesty, and ensuring access.

- What concerns do you have in any of these areas?

2.3.3 Learning management systems

Many blended teachers use learning management systems (LMS) to organize their classrooms. They keep grades, give announcements, and create content pages, quizzes, assignments, and discussion boards in the LMS.

- Does your school already use an LMS? Which one? How familiar are you with it? How can you learn more? Is there another teacher or a coach in your school who could help you?

2.3.4 Educational Software

Blended teachers have resources for finding content-specific educational software that helps them meet their learning objectives.

- What content specific educational software are you aware of? Does your school already subscribe to any?
- Are there any free sources you can use?

2.3.5 Media Creation Tools

These tools help teachers create or edit online materials to meet specific needs. They are also tools that students can use to create.

- What media creation tools are you familiar with?
- How could you use them to create materials for your classroom?
- How could you let your students use them to learn or to demonstrate learning?

2.3.6 Communication Tools

Blended teachers use a variety of tools for communicating with their students, parents, administrators, and other stakeholders. They also leverage these tools to help students communicate and collaborate with each other.

- How can greater communication with students, parents, administrators, and others help enhance your teaching ability and your students' learning experiences?
- What tools do you already use to interact with others? Could some be adapted to use with students and others?
- What new tools (such as [Flipgrid](#)) could you incorporate into your classroom?



2.4 Online Integration

Online Integration focuses on the teacher's ability to make and implement decisions related to selecting when and how to effectively combine online and in-person learning as part of core instruction.

Online integration is the one competency that is truly integral to blended teaching. Why is this so? If you don't have some kind of strategic combination of online and in-person instruction, you don't have blended teaching. However, don't let this overwhelm you. All of the other competencies we will discuss provide specific tools to use in integrating the online and in-person space.

- What part of your instruction could be moved online so that you have more time to spend one-on-one or in small groups with students?
- How could you make this content available to students in the online space?
- What parts of student learning are especially well suited to in-person learning?
- How can using the online space help make learning more interactive and personalized?

Read more about [online integration practices](#) in the in K-12 Blended Teaching (Volume 1).



2.5 Online Interaction

Online Interaction focuses on the teacher's ability to facilitate online interactions with and between students. Online interaction in a blended teaching classroom broadens the opportunity for students and teachers to communicate with one another about their learning. Online interaction might include digital instruction, discussions, and feedback.

In 1989, Michael Moore defined three different types of learning interactions: (1) Student–content, (2) Student–instructor, (3) Student–student. Moore explained that each type of interaction contributes to a quality learning experience. Though Moore defined these types of learning interactions in a discussion about distance learning, they also apply to online interactions that occur in blended teaching.

Online student–content interaction occurs when students engage with online learning materials by reading, listening, watching, and/or reflecting. Online student–instructor interaction occurs when students have opportunities to apply what they have learned from their content interactions, demonstrate new knowledge, and receive feedback in an online forum from the teacher as the “expert.” Finally, online student–student interaction occurs when students communicate online with one another—sharing their understanding and building on what they have learned.

One of the key elements to being able to leverage the advantages of blended learning is the ability to create a positive, supportive, and safe space—not only in the physical classroom, but in the online space as well. Just as students must develop an understanding of the rules, routines, and procedures for communicating and participating in-person, they must also learn the guidelines for online interaction.

Read more about [online interaction](#) in K-12 Blended Teaching (Volume 1).

2.5.1 Online discussions

One of the major interactions that can happen in an online setting is the use of discussions. The advantage of online discussions is that they are one of the few online activities that can combine all three types of interactions. Students usually read or view materials to prepare for the discussion (student–content interaction), then share their thoughts with their peers (student–student interaction) in a forum that is moderated by the instructor (student–instructor interaction). As a result, online discussions can be critical in helping students achieve course outcomes because they provide students with a variety of interactions.

Discussion Variations

Online discussions can happen synchronously (in real time) or asynchronously (not in real time). The advantages of an asynchronous discussion is that it allows additional flexibility in time, place, and depth of reflection. Online discussions can also range from low fidelity (mostly text based with no communication cues) to higher fidelity (video communication with more communication cues). Higher fidelity discussions that utilize video or audio discussion platforms contain many of the communication cues that we are used to having in person.

Learning Objectives

It takes careful thought and preparation to create an effective online discussion. Once you have established guidelines, you must figure out how an online discussion can support and improve student learning. It is helpful to keep in mind what you want students to know and take away from the online discussion. You might want to communicate this rationale with students, highlighting what you hope they will gain from their participation.

Once you have determined your objective(s), consider how you are going to make sure that students meet them. You may want to think about the source material students will need to read or watch prior to participating, how the online discussion will inform in-person discussions, and whether the discussion will be started, continued, or finished in the online setting.

Effective Prompts

All good online discussions begin with well-planned discussion prompts. You may wish to consider a range of question types depending on the specific objectives and what you want students to take away from the discussion. These questions can take a variety of forms, similar to any in-class discussion. As Davis (2009) described, you might consider asking the following types of questions:

- Exploratory questions: probe facts and basic knowledge
- Challenge questions: interrogate assumptions, conclusions, or interpretations
- Relational questions: ask for comparisons of themes, ideas, or issues
- Diagnostic questions: probe motives or causes
- Action questions: call for a conclusion or action
- Cause-and-effect questions: ask for causal relationships between ideas, actions, or events
- Extension questions: expand the discussion
- Hypothetical questions: pose a change in the facts or issues
- Priority questions: seek to identify the most important issue(s)
- Summary questions: elicit synthesis

These question types can be mapped to Bloom's Taxonomy, ranging from those that focus on factual information such as exploratory questions, to others that require more in-depth synthesis and evaluation.

Online discussions are more productive when teachers give participants explicit instructions. You will want to model the nature of the posts you are expecting. Directions may also include a number of factors such as post length, style of writing, specific formatting conventions students are expected to follow, required references, expectations for number of replies, who will respond to whom, and when initial posts and response posts are due. You can group these aspects into categories of structure, content, flow, and timing. Each aspect of these categories is described in Table 1.

Table 1

Characteristics of Online Posts

Category	Factor	Description
Structure	Length	How long should posts be? Can you include a range of the number of words expected? Should the post be a certain number of sentences or paragraphs?
	Style	How formal do you expect the language to be? While it might be more conversational, the tone should still be academic in nature. Helping students strike this balance is important to model in online discussions.
	Formatting	Are there any guidelines you want students to follow when posting , such as a specific title for the subject line? Should students use a greeting and a closing in their responses? Is there specific content you want in each paragraph?
Content	Requirements	Are there sources/references the students need to connect to or cite in their responses? What ideas must students present in their posts?
Flow	Replies	How many posts/responses are required to adequately participate in the discussion? How will students know who to respond to?
Timing	Due Dates	When are initial posts due? Do students have enough time to understand the material or discussion before posting?

Managing Discussions

One of the mistakes that teachers who are new to blended learning often make is using their LMS to create whole class discussion activities. It can be okay to have a class discussion board for sharing general ideas about class or asking general questions, but these are not ideal for creating student-student interactions. If the discussion group consists of more than 10 members, it becomes very difficult for each member of the group to read all the posts and know what has been said and what has not been said. Additionally, large discussion groups make it more difficult to create a sense of community, whereas members of a small group have a better chance of getting to know one another.

For managing discussions, breaking your class into smaller groups can be helpful. You might consider creating groups with between 4 and 6 members (certainly fewer than 10). If you want all students to get a sense of the discussion happening throughout the entire class, groups can have their discussion and then report to the entire class with a synthesis activity. Another strategy is to assign specific roles within the small discussion group to focus students' contributions. Over a series of weeks, these roles can rotate so that each student has an opportunity to fulfill each role. Several possible discussion roles might be facilitator, devil's advocate, connector, explorer, and summarizer (North, 2017).

When facilitating online discussions, it is also important to strike the right balance in terms of teacher interaction. Too little teacher interaction and students can feel like no one is listening. Too much and you run the risk of dominating the discussion which can limit or hamper students' interactions, both in terms of quality and quantity.

You will also want to establish guidelines for giving students credit for discussion board participation, and provide ways to allocate points for posting regularly, responding to classmates' posts, staying on topic, and responding in a thoughtful manner. Assessing the quality as well as the quantity of the students' online posts is important. Using rubrics will allow students to have clear guidelines of your expectations for the quality of their posts.

2.5.2 Feedback

Effective feedback highlights strengths and areas for improvement for student work, is given promptly and respectfully, and motivates students to improve. Feedback should build relationships, offer praise, suggest corrections, and offer support. In a blended classroom online tools can be used to facilitate these goals. Online rubrics within most learning management systems help teachers to quickly assess and communicate expectations to students. Feedback templates may be used to provide feedback about common weaknesses by completing a digital form for each student. Video and audio comments can allow for more complex feedback.

Peer Feedback

Quality peer feedback can allow teachers to spend their time more effectively. For instance, you can implement a three-before-me policy that requires students to receive feedback from three peers before submitting the project to you for feedback. John Hattie's (2008) review of research found that 80% of feedback that students receive comes from their peers. Unfortunately, 80% of that feedback is incorrect! As a result, you should help students learn how to provide quality feedback to their peers. For instance, you can create specific rubrics and then help students understand how to use those rubrics while providing feedback (2008).

Teacher Feedback

Student to teacher feedback can improve learning for all students. Again, John Hattie's seminal synthesis of over 800 meta-analyses relating to student achievement highlights the need for student-provided feedback. Hattie explained, "the most important feature was the creation of situations in classrooms for the teacher to receive more feedback about their teaching" because it created a "ripple effect back to the student" (2008, p. 12). Online communication can help students provide you with meaningful feedback because their comments can be anonymous. It can also give students the opportunity to provide you with feedback at any time. For instance, you could create an anonymous feedback survey using Google Forms linked in the sidebar of a course website that students can access while they are working on assignments.

Supporting Learning with Online Interaction

Sometimes teachers don't see a need to communicate online if students have the opportunity to do so in-person. However, there are advantages and disadvantages to both in-person and online communication. The challenge is leveraging the advantages of both in-person and online interaction. Some of the strengths of online communication include:

- **Flexibility:** Students can contribute to the discussion at the time and place that is most convenient and comfortable to them.
- **Participation:** All students can participate because time and place constraints are removed. The discussion is not limited to the time that class is meeting or to the students that are present or feel most comfortable speaking in front of others.
- **Depth of reflection:** Students have time to carefully consider their claims, provide supporting evidence, and engage in deeper, more thoughtful reflections (Mikulecky, 1998; Benbunan-Fich & Hiltz, 1999).

Notice how the strengths of online communication are some of the weaknesses of in-person communication.

2.5.3 Conclusion

Online interaction facilitates student learning by taking advantage of the strengths of both in-person and online communication. You can begin or improve your blended teaching by considering the advice and guidelines recommended in this chapter.



2.6 Data Practices

Data Practices focus on the teacher's ability to use digital tools to monitor student activity and performance in order to make informed choices about interventions and to help all students progress.

Read more about [data practices](#) in K-12 Blended Teaching (Volume 1).

2.6.1 Performance Data

Performance data shows direct measures of how students perform on assessments. It may include measures such as grade books and state and national exams. Performance data can also be found in mastery or performance dashboards in an LMS.

2.6.2 Activity Data

Activity data are indirect measure of student participation and engagement. It includes attendance, participation, LMS log-in times, and engagement. Some of this data can be found in LMS dashboards; other data could come from one-on-one interviews or observations.

2.6.3 Learner Profile Data

Learner profile data are measures of a learner's background, interests, goals, and preferences. These data are just as important to data-driven instruction as performance data and activity data if teachers want to provide data-driven instruction and help students to personalize their learning.

Read more about [learner profile data](#) in section 4.1.3 in the Personalization chapter of K-12 Blended Teaching (Volume I).



2.7 Personalization

Personalizing instruction focuses on the teacher's ability to implement a learning environment that allows for student customization of their learning goals, pacing, time, place, and/or path. It is the process by which teachers shift their focus from a classroom in its entirety to individual students. Through personalization, students begin to understand how they learn and how they become life-long learners. Helping students learn how to learn is a goal that almost all teachers have for their students; the question therefore becomes, "How do I empower to students to personalize their learning in my classroom?"

Personalization means allowing a student's needs and desires to motivate what, when, where, and how the student meets the learning outcomes for a course (Patrick et al., 2013). This involves the teacher giving the students more freedom while still guiding and facilitating the learning process in the classroom. It is helpful to think about how learning can be personalized across various instructional elements, dimensions of personalization, and levels of student agency.

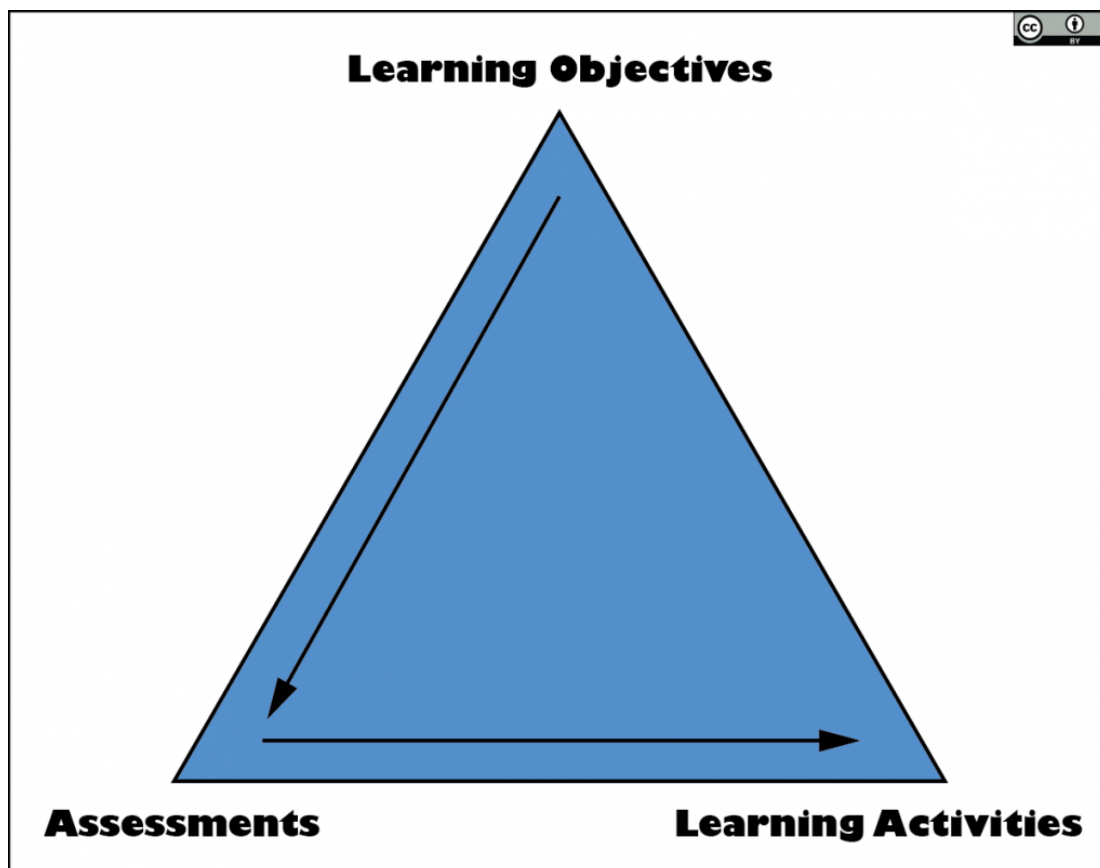
Read more about [personalization](#) in K-12 Blended Teaching (Volume 1).

2.7.1 Personalization Across Instructional Elements

Learning can be personalized along any of the three elements that commonly make up instruction: learning objectives, assessments, and learning activities (Figure 5). Describing the personalized learning of these elements helps explain what is being personalized.

Figure 5

Instructional Elements According to Backward Design



"Backward Design" created by Cecil R. Short is licensed under a [Creative Commons Attribution International 4.0 License](#)

While some assessments may have mandated times, places, and formats, other assessments may offer students some flexibility in demonstrating their knowledge or ability. For instance, some assessments can be personalized by allowing students to choose how they show their understanding; the level of mastery they hope to attain on the assessment; how quickly an assessment must be completed; or even when and where the assessment should be completed—such as at home or in an alternate school environment during class, before school, or after school.

Similar to assessments, learning activities can also be personalized by allowing students to choose from various kinds of activities, formats, or media to use in preparing for assessments; how quickly learning should occur; when and where

study or completion of learning activities should occur; with whom the student would like to work; or even the learning habits students aim to develop while completing the learning activities.

We further discuss how these instructional elements can be personalized by describing the various dimensions of personalized learning below (Figure 6).

Figure 6

Dimensions of Personalized Learning



“Five Dimensions of Personalization” created by Jered Borup is licensed under a [Creative Commons Attribution 2.0 International License](#)

2.7.2 Goals

Teachers often feel pressure to make sure their students meet certain outcomes by the end of their time together. These learning outcomes and requirements are usually designated on the district, state, or even national level. However, students can benefit from being encouraged to set, track, and achieve their own short-term goals throughout their learning. As teachers help their students to make Specific, Measurable, Attainable, Relevant, and Time-Based (SMART) Goals (see Figure 5), they show that students are responsible for their own learning and give students the tools to reach their potential (Graham et al., 2019).

Figure 7

SMART Goals



“SMART Goals” created by Dungdm93 is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](#)

It is important that both teacher and student work together to set appropriate goals to help the student reach the outcomes for the course and for personal growth. These goals, which can be academic (performance-based) or behavioral (habit-based), will allow the student to feel accomplished as they reach their own milestones throughout the course. The personalization of goals and the individual process of setting them will help motivate struggling students, showing them that they are growing in meaningful ways, and challenge advanced students, allowing them to set goals at their own level. Students and their teachers can also decide on personalized means of assessing if the students are reaching their goals and the learning outcomes for the course.

Not a Personalized Goal

The teacher decides that students will work towards 80% mastery of an assessment for a specific state standard.

Personalized Goal

Students aim for different levels of mastery, based on their previous performance data.

2.7.3 Time

Photo by [Ales Krivec](#) on [Unsplash](#)



Like most people, students often have a preferred time of the day in which they are mentally more astute and a preferred amount of time they can efficiently spend on a single task. As teachers get to know their students, they may begin to understand what these times are for each student. Personalizing time in a classroom allows students to focus on their more difficult content areas while they are more alert. In a full-day class, this may mean allowing some students to write in the morning, while others may choose to do so after lunch. In a period-based schedule, this may mean working with students to adapt the times and dates assignments are due, motivating students to work on their assignments at a time that cognitively works best for them. Additionally, some students may wish to work at home or

on a project before or after school. Personalizing time means allowing students to have access to the materials they need when they need them. It should also be noted that allowing students to work at a time that is best for them may also mean allowing them to work at a pace that is best for them.

Not a Personalized Time	Personalized Time
The teacher chooses when the whole class will participate in an instructional activity.	Students choose how to spend their time during a class's "flex" time.

2.7.4 Place

The personalization of place consists of both the location in which the students are learning and the people with whom they are learning (Graham et al., 2019). Personalizing place in a classroom allows students to learn the types of environments and interactions that are most conducive to their individual productivity while in a structured, low-stakes setting. This knowledge will benefit them as they graduate and move on to more high-pressured environments, such as college and careers. Teachers can open the space in their classroom to allow students to work in different groups or stations, or they may allow more freedom in what happens in the classroom or at home. The teacher can be in only one place at a time, so technology often plays a role in allowing students to have flexibility in the location of their learning by providing them with access to learning materials.

