

K-12 Blended Teaching: Math Edition

Michelle Jensen, Cecil R. Short, Qi Guo, & Whitney Keaton

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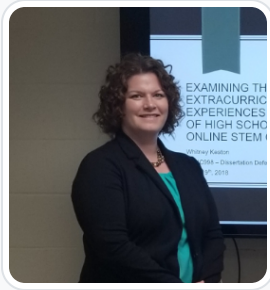
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Preface and About This Book

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