It is important to note that personalization is not always a separating process. There are many ways to group students in a classroom: in pairs or in small groups, with similarly skilled students working together, or with students on a spectrum of skills helping and tutoring each other (Graham et al., 2019). Teachers must decide how much freedom they give their students in determining both the other students in their groups and their roles within their respective groups.

Not a Personalized Place	Personalized Place
The teacher creates a seating chart and each student is expected to sit in his or her assigned seat.	Students are given a choice of where to sit based on several flexible seating options.

2.7.5 Pace

Personalizing pace allows students to adjust the speed at which they complete learning activities and content. While teachers may need to set a minimum pace at which student are allowed to work, adjusting the flow of material for each student helps to ensure that those who need more time to absorb the material are not left behind, while those who may grasp a particular concept more quickly are able to advance to activities that allow them to further develop their knowledge.

Not a Personalized Pace	Personalized Pace
The teacher determines when the class begins and ends working on a lesson or unit.	Students are able to work through units at the speed that works best for them, working ahead or slowing down as needed.

2.7.6 Path

A personalized learning path consists of students choosing how they will achieve a specific learning outcome or personalized goal. While the personalized goal or learning outcome is the end result, with personalized paths the students are able to decide the learning activities they complete as they strive to reach that goal. These options can take a variety of forms: students choosing assignments from a list of different learning activities that all teach the same principle, students deciding whether they would rather listen to instructions through a recording or read them on a page, or students each choosing how they will show mastery at the end of a unit. While these methods help the students to

feel ownership and connection to their learning, it also can prevent the tedium of grading worksheets or multiple-choice exams for every unit.

Not a Personalized Path

The teacher determines the sequence of activities that everyone in the class will complete.

Personalized Path

Students choose from among a list of activities that will help move them towards mastery.

2.7.7 How to Begin Personalizing, Levels of Learner Agency

Photo by [Paul Melki](#) on [Unsplash](#)



While the task of personalizing a classroom seems daunting, it is important to realize that teachers do not need to start implementing all five dimensions of personalization across learning objectives, assessments, and learning activities all at once. There are some domains that may already fit within a classroom's structure and others that may follow later. For example, a teacher may begin by helping students set their own goals, which might eventually develop into the personalization of path. The most important criteria are that a teacher starts with a student-centered mentality, builds a support system, and has a personalization plan in mind.

Becoming student-centered

The task of personalizing a classroom requires more than just a structural change in a classroom. It also requires the humility and patience to allow students more autonomy in their learning. The teacher must step away from a lecturing role and into the role of a facilitator and a guide, which often means getting to know the students in a more personal way. While it may be unfeasible to sit down with every student on a regular basis, even simple connections like sending surveys about students' preferences and needs can go a long way. These surveys can contain both multiple-choice sorting questions (Do you prefer reading instructions, watching video instructions, or both?) and open-ended, interest-

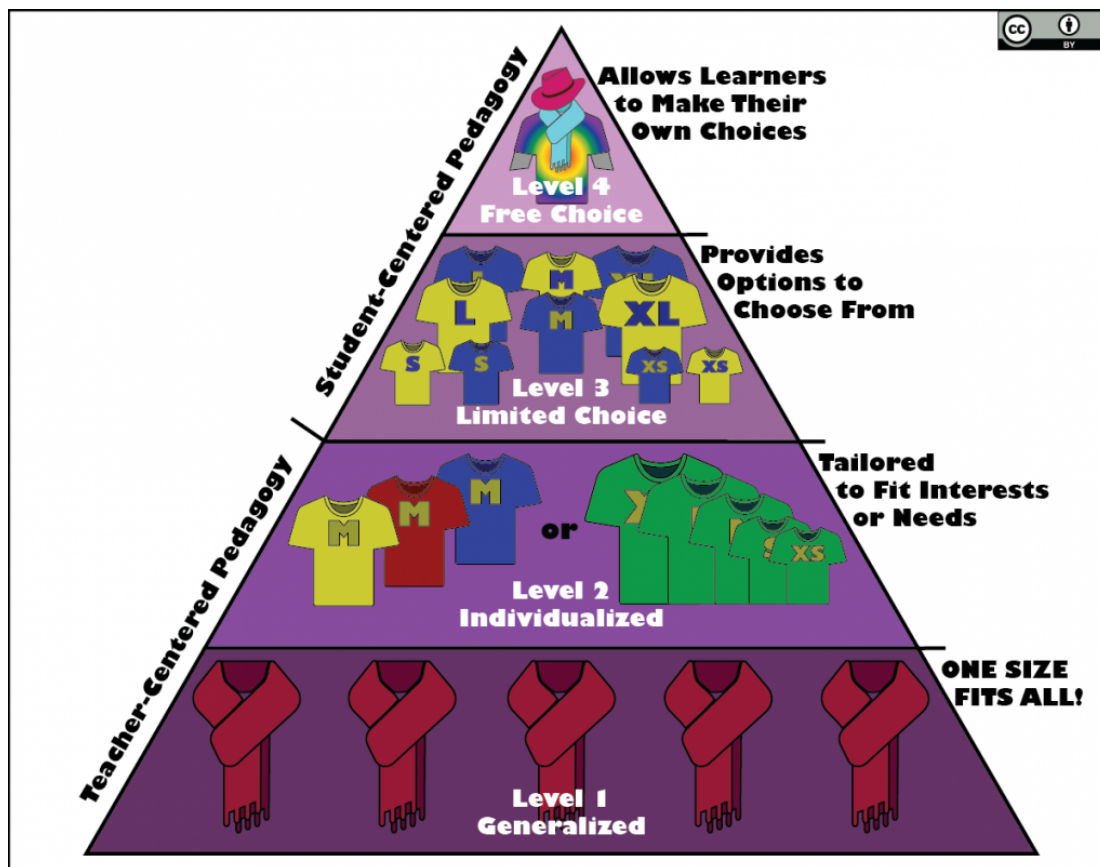
based questions (What do you like to do in your free time?) (Graham et al., 2019). The answers to questions like these can be used to develop a more student-centered classroom.

Short (2022) notes that teaching can incorporate four different levels of learner agency for personalization (See Figure 6). These levels are outlined as follows:

- Level 1 - Generalized Instruction. At this level, the instruction is largely teacher-centered and takes a “one-size-fits-all” approach to learning.
- Level 2 - Individualized Instruction. Instruction includes some differentiation, individualization, or adaptation. These modifications come from the teacher making decisions based on students' needs, interests, and abilities, or from technology that measures student knowledge or abilities and adapts instruction based on such data.
- Level 3 - Limited Choice. Students have some choice over their learning related to the goals, time, place, pace, and/or path of their learning. At this level, teachers provide students with options to choose from such as various levels of mastery to work toward, various forms of assessment to complete, or various videos to watch.
- Level 4 - Free Choice. Students fully direct the goals, time, place, pace, and/or path of their learning. At this level, students have full autonomy in directing their learning. It may be uncommon in K-12 contexts for students to reach this level all the time but there are opportunities for students to practice this level of agency. For example, students may freely choose the topic of an essay or whom to work with for completing a project.

Figure 8

Short's Taxonomy of Learner Agency



“Learner Agency Taxonomy” created by Cecil R. Short is licensed under a [Creative Commons Attribution International 4.0 License](https://creativecommons.org/licenses/by/4.0/)

These four levels of agency can be applied to any of the five dimensions of personalized learning (goals, time, place, pace, and path) and to any of the three elements of instruction (learning objectives, assessments, and learning

activities).

Developing a support system

Personalized learning is not the same as giving students free reign in the classroom. In order to truly help students, teachers need to find a balance between the overall structure of the classroom and the flexibility of student choice within that structure. As the teacher begins a school year with a plan of what decisions the students will be able to make and which ones the teacher will resolve, the teacher will be more prepared to help students reach their full potential. However, in order to truly be student-minded, teachers must remember to maintain a flexible mindset as they create personalization plans. Once teachers begin to understand the unique individuals in their classrooms, they will be able to fine-tune their plans for personalization in a way that supports those students.

Personalization plan

Personalizing learning is not the same as giving students free reign in the classroom. In order to truly help students, teachers need to find balance between the overall structure of the classroom and the flexibility of student choice within that structure. As the teacher begins a school year with a plan of what decisions the students will be able to make and which ones the teacher will resolve, the teacher will be more prepared to help students reach their full potential. However, in order to truly be student-minded, teachers must remember to maintain a flexible mindset as they create personalization plans. Once teachers begin to understand the unique individuals in their classrooms, they will be able to fine-tune their initial plans for personalization in a way that supports those students.

Teachers Talk: Results of Personalization



[Watch on YouTube](#)

Personalization is by no means easy, but it is feasible. As teachers approach their classrooms with the students' needs in the center of their pedagogy, the needs and desires of the students will frame how the learning outcomes are presented, achieved, and demonstrated. Students and teachers will benefit from the preparation and dedication that each will put forward in the learning process.

References

- Benbunan-Fich, R., & Hiltz, S. R. (1999). Impacts of asynchronous learning networks on individual and group problem solving: A field experiment. *Group Decision and Negotiation*, 8(5), 409–426. <https://edtechbooks.org/ilc>
- Davis, B. G. (2009). Tools for teaching. John Wiley & Sons.
- Graham, C. R., Borup, J., Short, C. R., & Archambault, L. (2019). K-12 blended teaching: A guide to personalized learning and online integration. Provo, UT: EdTechBooks.org. Retrieved from <http://edtechbooks.org/k12blended>
- Hattie, J. (2008). Visible learning: A synthesis of over 800 meta-analyses relating to achievement. Routledge.
- Mikulecky, L. (1998). Diversity, discussion, and participation: Comparing web-based and campus-based adolescent literature classes. *Journal of Adolescent & Adult Literacy: A Journal From the International Reading Association*, 42(2), 84–97.
- Moore, M. G. (1989). Editorial: Three types of interaction. *American Journal of Distance Education* 3(2) 1–7. <https://edtechbooks.org/-RwN>
- North, S. (2017). Using “roles” in your online discussions. University of Colorado Denver’s Online Blog for Faculty. <https://edtechbooks.org/-xEtr>
- Short, C. R. (2022). Personalized Learning Design Framework: A theoretical framework for defining, implementing, and evaluating personalized learning. In H. Leary, S. P. Greenhalgh, K. B. Staudt Willet, & M. H. Cho (Eds.), *Theories to Influence the Future of Learning Design and Technology*. EdTech Books. <https://edtechbooks.org/-GBqb>

Previous Citation(s)

Graham, C. R., Borup, J., Jensen, M. A., Arnesen, K. T., & Short, C. R. (2022). K-12 Blended Teaching Competencies. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines*, Vol. 2. EdTech Books. <https://edtechbooks.org/-KtaM>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/competencies.

Evaluating Blended Teaching with the 4Es and PICRAT

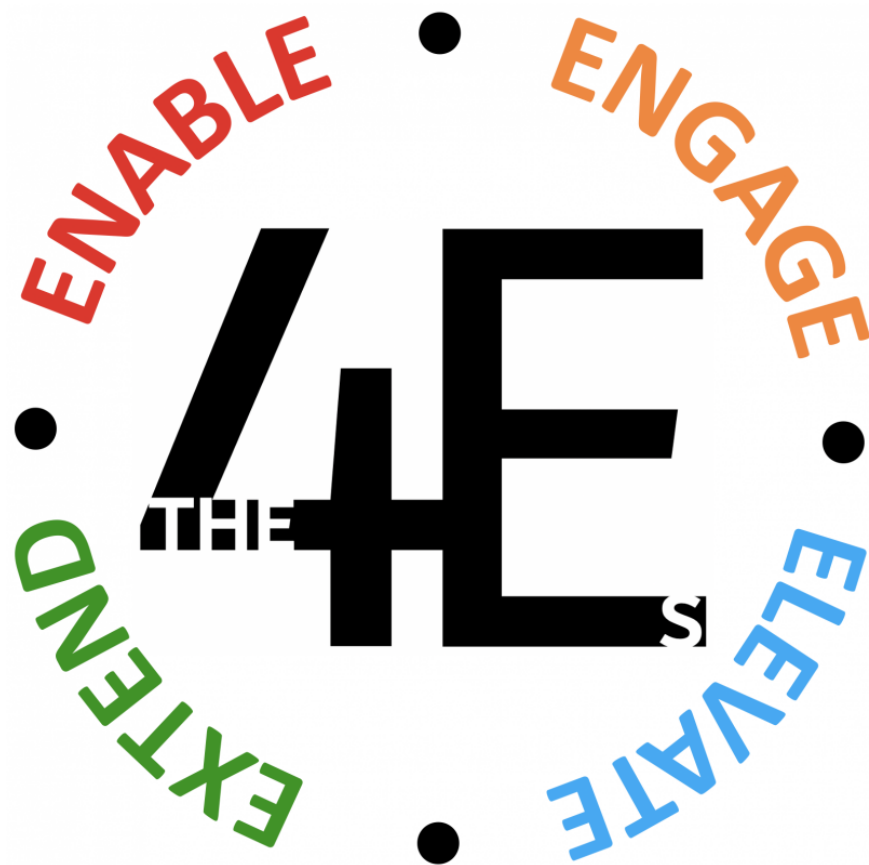
Jered Borup, Charles R. Graham, Cecil R. Short, & Joan Kang Shin

In the first chapter, we explored several scenarios and purposes for blending your students' learning. Regardless of your reasons for blending, it's important to evaluate your teaching and students' learning. Blended learning is the strategic combination of online and in-person instruction. But how will you know if your blended learning strategies are producing the intended results? As you implement your blended learning strategies, it's important that you examine and evaluate their effectiveness and how it has (or hasn't) benefited students' learning. Building on previous research and frameworks such as [David Merrill's \(2009\) e3](#) and [Liz Kolb's \(n.d.\) TripleE](#) frameworks, we identified four evaluation criteria to determine the effectiveness of your blended learning strategies (see Figure 1). Specifically, our 4Es framework asks if your blended learning strategies:

- ENABLE new types of learning activities.
- ENGAGE students in meaningful interactions with others and the course content.
- ELEVATE the learning activities by including real-world skills that benefit students beyond the classroom.
- EXTEND the time, place, and ways that students can master learning objectives.

Figure 1

The 4 Es



"The 4Es" created by Jered Borup, CC BY SA



3.1 Enable

Guiding Question

Do your blended learning strategies ENABLE new types of learning activities?

[Kimmons et al. \(2020\)](#) used the RAT framework to explain that blended learning strategies can use technology in ways that replace, amplify, or transform learning activities (see Figure 2).

Figure 2

The Rat Framework

R EPLACES

Technology sustains current practice without making meaningful changes to the learning activity.

A MPLIFIES

Technology incrementally improves the learning activity in ways that may result in some improvements in learning outcomes.

T RANSFORMS

Technology fundamentally changes the learning activity in ways that may result in significant improvements in learning outcomes.

Education has a long history of using technology to simply replace or digitize learning activities that were previously done without technology. For example:

- handwriting an essay is replaced by typing an essay.
- writing on a chalkboard is replaced by writing on a digital whiteboard. Chalk on a board is replaced by pixels on a screen.
- reading a textbook is replaced by reading an eBook.

These replacements can be a fine use of technology. As long as students have access to the technology, digitizing learning activities can reduce costs following the initial investment to purchase the technology. Additionally, replacing a learning activity using technology can make some learning activities more efficient than they would be without technology. For instance, an essay typed in a word processor can be revised more easily and quickly than a handwritten essay. However, simply replacing an activity will not improve learning outcomes. Best case scenario, students will achieve the same learning outcomes—only more quickly and/or cheaply.

To enable new types of learning that improve learning outcomes, teachers need to use blended learning strategies that move beyond replacing to using strategies that actually amplify or transform learning activities from what could be accomplished without technology.

Amplifying a learning activity requires teachers to introduce technology in ways that enable incremental improvements while the core of the activity remains largely the same. For instance, teachers may find that many of their students have met the target learning outcomes when they are reading students' essays. As a result, the teachers may choose to amplify the essay writing process by having students work in a collaborative document that enables better collaborative opportunities, peer reviews, instructor feedback, and editing. Students can also include multimedia elements to enhance what is written in the essay. Or teachers may use technology in ways that allow students to publish and share their essays in authentic ways. Teachers may also use technology to improve pre-writing activities by engaging students in an online discussion activity to brainstorm and formulate ideas for their essays. What's important to recognize is that the core activity is still the same—writing an essay—but technology enables incremental improvements and enough of these improvements could impact learning outcomes.

Transforming a learning activity is different than amplifying it because the teachers' goal isn't to improve the activity; rather, it's to use blended learning strategies in ways that introduces a new learning activity that they wouldn't be able to do without technology. For instance, rather than making improvements to the essay, teachers may choose to transform

the learning activity by holding a film festival where students write a script, edit a video, and then “premiere” their videos to their classmates and others that are invited to participate.

3.2 Engage

Guiding Question

Do your blended learning strategies ENGAGE students in meaningful interactions with others and the course content?

Engagement is a term with many different meanings. [Borup et al.'s \(2020\)](#) review of research identified three dimensions of engagement:

- Behavioral engagement: the physical behaviors required to complete the learning activity.
- Emotional engagement: the positive emotional energy associated with the learning activity.
- Cognitive engagement: the mental energy that a student exerts toward the completion of the learning activity.

Teachers will often refer to these three dimensions of engagement when they talk about engaging students’ hands, hearts, and heads (see Figure 3).

Figure 3

The Three Dimensions of Engagement



"Engagement" created by Jered Borup using images from Pixabay, CC BY SA

Of the three dimensions of engagement, behavioral engagement is the easiest to observe and categorize. Specifically, [Kimmons et al. \(2020\)](#) used the PIC framework to identify three types of behavioral engagement: passive, interactive, and creative (see Figure 4).

Figure 4

The PIC Framework

P

ASSIVE

Students simply consume presented information.

I

NTERACTIVE

Students take some control over their learning by interacting with others or learning materials

C

REATIVE

Students use technology to create original materials and artifacts.

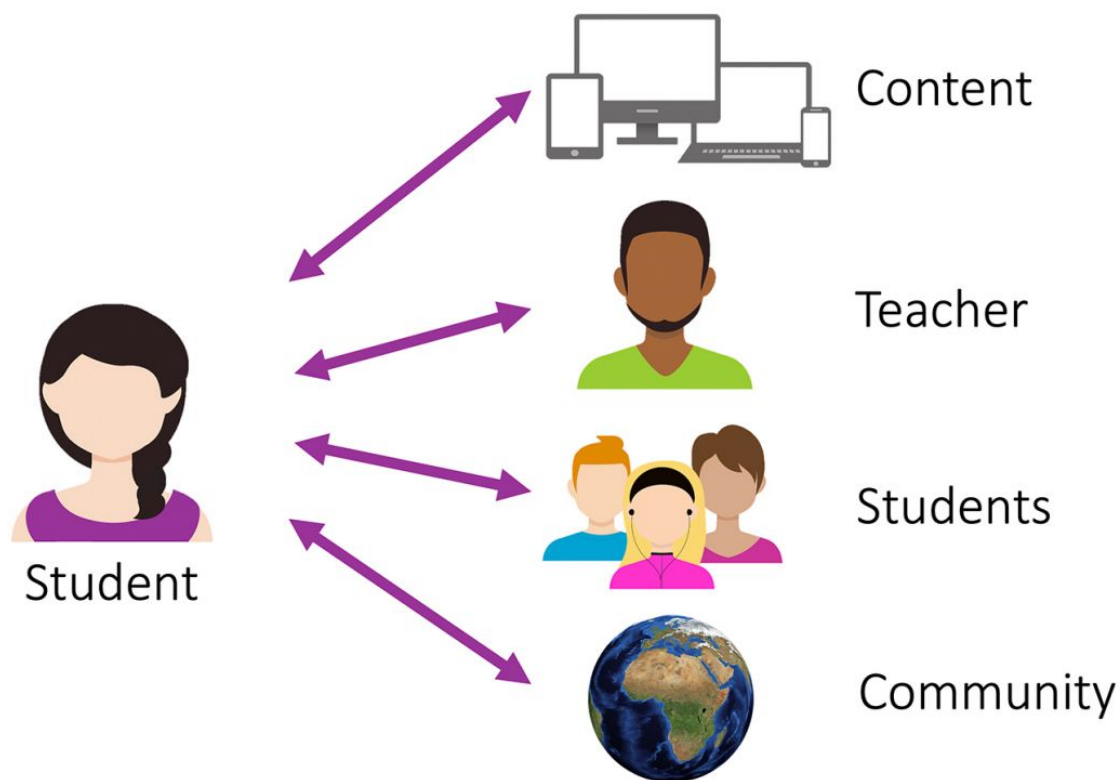
Passive learning examples include students watching a video, listening to a podcast, and attending a lecture. In some ways, these passive learning tasks represent the lack of engagement because they don't require or even allow for students to make meaningful choices or contributions.

Interactive activities are dynamic and require students to actively participate. Interactive activities include tasks where students are interacting with online content and tools. Interactive activities can also include opportunities for students to communicate with others such as the teacher, other students, and those outside of the classroom (see Figure 5).

Figure 5

Four Types of Interaction

Four Types of Interaction



Creative activities go beyond participation to actually creating something original like a blog post, edited video, or digital poster. Table 1 shares some additional examples of online passive, interactive, and creative activities.

Table 1

Examples of Passive, Interactive, and Creative Activities.

Passive	Interactive	Creative
• Watching a video. • Listening to a podcast. • Reading an online article.	• Playing educational games. • Participating in an online discussion. • Asking a virtual guest speaker questions.	• Writing an essay. • Editing a video. • Making an infographic. • Creating a website.

It's important to note that each type of behavioral engagement is important at different stages of the learning process. For instance, students may passively listen to a short lecture or watch a video before interacting with their peers regarding their thoughts about what they learned during the passive activity. Similarly, if students are tasked with creating a video essay, they will likely start with passive activities to develop a background understanding of the topic or to learn how to use the video editing program. Students could then interact with their peers to collaboratively create the video. Instructors can also consider when and where passive learning activities occur. For example, sometimes a flipped classroom trades having a passive video watching experience online to make time and space for an interactive/creative learning experience in-person.

When evaluating your blended teaching, it's important to see the value of passive learning activities while also understanding that these types of activities are limited in terms of deepening students' learning. Passive activities like watching a video or reading an article alone do not require students to demonstrate their comprehension of content or encourage higher levels of cognitive engagement, such as applying, evaluating, or creating. Too much time spent in

passive learning activities will limit your students' engagement so be sure to leave ample time for interactive and creative activities.

The following table provides examples of how technology can be used to replace, amplify, and transform activities that don't originally include digital technology (see Figure 6). As you read the table, notice that passive activities can be amplified or transformed by using technology to make the learning less passive and more interactive. Similarly, teachers can amplify and transform activities that are already interactive by using technology to adjust the time and place of the interactions or by allowing students to move beyond interactive activities to creative activities.

Figure 6

Examples Showing the Use of Technology to Replace, Amplify, and Transform No-tech Activities

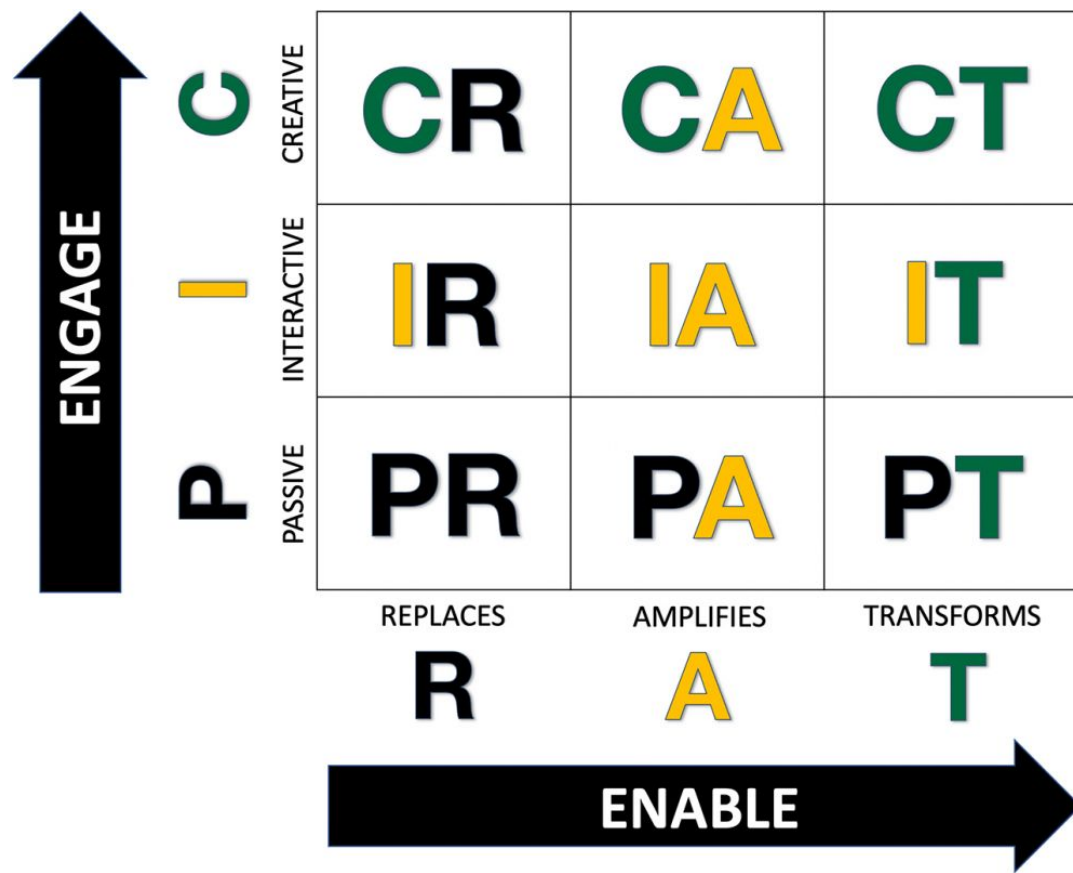
NO-Tech Activity CREATIVE ACTIVITY Students color and label a paper map of the continents. INTERACTIVE ACTIVITY Students engage in a classroom debate to demonstrate persuasive techniques. PASSIVE ACTIVITY Students listen to an in-person lecture to learn new concepts.	Students label an online map and selecting colors for each continent.	Students use a tool like ThingLink to add videos and images that highlight the different attributes of each continent.	Rather than create a map, students collaboratively create a travel website that highlights the different continents for visiting extraterrestrials.
	During class time, students engage in a "silent debate" where comments are written on a discussion forum rather than spoken aloud.	Students engage in a debate that combines in-person communication with asynchronous online communication to increase student participation and reflection.	Rather than engage in a class debate, students collaboratively work on a school-wide or community campaign that includes digital campaigning using posters and public service announcements.
	Students watch a video or online lecture.	Students watch a recorded lecture using a tool such as EdPuzzle that requires students to periodically answer multiple-choice questions.	Rather than watch a lecture, students learn concepts using adaptive learning software that automatically adapts what is taught based on student performance.
	REPLACES R	AMPLIFIES A	TRANSFORMS T

[Kimmons et al. \(2020\)](#) combined the PIC and RAT frameworks to form the PIC-RAT matrix that allows teachers to to chart how technology is being used in their blended learning strategies (see Figure 7). The matrix is a helpful tool for teachers to consider what the technology is adding to the activity. Ask yourself the following questions:

1. Is the technology being used to increase student engagement by making learning activities more interactive and/or creative?
2. Is the technology being used to simply replace activities or to amplify and transform activities?

Figure 7

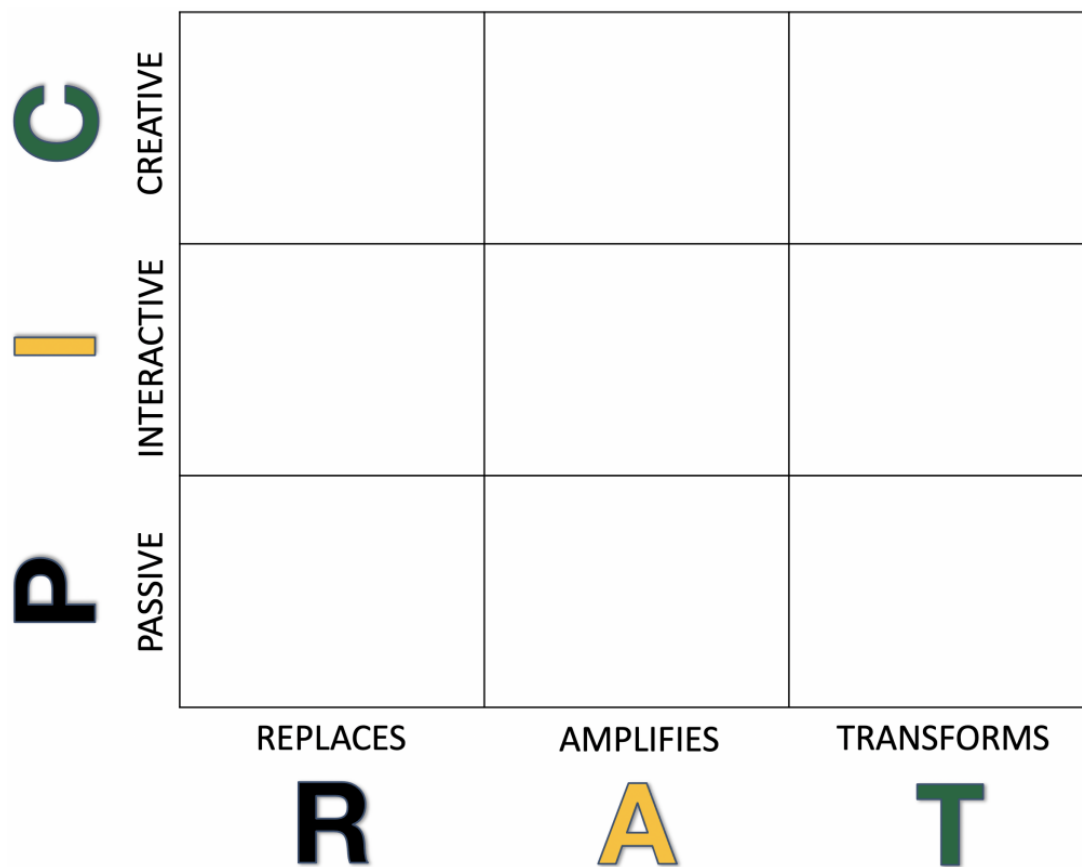
The PIC-RAT Matrix



When planning new blended or online activities, we recommend starting by focusing on the learning objective(s), then pulling out a piece of paper or pulling up a word processing document and filling out the PIC-RAT matrix (see Figure 8) with various ways that technology could be used to teach the learning objective(s).

Figure 8

Blank PIC-RAT Framework for Brainstorming Activities Using Technology



Moving up and across the matrix will likely improve the learning activity, but it's also important to note that the PIC-RAT matrix doesn't actually measure the quality of the learning activity. It's possible for teachers to transform a learning activity by having students create something that wouldn't be possible without technology and still not actually improve students' learning or experience. In fact, it is possible to transform students' learning for the worse. For instance, using the example shared above, a teacher may transform an essay writing activity so that students create an edited video instead. While this transformation may be positive for many students, there could be some students who detest making an edited video and refuse to participate. Similarly, a teacher may transform a passive learning activity into a creative learning activity that isn't as aligned to the learning outcomes. As a result, when amplifying or transforming a learning activity to increase students' behavioral engagement it's important to consider the other two dimensions of engagement—emotional engagement and cognitive engagement. Students will perceive the activity as “busy work” if teachers only engage their hands but fail to also engage their hearts and minds (see Figure 9).

Figure 9

Busy Work

Busy Work

BEHAVIORAL



EMOTIONAL



COGNITIVE



As you go through these chapters, you have the opportunity to reflect on what you have learned and to design your own activities in the [Blended Teaching Workbook](#). Click on the link to access your workbook. Make sure you save a copy and keep it available, so you can return to it as you go through the chapters.



Blended Teaching Workbook

In your workbook is a copy of the PIC-RAT grid. Use it to brainstorm activities you could use in your classroom. You can access the workbook [here](#).



3.3 Elevate

Guiding Question

Do your blended learning strategies ELEVATE the learning activities to include real-world skills that benefit students beyond the classroom?

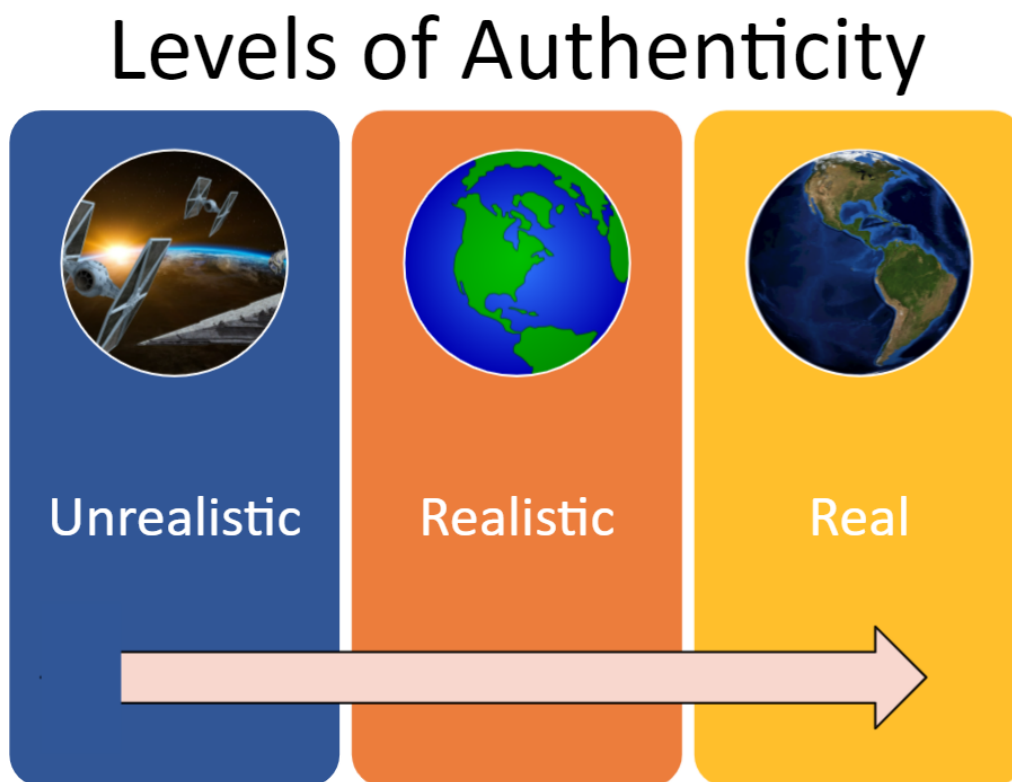
In addition to creating learning activities aligned with the course learning objectives, teachers' blended learning strategies can elevate students' learning to also include real-world skills that benefit students beyond the classroom. For example, the Partnership for 21st Century Learning stresses the need for students to develop the 4Cs—communication, collaboration, critical thinking, and creativity skills (<https://www.battelleforkids.org/networks/p21>). While widely-referenced and important, the 4Cs also take a somewhat narrow view of the skills that students need to succeed beyond the classroom. For [Ontario's education agenda](#), Michael Fullan (2013) expanded on the 4Cs to include character education and citizenship. Social-emotional learning is also critical for human development. These skills are best developed in a social learning environment. Clearly, students can't develop communication, collaboration, and citizenship skills in isolation. Even critical thinking and creativity skills are best developed when working with others. This provides more support for balancing passive activities with interactive and creative activities while urging teachers to elevate their instruction.

Learning activities are also best elevated when activities are situated in authentic tasks and projects. There are three levels of authenticity when you are considering the problems and stakeholders that students will be working on and with (see Figure 10).

- **Unrealistic:** These scenarios and problems can be out of this world—literally! Stakeholders and problems can be science fiction and include anything from time traveling to establishing a colony on Mars. They are intended to make the unit more exciting and emotionally engaging while still requiring students to demonstrate important knowledge and real-world skills.
- **Realistic:** These are scenarios and problems that feel like they are real but aren't. Real people can even serve as stakeholders but they are really just acting. For example, students might simulate creating a new business by coming up with a new product and working in groups to come up with the name of the product, a business plan, and a marketing plan. It is completely realistic, but they won't be really starting a new business!
- **Real:** This is the gold standard because you have real people who are really interested in and will benefit from students' work. These stakeholders can be of any age and in and out of the school. For example, students could work in groups to discuss some problems in their community, such as littering in their local park or school grounds. They might create memes, GIFs, and short video public service announcements to urge people to keep the park and playground clean that they can post on social media and distribute through local government social media.

Figure 10

Levels of Authenticity



"Levels of Authenticity" created by Jered Borup using images from Pixabay, CC BY SA

Authentic assessments are often renewable rather than disposable. Consider the target audience of most assessments—who it is that students are completing assessments for—themselves, their community, their teacher? Often assessments are completed for an audience of one, the teacher. The teacher then evaluates the assessment, provides

the student with some feedback, returns the assessment to the student, and hopes that the student uses the feedback to enrich their learning before the assessment is discarded in the trash can (or on the floor, or left on a desk) when class ends. These assessments are often seen as "disposable assessments." They are meant to be used and then discarded without retaining any real-world value.

"A 'renewable assessment' differs in that the student's work won't be discarded at the end of the process, but will instead add value to the world in some way." ([David Wiley, 2016](#)).

A movement toward assessments that can exist in a world that is larger than the four walls of a singular classroom can make learning more authentic and elevate what students learn and do beyond content-based curriculum and contexts. For example, a community college instructor found that having her students write an openly licensed textbook that would be shared with other students instead of traditional essays caused them to "write better than they've shown me in the past" ([Short et al., 2024](#)). Students want to know that their work matters and is destined for more than the nearest trashcan.

Table 2 gives some examples of renewable and disposable assessments.

Table 2

Renewable and Disposable Assessments

Renewable Assessments
• Students create a documentary about the life of a war veteran in their community. • Students create tutorial videos to help teach math concepts to peers. • Students create artwork to beautify the walls of city buildings. • Students create a picture dictionary to share with younger students.
Disposable Assessments
• Multiple choice exam • Short essay quiz • 5-page paper to check understanding or ability • Spelling test
Additional Resources
• Renewable assignments: Student work adding value to the world • Non-disposable Assignments in Intro to Philosophy • From Consumer to Creator: Students as Producers of Content • Are your assignments renewable or disposable? • What is Open Pedagogy -> Killing the disposable assessment

3.4 Extend

Guiding Question

Do your blended learning strategies EXTEND the time, place, and ways that students can master learning objectives?

Another way that blended learning strategies can improve learning activities is by extending the time, location, and ways that students complete learning activities. Attempting to extend students' learning time and location is nothing new. For instance, students have long had flexibility in the time and location that they completed homework. However, too often students are tasked with completing homework without adequate support resulting in frustration for both students and parents, as hilariously shown in the following video clip.



[Watch on YouTube](#)

Using technology teachers can not only provide students with more sensory-rich learning materials, within a learning management system (LMS) they can also provide them with digital scaffolding and direction to successfully complete learning activities using those materials. For instance, it's relatively easy for teachers to create short instructional videos that can help students to learn new concepts or complete learning tasks. [One teacher \(Farah, 2019\)](#), explained that creating instructional videos allowed him to "clone" himself so students could receive his help in the moment they needed it, not when he was presently available to help them. Once teachers feel comfortable making quick videos, they can use them to provide targeted scaffolding anytime students find something confusing or difficult. This allows the teacher to tailor instruction to specific students or classes.

This use of technology can also provide students with the flexibility in the pace of their learning and allows teachers to implement mastery-based grading. For instance, when learning activities are clearly organized in an LMS, students can complete and submit assignments that the teacher can then review and provide feedback on until students achieve

mastery. Providing quality feedback efficiently is especially important in a mastery-based grading system. Although detailed feedback is always time-consuming, technology can help lighten the load as we will see in the following chapters of this book.

Teachers can also extend the ways in which students complete learning activities. For example, teachers may provide students with multiple learning paths to choose from using a choice board. A choice board is a graphic organizer, usually in a grid of 4, 6, or even 9 spaces, with activities that students can choose to do. Often teachers design them to appeal to their learners' interests, talents, and abilities. Creating multiple activities that all lead toward mastery of your learning objectives allows students choice in their learning path—hopefully with choices that will motivate them and inspire them to do their best work. Once learning has been extended, teachers can also provide students with opportunities to form their own learning path and/or set learning goals.



3.5 Conclusion

Combining in-person and online instruction doesn't mean that the blended learning will be high-quality—or even good. As you begin to blend your students' learning, you will likely find that some lessons or even entire instructional units don't go as well as expected. The opposite will also be true and you will find that other blended lessons and units go incredibly well. As blended teachers it's important to carefully evaluate what works and what needs to be improved or even replaced. The 4Es framework can help you recognize quality blended teaching and learning. Specifically, as you plan new blended instructional units or evaluate previous blended instruction, ask if your instructional unit would or did:

- ENABLE new types of learning activities.
- ENGAGE students in meaningful interactions with others and the course content.
- ELEVATE the learning activities by including real-world skills that benefit students beyond the classroom.
- EXTEND the time, place, and ways that students can master learning objectives.



References

- Borup, J., Graham, C. R., West, R. E., Archambault, L., & Spring, K. J. (2020). Academic communities of engagement: An expansive lens for examining support structures in blended and online learning. *Educational Technology Research and Development*. 68, 807-832. <https://doi.org/10.1007/s11423-020-09744-x>
- Farah, K. (May, 2019). Blended learning built on teacher expertise. *Edutopia*. <https://www.edutopia.org/article/blended-learning-built-teacher-expertise>
- Fullan, M. (2013). Great to excellent: Launching the next stage of Ontario's education agenda. <http://michaelfullan.ca/wp-content/uploads/2016/06/13599974110.pdf>
- Kimmons, R., Graham, C. R., & West, R. E. (2020). The PICRAT model for technology integration in teacher preparation. *Contemporary Issues in Technology and Teacher Education*, 20(1). <https://citejournal.org/volume-20/issue-1-20/general/the-picrat-model-for-technology-integration-in-teacher-preparation>
- Merrill, M. D. (2009). Finding e3 (effective, efficient, and engaging) Instruction. *Educational Technology*, 15-26. <https://www.jstor.org/stable/44429676>
- Short, C. R., Hilton, B., Hilton III, J., Wiley, D., Chaffee, R., Guilmett, J., & Darrow, J. (2024). Higher education instructors' perceptions of open pedagogy: an exploratory study of open pedagogy definitions in practice. *Open Learning*:

The Journal of Open, Distance and e-Learning, 1-16.

<https://www.tandfonline.com/doi/full/10.1080/02680513.2024.2334237>

Wiley, D. (2016, July 7). Toward renewable assessments. *Improving Learning*.

<https://opencontent.org/blog/archives/4691>

Previous Citation(s)

Borup, J., Graham, C. R., Short, C. R., & Shin, J. K. (2022). Evaluating Blended Teaching with the 4Es and PICRAT. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines*, Vol. 2. EdTech Books. <https://edtechbooks.org/-aCm>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/evaluating_bt.

Discipline Specific Blended Teaching

Science: Intro to Blended Teaching
Science: Why Blend?
Science: Online Integration & Management
Science: Online Interaction
Science: Data Practices
Science: Personalization



This content is provided to you freely by EdTech Books.

Access it online or download it at

https://edtechbooks.org/k12blended_science/discipline_specific_.

Qi Guo, Whitney Keaton, & Cecil R. Short

Qi Guo, Whitney Keaton, & Cecil R. Short



classroom. The image on the cover of the book shows a broad range of disciplines, each represented by a branch of the tree. The four core skills for blended teaching are represented by the common roots of the tree that feed the branches.

While there are some broad commonalities in how blended learning looks across disciplines, there are also many subtle and unique approaches to blended teaching within each discipline. Science teachers can benefit from examples of blended teaching in science classrooms. As a result, this set of chapters is geared towards providing examples of blended teaching that are specific to the secondary science classroom.

In these chapters, we also use examples from practicing teachers. They will help you see blended teaching in science through the lens of the blended teaching competencies: online integration, online interaction, data practices, and personalization.



4.2 Meeting the Science Blended Teachers

In these chapters, you will receive instruction and ideas from experienced science teachers. Learn more about these teachers below.

Meet Your Teacher: Meredith Brady (2:08)



Meet Your Teacher

Meredith Brady
~ Science Teacher

 EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY



[Watch on YouTube](#)

Meet Your Teacher: Matthew Harris (1:31)



Meet Your Teacher

Matthew Harris

~ Science Teacher

 EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY



[Watch on YouTube](#)

Meet Your Teacher: Patrick Hemmingsen (2:51)



Meet Your Teacher

Patrick Hemmingsen

~ Science Teacher

 EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY



[Watch on YouTube](#)

Meet Your Teacher: Dr. Darren Ritson (1:03)



Meet Your Teacher

Darren Ritson

~ Science Teacher

 EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY



[Watch on YouTube](#)

Meet Your Teacher: Alan Schwalb (1:24)



Meet Your Teacher

Alan Schwalb

~ Science Teacher

 EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY



[Watch on YouTube](#)

Previous Citation(s)

Guo, Q., Keaton, W., & Short, C. R. (2022). Science: Intro to Blended Teaching. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines , Vol. 2*. EdTech Books. <https://edtechbooks.org/-HrhS>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/science.

Science: Why Blend?

Qi Guo, Whitney Keaton, & Cecil R. Short



5.1 Blending in Science Teaching

The first question you should ask yourself before embarking on the journey of blended teaching is “Why blend?” Teachers who are still searching for their answer to this question may end up spending a lot of time and energy implementing changes that do not serve any larger goal or purpose.

Guiding Question: Why Blend?

Teachers must answer the question “Why blend?” It is not sufficient to blend just because it is popular or because others are doing it.

Teachers Talk: Hands-on Learning



Meredith Brady

In science, I try to do as much hands-on learning as I can. Blending my class with technology gives me the chance to have more hands-on learning, even though students can't actually experience it. I'm trying to get everyone involved. A huge benefit to blending is increasing the engagement of students.

Teachers Talk: Benefits of Blending (3:42)



The video player interface features a dark blue background. On the left, a video frame shows a man with grey hair and a maroon shirt speaking. In the background of the video frame, a poster of Albert Einstein is visible with the text: "I have no special talents. I am only passionately curious." A large red play button with a white triangle is centered over the video frame. To the right of the video frame, the title "Benefits of Blending" is displayed in large white text, followed by the name "Alan Schwalb" and his title "~ Science Teacher" in smaller white text. At the bottom left of the player, the EdTech Books logo is shown next to the URL "https://edtechbooks.org/k12blended2". At the bottom right, the text "Licensed under CC BY" is displayed next to the Creative Commons Attribution (CC BY) license logo.

Benefits of Blending

Alan Schwalb
~ Science Teacher

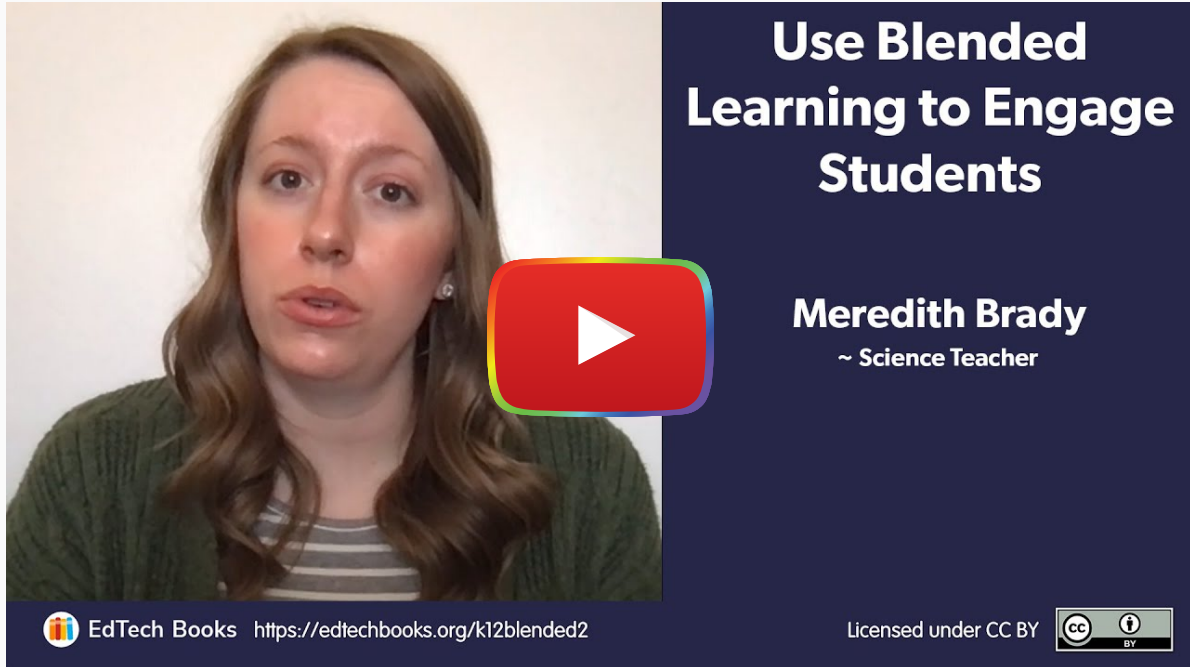
EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY

[Watch on YouTube](#)

Reflection Question: How could blending your teaching help your students?

Teachers Talk: Use Blended Teaching to Engage Students (5:44)



Use Blended Learning to Engage Students

Meredith Brady
~ Science Teacher

EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY

[Watch on YouTube](#)

Reflection Question: How does blended teaching involve every student



5.2 Reasons for Blending

There are three primary reasons why teachers choose blended teaching:

- Improved learning outcomes—Blended classrooms can increase personalization, allow for more individual and small group instruction, and make better use of classroom time.
- Increased access and flexibility—In blended classrooms students have access to materials anywhere and anytime. In addition, they have access to resources and activities that are unavailable to them without an online component.
- Increased efficiency/cost—Blended classrooms can help students complete learning activities in less time and with less energy, reduce printing costs, and help students stay more organized (less likely to lose assignments).

Matthew Harris and Patrick Hemmingsen have experienced the benefits of these reasons for blended teaching. As you watch their videos below, listen for how they use technology to allow them more time in class to work on individualized and deeper thinking.

Teachers Talk: Blended Learning Allows More Individualized and Targeted Instruction for Students (2:16, 3:05)



Blended Learning Allows More Individualized and Targeted for Students

Matthew Harris
~ Science Teacher



 EdTech Books <https://edtechbooks.org/k12blended2>

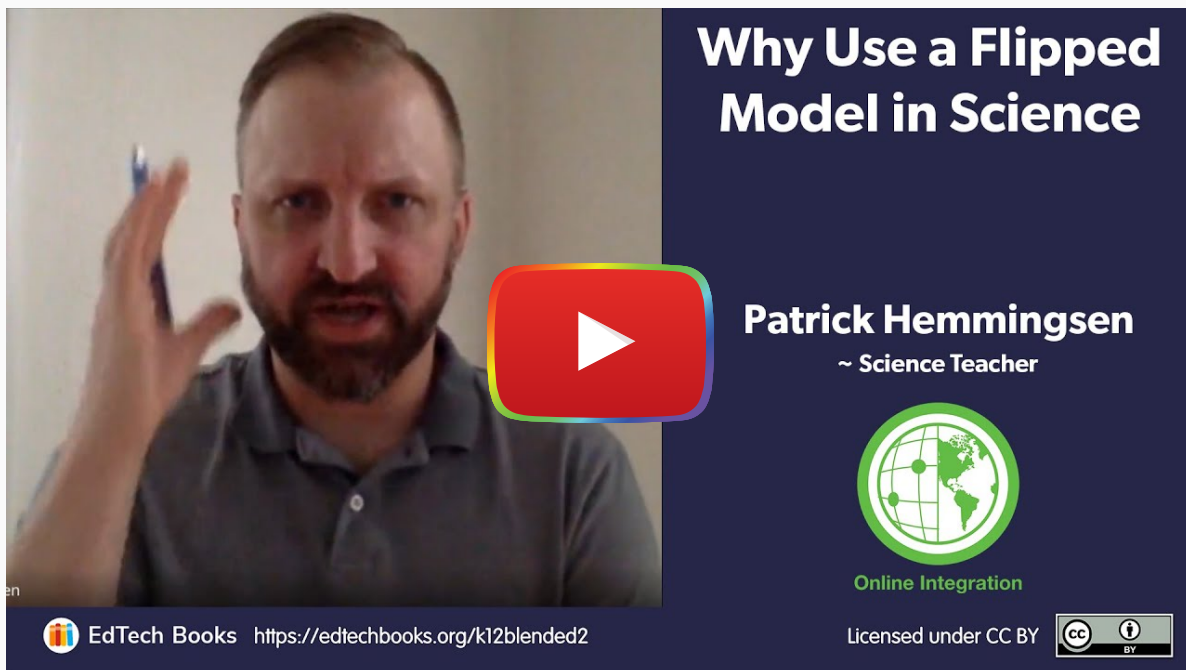
Licensed under CC BY



[Watch on YouTube](#)

Reflection Question: How does Matthew Harris use technology to allow him more time to do things that only he can do?

Teachers Talk: Why Use a Flipped Model in Science?



The video thumbnail features a man with a beard, Patrick Hemmingsen, speaking and gesturing with his hand. A large red play button is overlaid on the video. To the right of the video, the title 'Why Use a Flipped Model in Science' is displayed in white text on a dark blue background. Below the title, the name 'Patrick Hemmingsen' and his title '~ Science Teacher' are shown. A green circular logo with a globe and the text 'Online Integration' is also present. At the bottom left, the 'EdTech Books' logo and the URL 'https://edtechbooks.org/k12blended2' are visible. At the bottom right, the text 'Licensed under CC BY' and a Creative Commons license icon are shown.

Why Use a Flipped Model in Science

Patrick Hemmingsen
~ Science Teacher

Online Integration

EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY

[Watch on YouTube](#)

Reflection question: How can blended learning improve students learning outcomes through individualized instructions?

Teachers Talk: Helping Students Set Up Goals and Pacing (2:11)



Helping Students Set Up Goals and Pacing

Matthew Harris
~ Science Teacher



 EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY



[Watch on YouTube](#)

Reflection Question: How does Matthew Harris increase access and flexibility by helping students set goals and personalize pacing?

Teachers Talk: Advantages of Blending



Patrick Hemmingsen

In science classes, hands-on labs are great, but they cost time and money. One lab can last 90 minutes, and if you mess up something, that's a waste of a class. Some universities use PHET simulations, and they are Chromebook compatible. They work really well with the devices we've given to our students, and if you mess up on that, you just hit reset. The simulation takes about five minutes, not 90. So even though I still do some things hands-on, using the blended learning approach is imperative.

When we do hands-on activities, students can work on it for 20 minutes and see the data. Then I stop them and ask, "Why do you think those things happened?" Once they have sparked the idea, I will do a lecture. Because this method is a little more flipped, I don't have to spend 45 minutes talking to them; I can say what they need to hear in 15 minutes.

Blending is also helpful when we study the atom. Since the atom is so incredibly small, it can be really difficult for students to imagine what it could look like. So, I've really leaned on online simulations to model the atom when we've done molecular geometries and, in AP, the actual three-dimensional shapes of the molecules. Anything that's not macro science, I've really learned to use technology to support student learning.

Oftentimes teachers have multiple reasons for blending, but one of these three reasons is almost always primary in their minds. Table 1 below shows some simple examples of purpose-driven blended teaching in science and how it might help teachers achieve multiple purposes simultaneously.

As you go through the science chapters, you will be able to reflect on what you have learned and design your own activities and classroom in the Blended Teaching Workbook. Click on the "Blended Teaching Workbook" button to access your workbook.

Table 1

Examples of Multiple Purposes for a Blended Science Activity

Blended Example	Blended Purpose
Allows students to practice or complete labs using a virtual space and virtual materials.	Learning Effectiveness: Using science simulations can promote students' higher levels of understanding of the scientific concepts or phenomena that can hardly be seen or are difficult to imagine in daily life, such as the structure of the atom or experimenting with gravity.
	Access & Flexibility: It also allows students to access and interact with the learning content.
	Increased Efficiency/Cost: By modeling and manipulating difficult concepts using a virtual space and digital materials, students master principles faster than simply

Blended Example**Blended Purpose**

	learning from lectures. It also saves teachers effort and time to shorten tedious lectures by adding hands-on digital activities.
Creates opportunities for students to collaborate on reports and presentations using the online space.	Learning Effectiveness: The online space promotes an open environment that can give everyone the opportunity to contribute to group projects. Students can share their ideas and add images and videos to scientific reports to make them more engaging and easier to understand. When students present group projects, the online space can also help their audience learn more effectively. Access & Flexibility: The online space allows each student to access group projects and write reports and slides in flexible ways. Increased Efficiency/Cost: Blended learning saves students time by allowing groups to write and revise reports simultaneously.
Blended learning gives students some control over their learning.	Learning Effectiveness: Students can be assigned instruction and learning activities that are adapted to their specific needs. Students who get it can move on to additional learning materials and those who don't get it can go back and review content until it is mastered. Blended learning can also make it easier for teachers to provide individual feedback to students. Access & Flexibility: Students have the flexibility to access the content according to their individual learning progress and have some freedom concerning where and when to complete their assignments. If they can't finish in class, they can continue learning and complete work at home, work, or other locations away from their classroom. Increased Efficiency/Cost: Students don't waste time studying content in which they are already proficient. Top students don't have to wait for other students to catch up. Slower students don't have to worry as much about falling behind.

Think about why you would like to blend your classroom. In your blended teaching workbook, write your thoughts, creating your own purpose.

**Blended Teaching Workbook**

Write a brief statement about why you want to blend your classroom. Which purposes and outcomes are you most interested in for your blend? Access your Workbook [here](#). Make sure you save your copy where you can access it as you go through the social studies chapters.



5.3 Common Challenges to Teaching/Learning Science

Teachers Talk: Hard to Provide Authentic Feedback in Traditional Classroom



Matthew Harris

When I was a teacher in a traditional classroom, it was very challenging to give authentic, real feedback in a way that actually benefitted the individual student. And I feel like the biggest way that blended learning improved my teaching is that it makes a difference, allowing me to provide feedback that is more targeted to each student. And that's a system that didn't exist in the same sense previously. Now, the blended learning model specifically enables me to gather data on what students are thinking and how they are doing. Gathering that data is helping me become more than I am. Now it's like I have 10 teaching assistants with me. I can provide individual feedback to students based on those data.

Reflection Question: How can the advantages of blended learning help you overcome the challenges you face in the traditional classroom?

Your choice to blend will be more meaningful to you and your students if it helps address challenges that you and your students face in the traditional non-blended classroom. We refer to these challenges as “problems of practice.”



5.4 Problems of Practice

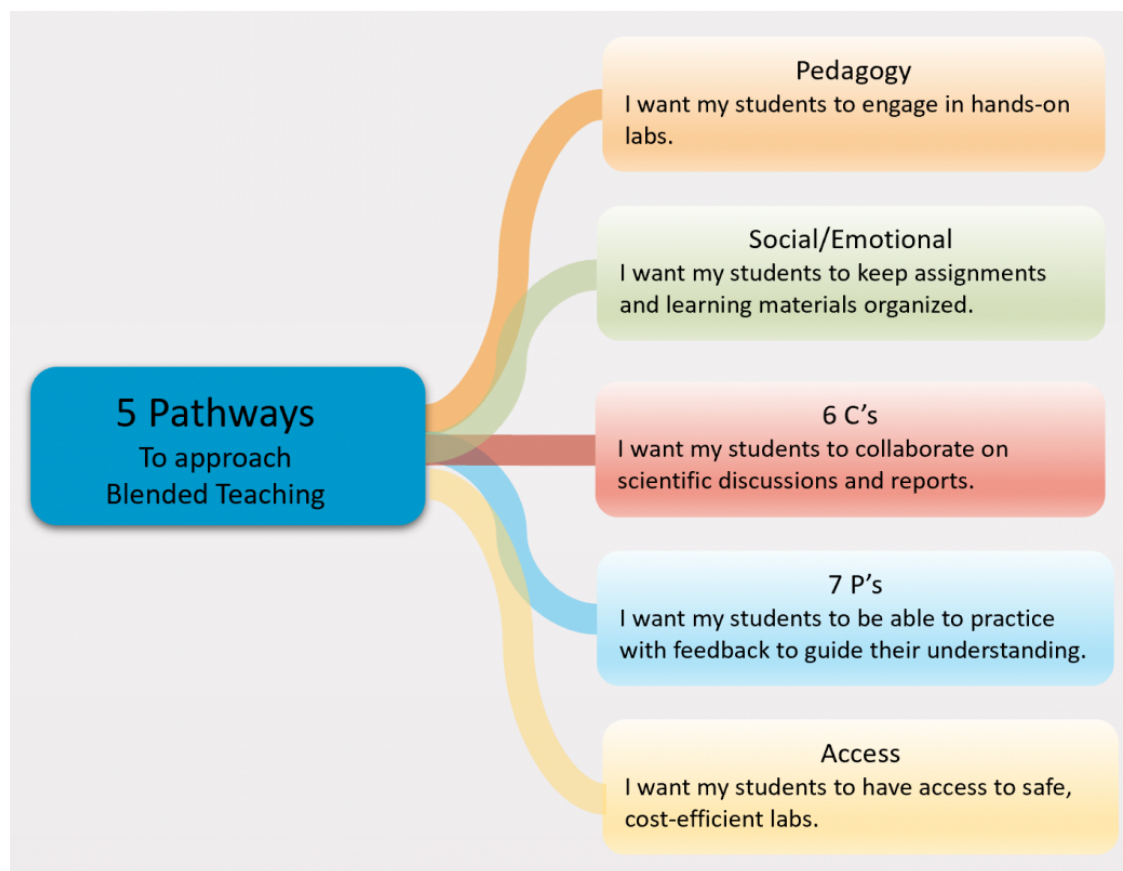
Definition: Problem of Practice

A problem of practice is a current problem or challenge that you believe could be improved through blended teaching.

Problems of practice can fall under any of the three purposes outlined in section 5.1 and 5.2. However, the most meaningful and powerful problems of practice for teachers deal directly with improving learning outcomes for their students.

Figure 1

Problems of Practice in Science

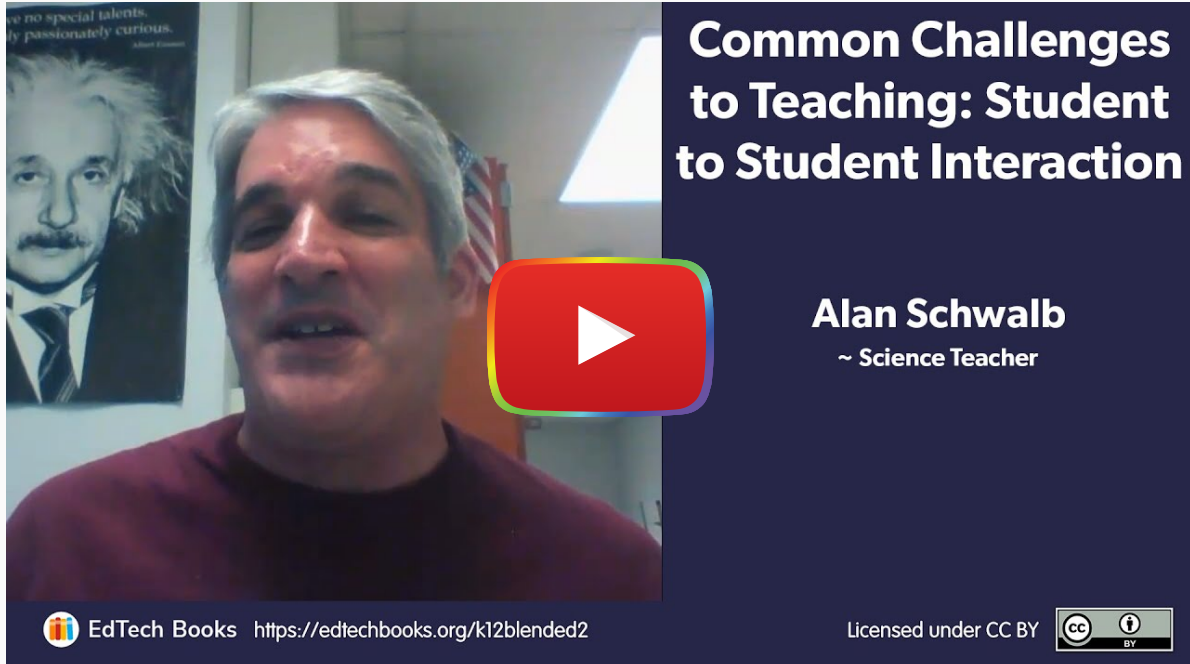


These five pathways are a powerful tool to help you think deeply about problems of practice that are relevant to you. Once you identify specific challenges in your current approach to teaching, you will be able to explore what online approaches may be combined with your in-person approaches to create a better learning experience for your students and you alike. While implementing blended learning can be valuable to both teachers and students, its implementation is not without its challenges. Teachers, Meredith Brady and Alan Schwalb, talk about some of the barriers they have faced with implementing blended teaching and provide ideas for overcoming those barriers.

Teachers Talk: Common Challenges to Teaching (3:30, 2:15)

Reflection Questions: What barriers did Meredith Brady face in implementing blended teaching? What resources did she use to overcome those barriers? What resources are available to you in your school?

Teachers Talk: Common Challenges to Teaching: Student to Student Interaction



Common Challenges to Teaching: Student to Student Interaction

Alan Schwalb
~ Science Teacher

EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY

[Watch on YouTube](#)

Reflection Question: What were some of the challenges that Alan Schwalb faced with blended learning? What are some ideas for overcoming those challenges?

Finding Your Problems of Practice

Now that you have reviewed the five pathways to identifying problems of practice, it is your turn to look at your own practice and try to identify a couple of challenges that you can consider as you continue throughout these science chapters. What student outcomes and teaching practices would you like to improve? What stands in the way of your teaching having the impact you would like it to have?



Blended Teaching Workbook

Identify 2-3 problems of practice (PoP) that you can use as you consider blended options for your classroom.

Note: You should identify several problems of practice (PoP) because not every PoP has a good blended learning solution.

If you haven't already opened and saved your workbook, you can access it [here](#).

Previous Citation(s)

Guo, Q., Keaton, W., & Short, C. R. (2022). Science: Why Blend? In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines , Vol. 2*. EdTech Books. <https://edtechbooks.org/-mgg>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/science_why.

Science: Online Integration & Management

Whitney Keaton, Qi Guo, & Cecil R. Short

Review foundational knowledge about [Online Integration](#) in K-12 Blended Teaching (Volume 1).



6.1 Online Integration and Management in Science Classes

Online integration is at the very heart of blended teaching. It has to do with how you combine your in-person science classroom with online activities (remember the baker mixing dry and wet ingredients from [Chapter 1](#)). Because the main component of blended learning is integrating online and in-person activities, online integration is a good place to begin thinking about blending your classroom.

This is where you as a science teacher begin to think about what specific online practices can help you address the problems of practice you identified in Chapter 5. The more examples of blended teaching you have personally seen and the more experience you have with blended teaching, the easier this process will be for you. But even if you are just starting out, you will probably have a few ideas of your own. This chapter will help you explore these ideas and more.

Teachers Talk: What Does Blended Learning Look like in a Science Classroom? (1:29)

Reflection Questions: How does the teacher in this video integrate a combination of in-person activities and online activities into each lesson? What are some techniques that she uses that would work well in your classroom?

Before you start, consider this advice from experienced science blended teachers—start with clear expectations and consider the possibilities blended teaching provides. Making sure you start your planning and teaching by clearly explaining the expectations to your students so that the new online learning techniques and tools are seamlessly integrated into your in-person instruction. Also, while implementing blending learning will take some extra effort at the start, it can lead to greater authentic learning opportunities and is well worth it (see the J-Curve in [Section 6.5 of Volume I](#)).

Teachers Talk: Expectations and Opportunities



Meredith Brady

Focus on making sure the kids know the expectations with the technology There's some really great stuff out there. It's definitely worth using. It's worth the trouble.

Teachers Talk: Expectations and Opportunities



Matthew Harris

I have the freedom to answer these random questions and work it back into stuff because I have the freedom of time. All the content they have to learn is already baked into their schedule. So, I have an hour and a half every other day with my students to explore science and to export curiosity.



6.2 Planning for Integration

You can take that first small step to blend your science classroom by doing the following:

1. Identify the problem of practice and the learning objective that you are interested in blending.
2. Think about activities, both in-person and online, that could support student learning. (A framework for this process is to think about activities that involve students interacting independently with content, activities that involve students interacting primarily with each other, and activities that might involve interaction with an instructor.)
3. Consider how the online activities and the in-person activities can connect.
4. Choose one of the activities you have considered and create a blended lesson.

See the example below for how your classroom setup might look in your learning management system (LMS). The teacher in this example explores several activities that could be blended in a science classroom.

Teacher Talk: The Procedures of the Blended Science Class (3:55)

Reflection Question: In Mr. Schwalb's class, they use Google Classroom for their LMS. How can you set up your LMS in order to give students some choice in their learning path and pace?

Consider a teacher who has identified her problem of practice: I want my students to be able to analyze experimental data and draw conclusions on their findings. The learning objective states: "Interpret graphs for heating and cooling processes that involve a change of state."

Tables 1, 2, and 3 provide some of the ways she could combine online and in-person activities related to student-content interactions, student-student interactions, and student-instructor interactions respectively.

Table 1

Planning for Online Integration: Examples of Student-Content Interactions

Student-Content Interactions

Online Activities:

1. Students use an online simulation to experiment with heating and cooling various substances, collecting time and temperature data for each test into a spreadsheet.
2. The student will then use digital tools such as Microsoft Excel or Google Sheets to graph their data for each substance.

In-person Activities

1. Students analyze their data and use the graphs they created to answer questions on a worksheet.

Connection: The students will use what they found in the online simulation to create their graph and then analyze their data in person.

Table 2

Planning for Online Integration: Examples of Student-Student Interactions

Student-Student Interactions

Online Activities:

1. Students will be placed into small groups and will share their graphs with other members of the group via Google Slides or an online discussion board.
2. Students will comment on each other's graphs virtually to make note of any similarities and differences between their graphs and data gathering processes.

In-person Activities:

1. Students will meet via in-person groups to discuss their findings and create a brief presentation to share their results with the class.

Student-Student Interactions

Connection: The work the students do collaboratively online will allow them to consider how their findings compare to those of the rest of the group before they meet in person. This will allow them to reflect on their own results and streamline their in-person discussions.

Table 3

Planning for Online Integration: Examples of Student-Instructor Interactions

Student-Instructor Interactions

Online Activities:

1. The teacher will leave feedback on a discussion board used by students to compare their data, making one comment on each student's graph.

In-person Activities:

1. The teacher will meet briefly with each group when they meet in-person to answer questions about the worksheet and help in planning each group's presentation.

Connection: The teacher will respond online to the individual graphs to help students think about their results more deeply. This will allow the students to consider these comments before meeting with the teacher as a group in person and ask the teacher more meaningful questions about the results from the simulation.



Blended Teaching Workbook

In your workbook, using one of your problems of practice, fill out the Planning for Online Integration table.

If you haven't already opened and saved your workbook, you can access it [here](#).



6.3 Selecting a Blended Teaching Model

Once you have chosen the activity or activities you want to blend, consider which blended teaching model best fits the activity. (For a review of blended teaching models, see [Chapter 2: Online Integration in K-12 Blended Teaching: A Guide to Personalized Learning and Online Integration](#).)

Teachers Talk: A Flipped Science Classroom (4:19)

Reflection Questions: What is the advantage of posting various types and levels of videos and simulations? When might this technique be useful in your science classroom?

Teachers Talk: Connecting In-Person and Online Spaces



Dr. Darren J. Ritson

For me, personally, I incorporated a lot of hands-on activities kind of things. The students were presented with their learning on their own with me supporting them. But I would also go around and have stations set up around the room, or there would be labs around the room. There was some kind of hands-on activity that was connecting it back to what they were learning online to ensure they were learning.

Teachers Talk: Using Playlists to Teach Students in a Science Classroom (4:01)



Using Playlists to Teach Students

Matthew Harris

~ Science Teacher



Online Integration

EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY



[Watch on YouTube](#)

Reflection Question: What is one topic in your science classroom in which you would like to give your students a more personalized experience through the use of playlists?



6.4 Deciding What To Do In-Person in a Science Class

Blended learning is the *strategic* combination of online and in-person modalities. But how do teachers decide which activities to do online and which to do in person?

One way to begin answering the question of what can be done most effectively in person is to look at your strengths as a teacher, the needs of your students, and the types of activities that lend themselves to the best use of the in-person space.

For example, students may be working (collaboratively or alone) on a science concept, like Punnett Squares, that has proved difficult for students to understand in the past. You want to do this in person because you know they will have many individual questions. Answering those questions at the moment they occur can keep students from getting stalled in the process and keep motivation and engagement high. It also helps assure that students don't have to back up and redo work.

Similarly, you may want to begin scientific research in person. You want students to get excited about the topic and begin thinking about the possibilities of the project. Once they've had this beginning, they may be more ready to participate in online research and organization of their findings virtually.

Perhaps you are good at explaining calculations in Chemistry, and your students enjoy working through these problems as a class. You might want to introduce a new calculation in person, modeling problems and discussing them.

Know yourself, your students, and your subject matter well enough to determine what you want to reserve the in-person space for.

Once you know how you can best use the in-person space, you can begin to explore ways to use the online space to support in-person activities. You might also consider the affordances of the online space, such as providing quick data, and plan your blended activities around those affordances. The key to successful blended teaching is to make meaningful connections between the two modalities. Answers to the following questions may help you decide how to strategically combine the online and in-person modalities.

- Can I put some instruction online so I have more class time to work with students individually or in small groups?
- Can putting an activity online increase student participation?
- Can I use the online space to allow my students to personalize the goals, time, place, pace, and/or path of their learning?
- How can I use the online space to target individual learning needs?
- Can I use the online space to help students increase ownership of their learning?
- Can I use the online space to give my students access to materials they wouldn't otherwise be able to have?
- Can I use the online space to teach the same concept in different ways, so learners will have more than one option in their learning?
- Can I use the online space to allow for greater learner-learner interaction and collaboration?
- Can I use the online space to adapt or differentiate materials to different students' needs?
- Are there new ways I can use the in-person space when I put some instruction and activities online?



6.5 Evaluating Blended Activities

Blended learning is not just about using technology in the classroom. It is about strategically combining technology with in-person activities to improve pedagogy and student outcomes.

The PIC-RAT and 4E frameworks provide a means of evaluating your use of technology to see if it is adding value to your classroom. It helps you evaluate students' relationship to technology as well as the way using technology relates to traditional practices.

For a more thorough explanation of the PIC-RAT framework, see sections 2.3.1 "[The RAT Framework](#)," 2.3.2 "[Blended Activities that Engage \(The PIC Framework\)](#)," and 2.3.3 "[An Evaluative Framework for Blended Teaching](#)" in Chapter 2 "Online Integration" of *K-12 Blended Teaching: A Guide to Personalized Learning and Online Integration*. For a description of the 4E framework, refer to [Chapter 3](#) of this book.



6.6 Planning Blended Routines and Behaviors

Routines

Establishing routines in a blended classroom is crucial. Helping students understand when and how to move around the classroom, how to access an LMS or other online programs, how to log in and out, where and how to store hardware, how to communicate civilly and respectfully, and how to turn in assignments is essential to creating a usable blend. In addition, making plans for how to manage off-task behavior can prepare you for situations that are sure to arise.

In general, it can help to complete the following as you start to blend:

1. Decide specifically the kinds of behavior and routines you want to put in place.
2. Spend the first two or three weeks drilling and practicing those routines.
3. Set clear expectations.
4. Decide what you will do to help students who have a difficult time meeting the expectations. How will you respond to them?
5. Evaluate your plan and make adjustments as needed.

Teachers talk: Set up a Blended Science Class (2:59)

Reflection Question: What are some blended techniques that Dr. Ritson used that allowed for personalization of his lessons? Think about how students may have been able to have some flexibility in their place, pace, and path of the learning activities.

Teachers Talk: Routines for Blended Learning



Alan Schwalb

I have a little video that they watched explaining how the class is going to work and everything is online, so I don't lecture at all. Basically, they come in, they sit down. I usually have the agenda on the board, so they can see what they're going to do. And then they get work at their own pace, and I just walk in circles around the room, helping the kids that need it.

Table 4 presents some tips for creating blended learning routines.

Table 4

Blended Learning Routines

Blended Learning Routines—Teacher Tips

Student Movement	• Plan how students will move around your classroom (such as in a station or lab rotation). ◦ Will students be moving all at the same time? ◦ At different times? ◦ Plan an efficient way to facilitate those movements. (This is very important when science experiments and materials are involved.) • Be very clear. Make a few rules but enforce them well.
------------------	--

Blended Learning Routines—Teacher Tips

Hardware Management	• Don't waste time plugging in computers between periods if they will be used in back-to-back periods. Make sure they're plugged in at the end of the day and during any breaks you have for lunch or planning. • Establish a routine for making sure computers are charged in the right charging station. This applies to any laboratory equipment that may need to be charged as well. • Create checklists to ensure that you have charged all devices at the end of the day or when devices will not be used. Students should follow these checklists before they leave your class. • Make assignments for students to help with these procedures: ◦ Making sure computers are plugged in and charging. ◦ Sanitizing computers. ◦ Keeping a log of damages or problems. • Assign specific computers to specific desks or specific students; this increases accountability. • Keep electronic laboratory devices in a specific location in the lab to avoid breakage or students accidentally walking off with them. • Teach students how to hold and carry devices and equipment. Practice these procedures.
Software Management	• Be sure that all students know how to turn on the computer, log in, and access the internet. • Practice using your LMS, opening it, finding assignments, checking grades, submitting assignments, etc. Include a screencast of you walking students through the course structure and any special features they should know about. • If you have specific formats you want students to use when submitting assignments, teach them what they are. • Create checklists to guide the use of software, as well as for troubleshooting common problems. • Teach how to download, upload, and organize files. • Practice everything you teach them, including daily routines such as: ◦ Opening their grading portal and checking their grades. ◦ Opening their email. ◦ Opening the class website to see if there are any new posts.
Student Questions	• Teach them where to find answers before they ask you. Include clear instructions for asking questions in your LMS with videos, when possible. • Provide specific ways for students to contact you outside of class and how to address you and classmates politely. • Teach them how to use email and other methods of communication, such as discussion boards. • Utilize an online discussion board so students can ask and answer questions all in one place. • Create instructional videos, reviews, or guides that students can access when they have common questions.

Blended Learning Routines—Teacher Tips

Classroom Configuration	• Decide what kinds of activities you do in your classroom. Are there classroom configurations that will support those activities? For example: ◦ Create a comfortable reading or work space for students to work individually on their coursework. ◦ Create a space for collaboration, where students can talk and work together. ◦ Create a quiet space for writing, analyzing data, or other thoughtful activities. ◦ If you do not have a separate lab room, create a space that is just for science experiments or specific materials. ◦ If you have fewer than 1-to-1 devices, create a space for working on computers. Be clear in determining what else is allowed in that space and whether the computers can leave that space.
Off-task Behavior	• Proactively work to prevent off-task behavior by creating an organized and engaging blended classroom. Students who understand how to use the LMS, their assignments, and essential procedures are less likely to get off task. • Allow students choice in what they are doing and vary the type of activities to keep them interested. • Use software that allows you to monitor what is on the screen of each student. • Teach students to monitor themselves using guided reflection sheets or data trackers that track their activity data (behavior and learning habits). • Try to always walk around the classroom, both to be available for help and to give quiet reminders to stay on task. Even good students can get off task. • Utilize your LMS or other software to keep track of online behavior. • Create a plan for monitoring problematic students. For example, some teachers have a table by their desks. If there is a student who is really having a difficult time staying on task, they place him or her at that table away from other students and monitor that student more closely.
Other	• Help students develop time management skills so that they use their time as efficiently as possible. • Teach students how to work well individually and in groups. Scaffold new types of activities to give them a lot of support the first time you do it and then remove those supports as they learn to work on their own.

Science teachers say they typically spend four to six weeks at the beginning of the year establishing routines and expectations and teaching students how to successfully and appropriately use technology and equipment. But, they say it pays off in the long run with a smooth-running class and increased opportunities for interaction and personalization—all of which they see as positives in their blended classroom.

Teachers Talk: Engaging Students (3:05)



Engaging Students

Matthew Harris
~ Science Teacher

Online Integration

EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY

[Watch on YouTube](#)

Reflection Questions: How does Mr. Harris help his students understand what they will do each day? What do you find to be the ideal amount of time for activities in your classroom?

As you begin to blend your science classes, it is important that you make sure to do so with specific goals in mind and that you provide supporting scaffolds for everyone involved in the process. This includes yourself, your students, and any other stakeholders who may be affected by your transition to and implementation of blended learning.

What does your ideal blended classroom look like and what routines do you need to put in place to create such an environment?

Previous Citation(s)

Keaton, W., Guo, Q., & Short, C. R. (2022). Science: Online Integration & Management. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines*, Vol. 2. EdTech Books. <https://edtechbooks.org/-frla>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/science_olim.

Science: Online Interaction

Qi Guo, Whitney Keaton, & Cecil R. Short

Review foundational knowledge about [Online Interactions](#) in K-12 Blended Teaching (Volume 1).



7.1 Online Interaction in Science

Science classrooms thrive on interactions with and between students. Both in-person and online interactions and feedback provide students with ways to share and support their understandings, give and receive feedback, and present both written and spoken opinions and positions concerning scientific principles with both civility and evidence.

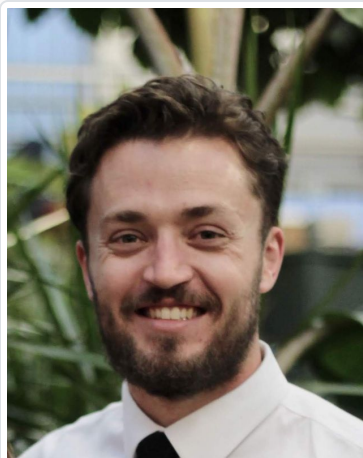
Teachers Talk: Online Interactions in a Flipped Science Class (3:38)

Reflection Question: How can you enhance student interaction using flipped classroom model?



7.2 Student to Student Interactions

Teachers Talk: Peer Comments



Matthew Harris

I often have students do presentations together. Their collaboration tends to take place through discussion, dialogue, and the ability to have a shared document where everyone punches in their critiques, comments, or thoughts. Even the students who are maybe more shy about speaking up in front of the class [can contribute]. That's where I've seen the biggest benefit—I can get students to comment, even on their peers' work. It would be very hard to do it otherwise, but this way it's written down and immediately available to those students.

Teachers Talk: Online Collaboration



Meredith Brady

What we do the most is PowerPoint presentations. In some of those projects, we allow students to work with a partner or in a group. Most often with a partner, which means that they'll have to work on that presentation together online. But I don't really expect them to do it outside of school. So there's not a whole lot of communicating outside of school for that. But that does require them to work together online in the classroom.

Exploring, experimenting, observing, providing evidence, collaborating, discussing, reading, sharing, and presenting are at the heart of studying science. Conversations around these activities can help students build critical thinking skills, express themselves, listen and civilly respond, revise their opinions, and participate in discourse when needed.

There are many technologies that support online discussions. Below are a few of them that can be used in science classes. Examples of the kinds of discussions you might facilitate using these tools are presented in Table 1. (You might want to become proficient with one technology before branching out to another one. Don't try too many at once.)

- Discussion Boards: Usually part of a learning management system (LMS), they allow threaded discussions that can be tied to the grade book.
- [Padlet](#): An online bulletin board where students can post and reply to comments using text, images, audio, and video. Students can also create timelines, storyboards, and collages individually or collaboratively.
- [Flipgrid](#): a video discussion board. Instead of using a text-based discussion, Flipgrid allows students to post and respond with video, which can increase the sense of community and presence in the discussion. Flipgrid also allows students and teachers to create and share screencast videos.
- [GoReact](#): Another video tool that allows students to submit videos of themselves for observation and feedback. This can be useful for helping students create, evaluate, and receive feedback on their presentation and oral skills.
- [VoiceThread](#): A video/audio tool that allows students to add pictures or text to a project, give feedback on writing, and explain their work. It can also be used to make instructional videos with interactive elements (such as turning the videos into quizzes), and create situations where students think aloud about their projects or learning and share their videos with each other.
- [Google Docs](#): A collaboration tool, where students can write and receive feedback and suggested edits on their writing and where students can collaborate on projects.
- [Google Slides](#): Similar to Google Docs, Google Slides allows students to individually or collaboratively create presentation slides. Google Slides is also increasingly used to generate quick ideas and brainstorming, with each student or group of students having one slide.

Just like in-person discussions and interactions, online interactions can become stale if they do not include variety and contrast, inviting students to think deeply and/or creatively.

Table 1

Online Discussion Ideas

	In-person	Online
Precipitation Reactions Lab	1. While you are completing the given experiments, list two chemical reactions that resulted in a yellow, orange, or red precipitate. List the possible chemical name of the precipitate. Then, talk about what these reactions have in common.	2. How many of the reactions that you performed resulted in a precipitate and how many did not? Use the term double-displacement reaction to make a general statement about the interaction of aqueous ionic compounds. Review others' statements and support the degree to which you agree with their statements.
Reaction Rates Lab	1. Use a timer to record the time required for each of the seven provided mixtures to go to completion.	2. Do you agree or disagree with this statement, "the concentration of reactants will have an effect on reaction rates"? State your case by citing data from your trial runs in this laboratory. 3. Do you think the results of this experiment are enough to make a general statement about the above statement? Look at the data shared by others who completed the experiment. Explain your thoughts by providing a synthesis of their data with your own.

	In-person	Online
Calculating Half-Life	1. Answer the following questions by analyzing decay in the laboratory guide: Scientists find a piece of wood that is thought to be from an ancient fire circle. They find that the amount of carbon-14 (^{14}C) in wood is about $1/16$ of the current atmospheric ^{14}C levels. Determine approximately how many years ago this tree was chopped down for firewood. If you started with 1 million carbon-14 atoms, how many atoms would remain in the wood? ^{14}C has a $t_{1/2}$ of 5,750 years.	2. Why do you think ^{14}C dating is a good way to date a human leg bone but not so good to date a dinosaur bone? You may need to check the dates of existence of humans and dinosaurs on earth on a chart showing their geological eras. Compare your response to one of your peer's responses. How aligned is your thinking? Do they use the same reasoning that you do?
Four States of Matter	1. The teacher explains the four states of matter, then all students rotate to a lab and do an experiment using ice, water, and oil. 2. In class, have students discuss under what conditions solid, liquid, and gas transform from one state to another? If you change a substance, are the conditions for transformation still the same? --- (Go to Online Instructions) --- 4. Continue the online discussion in class by providing information about the discovery of plasma.	3. Watch a video about plasma, and in an online discussion, answer the following questions, a. Where is plasma found on earth and in the universe? b. What is plasma energy made of? c. What are the differences between plasma and gas? d. How do you think plasma was discovered? --- (Continue the Discussion In Person) ---
Physics	1. In a lab, students do an experiment about vectors. --- (Go to Online Instructions) --- 4. Develop your own trial using the best method that you have determined in discussion #2. Do not use the ones that have been posted on the discussion board by others. In your trial, calculate the resultant displacement between two points when there are two legs or distinct parts to the trip. Remember to include the displacement (both the direction and the magnitude) of each leg of the trip together with the resultant displacement of the entire trip.	2. Explain how to determine how much error there is between a vector addition and the actual results. 3. Respond to at least two students' posts by either agreeing with their method and explaining why it is superior to yours, or suggest why your proposal is superior to theirs. --- (Continue the Discussion In Person) ---
Erosion Deposition and Weathering	--- (Start the Discussion Online) --- 3. According to their answer in the online discussion, students form two groups based on their position. In their groups, they brainstorm and record the following in a Google doc: their position,	1. Students watch a video about people who had an apartment building on a cliff in California. The cliff was eroding away and the police came in and shut them out. All people were complaining that they were being kicked out of their apartment

In-person	Online
arguments, explanations, and evidence to support their position.	when their apartment was about to collapse into the sea.
4. In class, have an in-person debate about the discussion topic.	2. In an online discussion, the teacher asks students, "Do you think the government should have the right to kick these people out of their house?"
	--- (Continue the Discussion In Person) ---

In the examples above, the online and in-person spaces are combined in different ways to facilitate student-student interactions. Sometimes the discussion starts in person and then moves to the online space, and then may or may not resume in person. At other times, the discussion begins online and then moves to the in-person space. As a general rule, it is best to have interactions occur in person if they could be heated or controversial. Conversely, it can be better to start discussions in the online space if we want to prevent group-think, which can be really beneficial for forming unique hypotheses. Figure 1 provides an online discussion example from science teacher Patrick Hemmingsen, in which he used the online space to create a place for brainstorming questions for an upcoming exam.

Figure 1

Example of a Discussion Prompt–Atomic Structure and Properties

AP Exam Review: Unit 1 Revisit (Due Tues Oct 27 by 11:59 PM)

AP Exam: Unit 1 - Atomic Structure and Properties

1. *Moles and molar mass*
2. *Percent composition of a compound*
3. *Electron configurations*
4. *Periodic Trends*
5. *Empirical and molecular formulas*

ASSIGNMENT: Design your own free response/short answer question over Unit 1.

EXPECTATIONS:

- You may choose any combination of the five topics listed above.
- The question should be within the "goldilocks" range; not too easy but not too hard.
- The question cannot have more than three parts (Parts A, B, and C); choose short or long form.
- Post the question for other students to try to answer.
- **Be prepared to discuss the answer with your respondents.**
- You must try to answer at least two questions posted by other students.

The point of this activity is to continually review old material that is guaranteed to show up on the AP Exam in May. You could wait on Mr. Hemmingsen to give you practice, or search the internet, but sometimes digging deep into your brain to review a topic is far more effective.

Try your best; have some fun with it; please do not be offensive with your questions, answers or discussion points.

[The Big List of Class Discussion Strategies](#), compiled by Jennifer Gonzalez, is a longer list of ideas for interactions that include Socratic seminars, gallery walks, affinity mapping, etc. Use your creativity to modify them for use in both the online and in-person space.

An online discussion is most effective when the instructions are clear. For a review of how to create an effective discussion prompt, see 5.2.2 [Building Community and Setting Expectations](#) in *K-12 Blended Teaching (Volume 1)*.



In your Blended Teaching Workbook create an online discussion for the lesson/content area that you are addressing with your problem of practice. How will you make it engaging for the students? How will you target your problem of practice?

If you haven't already opened and saved your workbook, you can access it [here](#).

Not all online interaction has to take place in a discussion. It can also take place in a shared Google Doc, in a real-time Zoom meeting, through blogs or social media, through visits to each other's websites, etc. Below are some examples of online interactions that do not require the use of the online discussion format.

- Students could share their favorite natural or scientific phenomena (such as aurora, volcano, hot spring, etc.) on a web page or blog for their class or all of their teachers' classes, including a description of the phenomenon and why they like it. They could post some pictures or videos they collect. You might have a day to let them present how these natural or scientific phenomena form or exist.
- Students could create a page for students to share one of the scientific questions that they have been curious about, and ask them to form several small groups, with three to five students per group. The task is to choose one group member's question and design an experiment to answer the question. While they collaborate on the experiment, they are also required to collaborate in writing a report in a Google Doc. The report should include the question they asked; their hypothesis; the experiment preparation, supply, equipment, and process; results; and an analysis of whether their hypothesis was supported by the result, and why or why not.
- Students can create an "I found" page for themselves and their classmates to collect some unusual things from nature, such as unique rocks, leaves, fruits, or insects. Students could take pictures of their collection and research online to try and find each artifact's or organism's names, where they come from, and whether they are native or exotic. Students can then defend what makes their finds unique. This information can be recorded in a class blog or open education textbook. In class, students can display and describe their collections.
- The teacher can prepare some fake fossils and mix them with sand. Students can wash the sand out and pick up the fossils. Students can then make an online gallery of the fossils they found, including the fossil names, which animals the fossils came from, what part of the animals the fossils came from, and about how many years ago these fossils were likely buried.

Figure 2 shows an example of a discussion in Google Question talking about the types of plate boundaries.

Figure 2

Example of Google Question

6-3B Relationship Tectonics: Describe a relationship in your life using one of the types of plate boundaries.

Alan Schwalb • Mar 11

3 points

1. Think about another person in your life. It can be anyone... family, friend, boss, etc.
2. Describe your relationship with this person using one of the plate boundary types (convergent, divergent, transform). Example... "My relationship with my sister is like a transform boundary because..."
3. Don't forget to explain your choice!
4. Reply THOUGHTFULLY to two classmates. No one word answers please!

Class comments



Add class comment...



3 points



Mar 12

My relationship with my sister is like a divergent boundary because we don't talk as much anymore since she has moved away.

2 replies



Mar 12

Same, since my sister moved, we stopped talking and hanging out as often as we did before.



Mar 24

I agree with this statement but relating to my brother because he moved away an hour from us and we barely get to see each other and don't talk to each other like we used to.

Reply

Teachers Talk: Peer Interactions by Collecting Data From Each Other



Dr. Darren Ritson

We set up some of our assignments where students needed to get data from other students in the classroom in order to fill it out. It was more like gathering data so that they could have a data set, and they could work on assignments using that data.



7.3 Teacher to Student Interactions

Teachers Talk: Leave Online Feedback to Canvas (4:47)

Reflection Question: Mrs. Brady introduced four ways to leave feedback on Canvas. How can you use feedback to improve student learning and strengthen relationships with your students?

Interactions between students and the teacher are also important in a science course. Experienced blended teachers often report that their interactions with students online have strengthened relationships and contributed to student growth. What are some ways teachers can foster these interactions?

- **Participate in online discussions.** You don't have to chime in and respond to everyone's posts. Instead, your role in a discussion board is to guide and facilitate the discussion. You can monitor what is said for civility as well as content. If a discussion is going in a nonproductive direction, you can gently guide it back. You can respond honestly to good ideas and interesting insights. You can suggest further resources to keep the discussion going.
- **Provide feedback.** Students appreciate and need feedback. Teachers find that providing some types of feedback online is much easier than providing feedback with the traditional paper and pen. Here are some ideas for providing online feedback or feedback on online activities:
 - Give feedback on assignments through the LMS you use. Check out the ways your LMS allows you to communicate with students about their assignments. If you are using rubrics for grading, you can give very specific feedback then allow your students to improve the assignment. Your LMS may also have additional ways to contact students.
 - Use written, audio, or video feedback. Some students prefer written feedback because they can access it easily; others prefer audio or visual because it's easier for them to understand and feels more personable. There are also times when it's easier to provide audio or video feedback compared to typing out feedback comments. For instance, [Mote](#) is a Chrome extension that allows teachers to quickly add audio recordings to Google Documents and the Google Classroom gradebook. There are also several free screen-recording tools that allow you to create quick video recordings and then share them with students using an unlisted link. There are times when text, audio, or video feedback are the most effective and you can use all three during the year.
 - When students are online working during class, walk around the classroom, answering questions, and give verbal feedback as needed.
 - Schedule one-on-one meetings with students to discuss their progress and to provide feedback to them. These meetings can often be based on LMS data or data that you and your students have gathered to track their progress.
 - If students are writing a lab report online in a Google Doc, you can pull up as many documents as your computer will allow and give real-time feedback as they are writing. Students are more likely to rewrite and revise when they receive formative feedback during the writing process as opposed to summative feedback after the writing process.
 - In your feedback, share personal anecdotes that their projects bring to your mind. Let them get to know you. Establishing a teacher presence in the online space is important for creating meaningful academic relationships.
- **Use email.** Explain to students your process for receiving emails from class members. Encourage them to email you with questions. Explain to them when you will be available to look at emails, and how promptly they should expect responses.
 - Email students who are not in class, letting them know that they were missed.

Teachers Talk: Two Ways of Communicating with Students Outside the Classroom



Alan Schwalb

I use remind.com, where I can send out texts to students, and they can send texts back, and it protects our phone numbers from each other. I had one student last year, who would send me texts occasionally when she was having trouble with an assignment and I was able to help her from my house while she was working on an assignment at home. A lot of my students also email me, so I can set up sessions to help them. So the technology allows us to do that remotely. It's definitely made it easier for students to communicate with me and for me to communicate with my students outside of the classroom. I've had more success assisting them and helping them with assignments. And I have my school email hooked up to my phone. So I'm responding to them at all hours of the night.

Google has the comment feature. Students often comment very quickly like—"I couldn't find the answer to question number three;" "I can't open the assignment;" "I finished this. Can you please grade it?" It could be many things. And I will reply in different ways. A lot of times I will just leave a comment right underneath it answering whatever they've asked, sometimes I'll send them an email. Sometimes it'll be like, oh yeah, right. Sorry, let me fix that. So most of our interactions outside the classroom are like that. Occasionally I'll bring something up that they may have commented on, and when they come to class the next day, we talk about it in person.

Teachers Talk: Opening up Academic Conversations



Dr. Darren Ritson

I always leave feedback on assignments when students turn them in. Do most of them read it? No. Most are probably just looking at the grade, but this past year there was more of where I'd leave a comment, and the kid would do something, and leave a comment and send it back to me. So the blended learning has opened up a little bit of the academic conversation going back and forth.

Teachers Talk: Using Check Points and Feedback to Communicate with Students (2:37)



EdTech Books <https://edtechbooks.org/k12blended2>

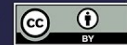
Communicating with Students

Matthew Harris
~ Science Teacher



Online Interaction

Licensed under CC BY



[Watch on YouTube](#)

Reflection Question: Mr. Harris talks about using checkpoints and feedback to communicate with students. How can you communicate with students regarding how to improve their cognitive skills?

The online space significantly increases opportunities for interactions between students and other students, and students and teachers. Students who never or rarely speak in class may find themselves suddenly communicating on a regular basis. The results of learning through a combination of content, interactions, instruction, and feedback can improve student outcomes, investment, and engagement with the subject matter. You don't have to start all at once. Just choose one interaction that looks promising to you and start there.

Previous Citation(s)

Guo, Q., Keaton, W., & Short, C. R. (2022). Science: Online Interaction. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines*, Vol. 2. EdTech Books. <https://edtechbooks.org/-Mzpw>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/science_olint.

Science: Data Practices

Qi Guo, Whitney Keaton, & Cecil R. Short

Review foundational knowledge about [Data Practices](#) in K-12 Blended Teaching (Volume 1).



8.1 Collecting Data in Science Courses

Data can inform all parts of your teaching. It can help students see their own progress and areas that need improvement. It can help you understand what specific students need. It provides information that students can use in setting and evaluating goals. Technology has greatly expanded the way to record, collect, organize, and use data in a timely and efficient way. Because of technology, teachers can easily and quickly collect and use data to change and enhance their pedagogy, group students, plan remedial and extended activities for students who need it, and target specific needs of individuals, groups, and the whole class.

Teachers Talk: Using Data from Different Sources to Assess Learning (2:53)

Reflection Question: Dr. Ritson uses tools in Google Classroom and other external tools to collect data about student learning. What tools do you have available in your LMS and externally that you can use to collect data on your own students' mastery of the learning objectives?

In order for data to be helpful, you have to organize it in a meaningful way. You may want to use qualitative and quantitative data, observations, performance criteria, and areas of a rubric aligned with a certain learning objective. Here are a few examples:

Table 1

Collecting Data—Some Ideas

Desired Data	Ways to Gather the Data Using Technology
Students' personal characteristics	These data often come from teacher-made resources and surveys that help you get to know your students. You might use a Google Form to have students answer questions about their learning preferences (such as working alone, in groups, by reading, by watching, or by writing), their best times of day for studying, their hobbies, their interests, their perceptions of their strengths and weakness in science, what they want from your class, what they are nervous about in the class, the types of

Desired Data Ways to Gather the Data Using Technology

	assessments and activities they prefer, etc. This data can also consist of socio-emotional data such as a student's mood, how much sleep they typically get at night, or when they last ate a full meal. Notice and take notes of students' participation, interest in various topics, friends, attention, outside interests, interaction with others, clues about home life, etc.
Mastery data	This data may be in your learning management system (LMS) or an outside mastery tracker that you create. It often includes data from activities and assessments. This data can usually be collected from the results and analytics of students' quizzes, assignments, or tests which reflect their understanding of certain concepts, definitions, formulas, their understanding of theories, their lab skills, or their ability to apply the theories they learned to solve real-world problems. This data can also come from state-mandated tests. Collecting and then analyzing mastery data can help teachers know where most students mastered, in which parts most students need remediation, and where the teaching approach needs some improvement. Teachers can then work on the specific parts guided by the data they collected and analyzed. Training/resources needed to obtain/access data: Training in using the grade book, quiz statics, or other grade tracker.
Activity data	You can obtain activity data from your LMS by running analytic reports. The reports may include students' time spent reviewing LMS pages or modules, participating in activities or assignments, who submitted assignments on time, who was late or absent, who missed assignments, etc. This data can also be obtained from observations of students' learning habits and behaviors, like staying on-task or not appearing challenged and engaged. Collecting and analyzing activity data can complement mastery data. Looking at activity data and mastery data together can help you understand the academic stories of individual students. For example, you may notice from mastery data that a student's academic performance has dropped abnormally, and upon checking his/her activity data, see if the decrease is due to less time spent on reviewing learning materials or not submitting assignments.
Goals and progress towards goals	You can keep track of goals and the progress students are making in a spreadsheet or goal sheet you create. You may choose to create SMART goal trackers that students keep in a data binder where they set and track their goals, growth, and challenges.
21st-century skills	You can collect data on how well students are developing the ability to collaborate through students' self-reflections on the process of collaboration and their contributions, participation in a discussion board, ability to work with students on a shared document, and reports from the students' peers. You can also track this data through class observations.
Help-seeking strategies	Observe how your students seek help and record what you see: Do individual students seek help online, from other students, or from you? Are they afraid to ask for help? Do they seek help when they might figure it out on their own?

**Blended Teaching Workbook**

In your blended teaching workbook, you have a blank table like the one above. Decide what sources of data you would like to use in your classroom. Fill out the chart based on what data you want to collect. You may have to ask others for ideas on types of technology and what you need to learn to use the technology.

Teachers Talk: Canvas Provides Good Data for Teachers to Reflect Their Teaching Approach



Meredith Brady

Canvas has pretty good data for the quizzes and stuff that we use. We use a lot of formative checks to see how students are doing. If we need to, we spend more time on the topic or do another activity in the next day. Most often the changes we choose to make based on data affect next year as opposed to the current year. And we're always trying to reflect back and do better.

Teachers Talk: What Kind of Mastery Data Do Teachers Usually Look For?



Dr. Darren Ritson

Sometimes we use anecdotal evidence based on our formative assessments that we're doing in the classroom. We may look to see a specific assignment in Google Classroom. What was the average score for the kids; did they learn it for the most part?

Teachers Talk: Collecting Activity Data in Google Classroom



Alan Schwalb

Google Classroom has a To-Do Button which was life-changing. When I figured out this brings up all the assignments such as the number of students who turned it in, the number of students that need to be graded and so forth. I look at that data to see who completed assignments, so I can grade them and put them in the gradebook and then see who's not completing work and maybe talk to them if they're not doing anything.



8.2 Utilizing Data in Science Courses

Tracking data can help science teachers improve student learning and their own teaching. Because data can help you know your students' skill levels in a large number of science objectives, it can help you in creating curriculum, differentiating and personalizing activities and assessments, helping students set goals, and tracking progress. It can also help you see strengths and weaknesses in your curriculum and approach to teaching, allowing you to improve your teaching. As you look at the examples below, notice how these teachers are using data. Think of ways you could improve your class by collecting and analyzing data.

Teachers Talk: Advice to New Teachers on Using Data



Matthew Harris

Find a way to efficiently gather student data that automatically informs you how they're doing. So, any platforms or programs you can find where you can spend less time gathering the data and more time using the data would be a huge benefit. Summit is a platform that does that pretty effectively. But there are ways to use things like Canvas and Google Classroom to give you that same data. Don't spend all of your time gathering the data. Because then you spend less time with your students, and I think some teachers over-focus on gathering data instead of using data.

In analyzing data, it is important to look for trends that may occur at the individual, group, or class level. Each of these different scopes may provide a different understanding of the data. For example, if you teach chemistry at three different times during the day and the second and third classes did well on an assignment but the first class did not, then you know there was likely some misunderstanding in the way the first class processed the information. Likewise, you may look at activity data for student progress in group labs and find that some groups are moving slower than other groups. This may allow you to provide slower groups with more time or support so they don't lag too far behind your other classes, or recognize which groups do not work well together due to getting distracted. At an individual level, you may recognize that some students seem to understand the class content really well when discussing it with you, but less well when they take a test. This pattern could be evidence of test anxiety or that the student was having an "off day."

Triangulating the kinds of data you track for students (such as performance data, activity data, and learner profile data) and the scope of that data (individual, group, or class data) can reveal different patterns and trends that help shape your instruction.

8.2.1 Mastery levels in a science class

Because the Science curriculum requires students to think critically and problem solve, it can sometimes be difficult to measure mastery. How do you decide when a student's understanding of a lab experiment meets the requirements for mastery of critical thinking and analysis skills?

This is where both data practices and personalization can help. A close analysis of such things as student papers, written and verbal explanations of scientific concepts, ability to argue their side of an issue, etc. can help you find strengths and weaknesses in your students' thinking, writing, speaking, and listening skills. For example, one person may be strong at explaining a scientific theory in concept but weak at providing evidence from an experiment done in class. Another may be strong at determining products of a chemical reaction but poor at the mathematical reasoning needed to balance that reaction. Maybe the student needs to improve in walking through the steps of a scientific problem step-by-step or making connections between theories and real-life situations. Maybe they need help using scientific language properly or using inquiry to solve a problem. Using this type of information to help students set measurable goals and create mastery paths can help both you and the student decide what mastery looks like and how to best measure mastery for each individual student.

It may be that some students have similar problems and can be grouped together to learn from each other and offer each other support. Students who excel can become mentors for those who need help and in turn can have students who are strong in areas in which they are weak become mentors for them. Determining what students have mastered and what needs additional reinforcement is an important place to start. In the video below, you can see some ways to determine the needs of your students.

Teachers Talk: Using Data to Target Difficult Concepts and Redesign Teaching Approach (2:20)

Reflection Questions: What types of formative assessments do you use in your classroom to determine how well your students are mastering the material and what you need to re-teach? Consider assessments you already use and how you could collect data from those in addition to new assessments you could incorporate.

8.2.2 Using data to help improve pedagogy

Because data often come from student performance and student activity, if you pay careful attention to student data, you can learn a lot about how to best teach your students and what pedagogy to use. What activities lead to the best results for what kinds of learning outcomes? What confuses your students? When are they most engaged? Does their engagement also lead to understanding and mastering learning outcomes? Reflecting on questions like these can help you evaluate yourself as a teacher and your students as learners. They can lead to insights that can strengthen your pedagogy and help students achieve mastery as well as their goals.

Quizzes (and other assessments) are a common source of data. Here are some ideas for using quiz data to improve your teaching and student learning:

1. Check to see if your LMS lets you align questions to specific learning outcomes. If it does, you can determine which outcomes students need more help with.
2. If many students miss the question, check to see if there is a problem with the question (miskeyed, difficult wording, unclear answers or expectations). If there are no problems with the question, check the standard to which the question is aligned. Pinpoint specific areas of confusion, analyze your instruction, and modify where needed.
3. If most students answer correctly, check to see if the question is too easy. If it isn't, review your teaching strategies for strengths that you might be able to use for similar learning objectives.
4. If just a few students miss the question, you may want to pull those students out in a small group and reteach specific principles, offer resources for remediation, or provide them with extra practice.

Teachers use data in all sorts of ways. Here are some examples of ways teachers have used data in a science classroom. What ideas do their experiences give you?

Example 1: Using Data to Help Students Get Services

Consider two students with opposite needs in a biology course. Through the use of data collection from tests and formative assessments done with programs like EdPuzzle and Nearpod during class, the teacher can assess their needs and determine how to best help them.

- With one student, the data showed overwhelmingly that the student was not understanding the basic concepts or terminology regarding plant cells. The teacher could provide remediation in this area using tools and programs geared toward struggling students.
- Another student was getting bored in the class. He was finishing all assessments quickly and earning high scores on all of them. The student could be given extension activities to allow him to do more inquiry activities that would hold his interest and allow him to stay engaged in the course.

Teachers Talk: Using Data to Provide Students with Targeted Tutoring and Feedback (2:42)

Reflection Questions: How can students in your classroom benefit from targeted feedback? Is there a time during your class session or your school day for targeted tutoring like Meredith Brady discusses?

Example 2: Using Data to Determine How to Make Questions Better

Sometimes what we intend to measure on an assessment is not what we are, in fact, measuring. It is important for you to analyze data from assessments not only to determine what your students know but to ascertain how well your assessments are actually measuring the intended learning objectives. For example, if a multiple-choice question on a test has a misleading choice as one of the wrong answers, it is possible that students are getting that question incorrect because of the way it is written rather than because of their own misconceptions in the science content. In order to best measure our students learning, teachers have to make sure they are actually asking the right questions. Analyzing assessment data frequently not only allows teachers to determine more about their students' learning, but also evaluate the quality of their teaching and assessing.

Teachers Talk: Test Data Informing Future Teaching



Dr. Darren Ritson

We would use data from the tests, the unit tests that we would give students, and we would use that data to look and see how the students were performing for the entire department. And that data wasn't going to change instruction for the students that we were teaching, it was going to change for the students we were going to teach in the future. It would allow us to look at test questions that we were asking, and we could look and see if somebody was scoring better on a specific question, and then we could find out what they were using in their classroom and see how we could adjust it to teach in our own classes.

Example 3: Using Data to Answer Questions

Using data teachers have been able to ask and find answers to a lot of different questions, for example:

- Q: Why did every single student miss this question?
- A: The question included a drop-down menu. The students didn't know how to use it.
- Q: Why did this class understand a certain concept and another class did not?
- A: We didn't have time for the online activity in one class. When I went back and did it with that class, their scores improved.
- Q: The data shows that my morning class struggles to understand concepts. Why?
- A: I had to experiment to find the answer to this one. Finally, I realized that these students needed to have some physical movement that early in the morning, even if it wasn't education-related. My afternoon classes, however, were tired from the day and just wanted to listen and work quietly. I had to adapt my approach for both classes.

Teachers Talk: Collect Data on Remediation Techniques



Alan Schwalb

Last year, a lot of the students had trouble with the concept of a density current, where essentially cold water sinks and warm freshwater floats and it creates a circular flow from the poles to the equator. And so we designed a digital source to address that concept. And then we basically tracked whether or not on that particular test question they did better after using the digital source.

Teachers Talk: Using the Flipped Model for Data-driven Instructions (8:38)

Reflection Questions: How is the flipped model that Patrick Hemmingsen uses helpful for him to collect data during class time? How does he use data to address misconceptions in science?

Example 4: Using Data to Group Students

Most Learning Management Systems will allow you to sort students by their scores on assessments. This data could be used to group students. For example, sometimes you may want to group a high-scoring student and a low-scoring student to allow for some peer tutoring. Other times, you may want to group a handful of students from the bottom together to work on some targeted remediation with you while the rest of the class moves on to something else. This data can also be used to group students for projects and inquiry-based experiments.

Teachers Talk: Grouping Students to Reteach Concepts



Meredith Brady

We have a time called "flex." It's like a 30-minute training version of second period where we help students who are falling behind, and I will often use data to teach groups during that time. I'll pull in certain students and we'll go through questions and quizzes that they've got wrong and kind of talk about that to reteach those topics.

Teachers Talk: Grouping Students According to Data (3:06)



Grouping Students According to Data

Matthew Harris
~ Science Teacher

Data Practices

EdTech Books <https://edtechbooks.org/k12blended2>

Licensed under CC BY

[Watch on YouTube](#)

Reflection Questions: What are some ways that you could group students in your own classroom? Do you have data available to you that could help you to do this more efficiently? What do you see as the advantages of grouping your students for targeted instruction?



Blended Teaching Workbook

Think of one source of data that you are not using but that you could use in your classroom. In your workbook, outline a way to collect that data and ways you can use it.

If you haven't already opened and saved your workbook, you can access it [here](#).

Collecting and using data may feel uncomfortable. You may think you can't do it. But if you think about it, you are collecting data all the time. You are already regularly questioning your students, reading their lab reports and grading their work, and giving them activities to practice and check their understanding. You are ready to take the next step and find more formal ways to include data in your understanding of your students, their learning patterns and needs, and your strengths and weaknesses as a teacher.

Previous Citation(s)

Guo, Q., Keaton, W., & Short, C. R. (2022). Science: Data Practices. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines , Vol. 2*. EdTech Books. <https://edtechbooks.org/-vPxh>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/science_data.

Science: Personalization

Whitney Keaton, Qi Guo, & Cecil R. Short

Review foundational knowledge about [Personalized Learning](#) in K-12 Blended Teaching (Volume 1).

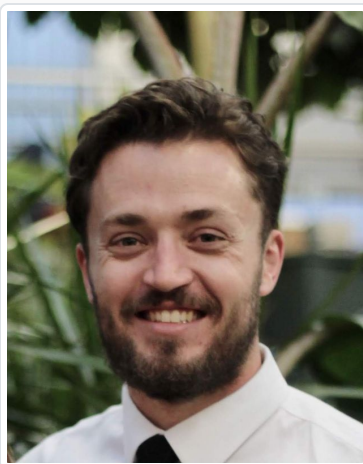


9.1 The Importance of Personalization in a Science Classroom

Within a blended learning environment, personalized learning is one of many instructional strategies. When we personalize learning for our students, we allow the instruction to be adaptable to individual students' abilities, interests, and needs. When we describe personalized learning it is important to consider what from our instruction is being adapted, how it is being adapted, who or what is doing the adapting, the data that the adaptations are based on, and to what extent students are able to take ownership of the adaptations.

In a science classroom, personalization can take many forms and use a variety of strategies. When teachers allow students to have choice in the pace and path of their learning by using strategies such as playlists, they are personalizing. Allowing student to use inquiry skills to find their own path in a scientific investigation is also personalizing. Science teachers can personalize learning objectives by allowing students some choice in the research they do for a project. Activities and assessments can be personalized when students can decide how to meet the course's learning objectives and how they will demonstrate their mastery of the concepts. If a student is allowed to show their understanding via a test or a presentation, etc. their learning has been personalized. Notice that in all of these examples, students are taking some degree of control over their learning.

Teachers Talk: Personalized Learning for Maximizing Success



Matthew Harris

I feel like Blended learning has given me more options and more ways to try to gather valid data on how students are doing, which has enabled me to know which of my practices work and which ones don't, and made me realize how important it is to have a personal relationship with each student to maximize their learning and their success.

As mentioned in the data practices chapter, science students vary widely in their abilities to think critically, employ evidence, organize information, and understand various scientific concepts. Personalization becomes a way to help students develop their strengths and overcome their weaknesses. It allows students to focus their attention on areas where they can really grow and not spend time doing exercises in areas they have already mastered. It allows students to use their time efficiently for their own growth. It can also help students gain confidence in their ability to master scientific concepts by using a variety of different strategies and find ways that they can communicate their understanding.

One of the advantages of a personalized science curriculum is that students can be involved in the same or similar activity but be working on different areas of growth. For example, in a chemistry unit on chemical reactions, some students may need more time to master the process of balancing a chemical reaction, while others may be able to quickly move onto predicting products. The teacher may provide a menu of activities for students to practice balancing equations and once they have mastered it, provide them with a recording about predicting products. The students who are able to move on may have a variety of online and hands-on activities to practice how chemicals react to predict products of chemical reactions. During all of this, the teacher could be available for individual and small group conferences for students who need additional help with any of these areas. Personalization looks a little different for each student. The teachers in this chapter share some of their experiences with personalization and its effects.

Teachers Talk: Providing Access Anywhere, Anytime



Dr. Darren Ritson

Another girl, the blended learning worked in her favor because for her, she had five younger siblings and in a lot of cases she was the first mom. She had a permanent mom at home but mom had to work and all sorts of other stuff. So this girl, it came down to her for being the caregiver. So there were a lot of times where this girl would either miss class or she would come to class and she would have other issues. But because of the blended model, she was able to catch up and get all of our work done in a timely manner. So it worked to her advantage.

It is helpful to approach personalization and in two different ways: through personalizing along the dimensions of personalization and through personalizing learning objectives, assessments, and activities.

Teachers Talk: Students Benefit from Personalized Learning (3:42)

Reflection Questions: What areas of the curriculum did Dr. Ritson personalize in his blended classroom? Which strategies do you already use that you can incorporate into a blended learning unit?



9.2 Personalization Dimensions in a Science Classroom

One way to think about personalization is to examine the ways students can personalize instruction. The five dimensions of personalized learning are guidelines for ways we can adapt instruction or allow our students to adapt their learning. These dimensions are goals, time, place, pace, and/or path.

Figure 1

Five Dimensions of Personalized Learning



In the sections below we explore each of these dimensions.

9.2.1 Personalizing Goals

Goals are a means of making choices specific and purposeful. Facilitating goal setting increases student ownership of their learning, encourages lifelong learning skills and attitudes, and increases motivation and self-regulation abilities.

In order for students to personalize their goals, you and they need to understand something of their needs and proficiencies as science learners. This is where you can use the data you have gathered from the activities mentioned in the Data Practices chapter.

Information from such sources helps you understand where students are in their science abilities, knowledge, and aptitudes. Learning outcomes and standards provide a focus for where students are expected to be. The difference between where students are and the course outcomes is the place for growth—and goals.

Goals are not goals if they are just aspirations. Writing goals down and tracking them are important processes for achieving them. Here are a few ideas about goal-setting conferences and how they might be used in a science classroom.

In Class

- Teach and discuss the purpose of setting goals.
- Help students develop a growth mindset; create a culture of growth.
- Introduce a goal-setting process such as using SMART goals (specific, measurable, attainable, relevant, and time-bound)

Conferencing (regular goal-setting meetings)

- Some teachers meet with a few students a day or a week, taking several weeks to meet with every student.
- Others plan a station or lab rotation, where students are working independently, then pull students out individually for a short consultation.
- Use these conferences to review current data and areas of growth.
 - Discuss growth in content areas, i.e. discuss academic goals.
 - You may also want to allow students to practice making personal or behavioral goals that are outside the scope of your learning outcomes such as personal health goals, interpersonal goals, college and career goals, or self-regulation goals.
 - Goals can be based on performance data, activity data, or learner profile data. The most important thing to remember is that the goals should be measurable. An example of a performance-based goal would be "I will get an 80% on this unit," while an activity-based goal may be more like "I will study 30 minutes per night during this unit." A goal based on learner profile data may focus on pursuing a student's particular interests.
- Invite the student to evaluate where new growth can take place in your content area and make goals for that growth.
- Record progress toward previous goals and new goals. Include a chart or data tracker to help students visualize progress.

Monitoring (tracking progress between conferences)

- Pair and share—place students in pairs (which either you or the students choose). The students share their goals with each other weekly and help their partner revise the goals if necessary. They also report their progress. This approach can help create accountability for tracking and fulfilling goals.
- Journal reflections—Students can keep an online daily or weekly journal in which they reflect on and record their progress toward their goals and/or the challenges they are facing. Teachers check in weekly and address individual student needs.
- Exit tickets—Students turn in an exit ticket daily, reporting that day's progress, struggles, need for help, and/or next steps. These exit tickets can be completed either online or physically. Either way, they should be easy for both you and the students to track and organize.
- Data trackers—Create charts to record student and/or class progress during the year.

Teachers Talk: Personalizing Goals (3:11)

Reflection Questions: Is personalized goal setting something that would be useful in your classroom? What techniques does Matthew Harris use that you could fit into your own lessons?

[Chapter 2](#) of this book refers to a taxonomy of student agency for guiding personalized learning. Level one of the taxonomy represents a one-size-fits-all generalized pedagogy, whereas level two is tailored to fit the interest or needs of each student, and levels three and four represent a more student-centered pedagogy and allow a greater deal of student agency. In Table 1, you will see some examples of what personalizing goals could look like in a science classroom that reaches levels 3 and 4 of the Taxonomy of Learner Agency.

Table 1

Examples of Personalizing Goals in a Science Classroom

Learning Objective Students will gain a unique understanding of Earth's place in space and time by studying the chemical, physical, and biological evolution of the Earth system.

	Level 3 Personalization	Level 4 Personalization
Performance-based goals	Students are given choices of what grade they want to earn in this unit. The teacher guides them to help them understand what they are capable of given their past performance and encourages them to challenge themselves but ultimately leaves the goal and strategies up to them.	Students are asked to come up with a goal for their grade or level of mastery in the unit and asked to write about strategies they will use to achieve that goal as well as ways they will measure and track their achievement throughout the unit.
Activity-based goals	Students are given a list of study strategies that would be helpful in this	Students are given the freedom to identify a behavior or habit that they want to focus

Learning Objective Students will gain a unique understanding of Earth's place in space and time by studying the chemical, physical, and biological evolution of the Earth system.

Level 3 Personalization

unit. Students pick one study strategy from this list that they will work on and come up with a goal and strategies for implementing it throughout the unit.

Level 4 Personalization

their efforts on during the unit. The teacher gives them some possible examples of ways to improve their behavior or change their habits but ultimately allows them to come up with their goal and strategies on their own.

9.2.2 Personalizing Path

When you allow students to personalize their learning path in your classroom, your students are not all doing the same assessments and activities. You may find that you have become a curator of resources and activities that will best help your students. These resources/activities can be compiled in playlists or choiceboards, which give the students choice about the order in which they complete the activities or about which activities they complete. Table 2 describes ways in which the learning path can be personalized in a science classroom at levels 3 and 4 of the Taxonomy of Learner Agency.

Table 2

Examples of Personalizing Path in a Science Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
Students will be able to identify the characteristics and basic needs of living organisms.	Create a menu of learning activities about the characteristics of living organisms. Have an appetizer round in which students are introduced to the concepts, an entree round in which students practice the concepts, and a dessert round in which students demonstrate their understanding. Students pick one activity from each round based on their preferred learning methods (reading, hands-on, videos, etc.) and have to check in with the teacher after each round before moving on.	The teacher creates a problem-based learning lab in which students are given several organisms and have to identify if they have the characteristics of living things. The teacher provides access to resources that may help in students' investigation but does not direct the students down any particular path (i.e., to specific resources) that they could use to solve the problem.

9.2.3 Personalizing Pace

Personalizing pace means allowing students to take more or less time based on their own ways of learning, their mastery of the content, and their personal or life circumstances. It often includes giving students a window of time to meet due dates for completing activities, assignments, and assessments. Personalizing pace encourages students to manage their time. They know what they need to do and when it needs to be completed, but they also know the other demands on their time (e.g., sports, school, plays, family and work obligations) and learn to plan for these situations. Table 3 provides examples of personalizing pace in a science classroom at levels three and four of the Taxonomy of Learner Agency.

Teachers Talk: The Benefit of Personalizing Pace



Alan Schwalb

Personalizing the pace allows me to focus on their challenges. I go over and sit down with them and work with them one on one because I know that the rest of them were being successful. So some of the lower kids might need more time.

Table 3

Examples of Personalizing Pace in a Science Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
The students will learn the laboratory skills needed to design, safely conduct, and interpret chemical research.	The teacher assigns a simple laboratory experiment to teach the concepts of laboratory skills and safety. The investigation contains several sections and multiple learning activities in each section. The students can pace themselves within each section but are given checkpoints by which they must complete each section.	Using the same investigation explained in the level three example, students are allowed to complete the entire investigation at their own pace, understanding that the course contains additional content that they must master for credit.

9.2.4 Personalizing Time

In a traditional classroom, students may have a class period to finish an assignment. In a blended classroom, this time can be expanded to include time outside of the class. Because activities can be accessible outside of the classroom, students can choose times that work well for them. For example, a student may have a difficult time learning in the morning, when he has his science class, but because he can access his assignment later in the day, he is able to complete it at a time that works for him and to perform well on the assignment. Time is closely related to pace because students are not bound to a specific time to complete an activity; they can increase or decrease their pace according to their own preferences, needs, and abilities. Table 4 provides examples of personalizing time in a science class at levels three and four of the Taxonomy of Learner Agency.

Teacher Talk: Give Students More Control on Assignments (2:13)

Reflection Questions: What were some of the reasons that Mr. Schwalb's students needed flexibility in their time and pace of the coursework? What was his goal of allowing students this flexibility and do you think it was successful?

Table 4

Examples of Personalizing Time in a Science Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
Students will be able to classify matter by observing the patterns that occur when it undergoes physical and chemical changes.	A teacher does a large group lecture on physical and chemical changes and then gives the students in-class work to complete. Anything that is not completed in class can be completed at home, after school.	The teacher gives students video lectures on the content and a checklist of work to be completed on that topic. Students can work on the videos and checklist at a time of their choosing as long as it is completed by a specific deadline.

9.2.5 Personalizing Place

Personalizing place revisits traditional practices about where learning occurs. Because blended courses include online instruction, students can choose to do activities at home or at school—or even during a break at their job. In addition, they can access instruction when they have to miss activities because of illness, travel, or extra-curricular activities. Personalizing place also includes allowing students to choose where in the classroom or school to learn, as well as with whom students want to learn.

Classrooms are often viewed as rows of desks or sometimes desks grouped into tables. But classrooms don't have to look this way. They can use flexible seating to be made more comfortable, inviting, and conducive to the kinds of activities that take place in a science classroom. In addition to providing students with flexible seating within the classroom, students can also be allowed to work in the hallway, library, or computer lab. Personalizing place also includes allowing students to learn from other teachers or with other students. Table 5 provides some examples of personalizing the place of learning at levels three and four of the Taxonomy of Learner Agency.

Table 5

Examples of Personalizing Place in a Science Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
Students will be able to communicate physics reasoning in oral and in written forms.	Students are given an assignment to research a physics topic assigned by the teacher. They are given a written research assignment and a recorded video assignment. The teacher provides stations around the room for researching, quiet writing, and recording videos. The students are able to choose where they want to work during class.	Students are given an assignment to do an online debate with their classmates about a controversial scientific concept. They are able to work on this assignment from home or at school because the materials are all provided in the online learning management system. Some students choose to work on their own to complete the discussion while others choose to work in groups.



9.3 Personalizing Instruction

Approaching personalization through the five dimensions is one way of implementing personalized learning. Another way is to look directly at what you do in your classroom. Typically teachers plan assessments and activities around learning objectives to make sure they cover the material they are mandated to cover. Finding ways for students to exercise choice in some or all aspects of these learning objectives, assessments, and activities is another way to foster personalization in your classroom.

9.3.1 Personalizing Objectives

In Tables 1–5 above, we provided several examples of learning objectives. While many of these learning objectives may not provide us or our students with room to adapt them to individual students' abilities, interests, or needs and are mandated by the states or organizations we teach for, other learning objectives do allow for such customization. For example, the following learning objective can be personalized in several ways:

"The students will learn the laboratory skills needed to design, safely conduct, and interpret chemical research."

- Goals - Students can determine what chemical research to prepare for based on their own interests or college and career goals.
- Time - Students can determine when to work on this learning objective, whether it will be during the regular class period and school day or before or after school.
- Place - Students can determine whether or not to work with others on meeting the learning objective or whether they will complete their chemical research at home, in a specified lab, or at school.
- Pace - Students can choose how quickly they meet the learning objective by choosing the pace at which they complete activities and assessments.
- Path - Students can be given a certain level of flexibility concerning when they will work on this learning objective in relation to other parts of the curriculum, whether the learning objective will occur according to a teacher-provided scope and sequence or outside of that order.

In many ways, personalizing learning objectives creates a guide for personalizing the assessments and activities used to prepare students for and measure their mastery of the objective.

9.3.2 Personalized Assessments

What do assessments look like in your classroom: an essay? an exam? a final paper? a lab report? short answer questions about a text? a presentation? Do all of your students do the same thing? Do they all need to do the same thing?

Personalizing assessments means giving students choices in the ways they demonstrate mastery of a learning outcome. Often this means creating a list of assessment methods that students can choose from, while also allowing them to suggest their own ideas. This would allow students to personalize the path they take for demonstrating their understanding. Table 6 provides examples of ways to personalize the path of assessments. While you look over these, consider the following questions:

- What are the different paths that these assessment options create for students?
- How are these assessments different from traditional assessments?
- What kinds of growth do these assessments encourage in the students?

Table 6

Personalizing the Path of Assessments

Personalized Assessments

- Students choose the media they use for the assessment: PowerPoint, Google Docs, video, etc.
- Students choose the form of the assessment: mindmap, essay, documentary, brochure, story, art, performance, exam, etc.
- Students choose the topic they will focus on for the assessment (i.e. students could choose one form of alternative energy on which to complete an assessment).
- Students choose to do the assessment in groups or on their own.

While assessments may most commonly be personalized according to path, they can also be personalized by allowing students to create their own performance or learning habit/behavior goals for the assessment, to choose when they will complete the assessment, to choose where they complete the assessment, or to choose how long they will spend on the assessment or how many attempts they will use on the assessment.



Blended Teaching Workbook

In your Blended Teaching Workbook, create a few ideas of personalized assessments that students can choose from in order to show mastery of the content area you chose earlier.

If you haven't already opened and saved your workbook, you can access it [here](#).

9.3.3 Personalized Activities

Personalization of learning activities should be based on students' data and goals. Students can choose activities that help them accomplish their specific performance or activity goals from playlists and/or choice boards, giving them choice in the time, place, pace, and path of their learning. Personalized learning activities may include both online interactions as well as online integration activities that are adapted based on individual students' abilities, interests, or needs. Table 7 provides examples of ways to personalize different learning activities in science.

Teachers Talk: Benefit of Using Playlists



Matthew Harris

When it comes to the playlist, I give them more information than they need in the playlist and I put the most important one at the top. If they still can't figure out an objective, there's more resources underneath going on for quite a while. And the objective is that they learned to self-select from that list what they themselves need to understand the concept and to know whether they've understood the concept and move on.

Table 7

Personalized Activities

Create a choice board or playlist of activities for exploring or reviewing a scientific concept.

Introduce inquiry activities by providing links to simulations and allowing students to investigate a new idea by exploring and answering some guiding questions you have provided.

Have students choose a scientist and write about the discovery of a scientific theory from that scientist's perspective. Share the writings in a discussion board and have the other students ask the scientist questions about their theory and investigation process.

Allow students to complete the work in a unit in the order they choose and at their own pace. This can be done by assigning the students a checklist and providing them with clear instructions and support via blended teaching strategies.



Blended Teaching Workbook

In your Blended Teaching Workbook create a few ideas of personalized activities that students can choose from in order to show mastery of the content area you chose earlier.

If you haven't already opened and saved your workbook, you can access it [here](#).

Personalization is a powerful pedagogical strategy. It allows students to grow where they need to grow and in a way that is meaningful and impactful to them. It combines all of the other competencies of blended learning: online integration, online interaction, and data practices to create unique learning experiences for each student. Throughout these chapters, you have learned how to use these competencies in a science context. Now it is up to you! You are ready to take your first small step towards a blended learning science class!

Previous Citation(s)

Keaton, W., Guo, Q., & Short, C. R. (2022). Science: Personalization. In C. R. Graham, J. Borup, M. A. Jensen, K. T. Arnesen, & C. R. Short (Eds.), *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines*, Vol. 2. EdTech Books. <https://edtechbooks.org/-rgk>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/science_pers.

Appendices

Charles R. Graham, Jered Borup, Michelle Jensen, Karen T. Arnesen, & Cecil R. Short

Appendix B: Research

Previous Citation(s)

Graham, C. R., Borup, J., Jensen, M. A., Arnesen, K. T., & Short, C. R. (2022). *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines, Vol. 2*. EdTech Books. <https://edtechbooks.org/-QNCX>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/appendices.

Appendix B: Research

Charles R. Graham, Jered Borup, Michelle Jensen, Karen T. Arnesen, & Cecil R. Short

This book was written for practitioners and so does not reference research throughout, as you might see in an academic publication. However, the editors are researchers in the area of K–12 blended and online teaching.

If you are interested in the research related to the K–12 Blended Teaching Readiness model that is used to organize this book, below are some references that you can look up. Also, please feel free to reach out via email to charles.graham@byu.edu or any of the other editors.

- Graham, C. R., Borup, J., Pulham, E., & Larsen, R. (2017). *K–12 blended teaching readiness: Phase 1—instrument development*. Lansing, MI. Retrieved from <https://edtechbooks.org/-JgM>
- Graham, C. R., Borup, J., Pulham, E., & Larsen, R. (2018). *Blended teaching readiness: Phase 2—instrument development*. Lansing, MI. Retrieved from <https://edtechbooks.org/-vWnY>
- Pulham, E., Graham, C. R., & Short, C. R. (2018). Generic vs. Modality-Specific Competencies for k–12 Online and Blended Teaching. *Journal of Online Learning Research*, 4(1), 33–52. Retrieved from <https://edtechbooks.org/-rXmo>
- Pulham, E. B., & Graham, C. R. (2018). Comparing k–12 online and blended teaching competencies: A literature review. *Distance Education*, 39 (3), 411–432. <https://edtechbooks.org/-Noyv>
- Graham, C. R., Borup, J., Pulham, E. B., & Larsen, R. (2019). K-12 blended teaching readiness: Model and instrument development. *Journal of Research on Technology in Education*, 51(3), 239–258. <https://edtechbooks.org/-Pbg>
- Arnesen, K. T., Graham, Charles, R., Short, C. R., & Archibald, D. (2019). Experiences with personalized learning in a blended teaching course for preservice teachers. *Journal of Online Learning Research*, 5(3), 251–274. <https://edtechbooks.org/-WEzU>
- Archibald, D. E. (2020). Validating a blended teaching readiness instrument for primary/secondary preservice teachers. Unpublished MS thesis, Brigham Young University, Instructional Psychology and Technology.
- Archibald, D. E., Graham, C. R., & Larsen, R. (2021). Validating a blended teaching readiness instrument for primary/secondary preservice teachers. *British Journal of Educational Technology*, 52(2), 536–551. <https://edtechbooks.org/-Rtye>
- Short, C. R., Graham, C. R., & Sabey, E. (2021). K–12 blended teaching skills and abilities: An analysis of blended teaching artifacts. *Journal of Online Learning Research*, 7(1), 5–33.
- Short, C. R., Graham, C. R., Holmes, T., Oviatt, L., & Bateman, H. (2021). Preparing teachers to teach in k–12 blended environments: A systematic review of research trends, impact, and themes. *TechTrends*, 65(6), 993–1009.
- Short, C. R., Hanny, C., Jensen, M., Arnesen, K. T., & Graham, C. R. (2021). Competencies and practices for guiding k–12 blended teacher readiness. In A. G. Picciano, C. D. Dziuban, C. R. Graham, & P. D. Moskal (Eds.), *Blended learning: Research perspectives, Volume 3* (pp. 193–213). Routledge.
- Hanny, C. N., Arnesen, K. T., Guo, Q., Hansen, J., & Graham, C. R. (2021 in press). Barriers and enablers to k–12 blended teaching. *Journal of Research on Technology in Education*. <https://edtechbooks.org/-JnSX>
- Short, C. R., & Graham, C. R. (2021 in review). Blending and personalizing: a cross-disciplinary analysis of k–12 blended teaching practices for personalization.

Previous Citation(s)

Graham, C. R., Borup, J., Jensen, M. A., Arnesen, K. T., & Short, C. R. (2022). *K-12 Blended Teaching (Vol 2): A Guide to Practice Within the Disciplines, Vol. 2*. EdTech Books. <https://edtechbooks.org/-QNCX>



This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/k12blended_science/researchn.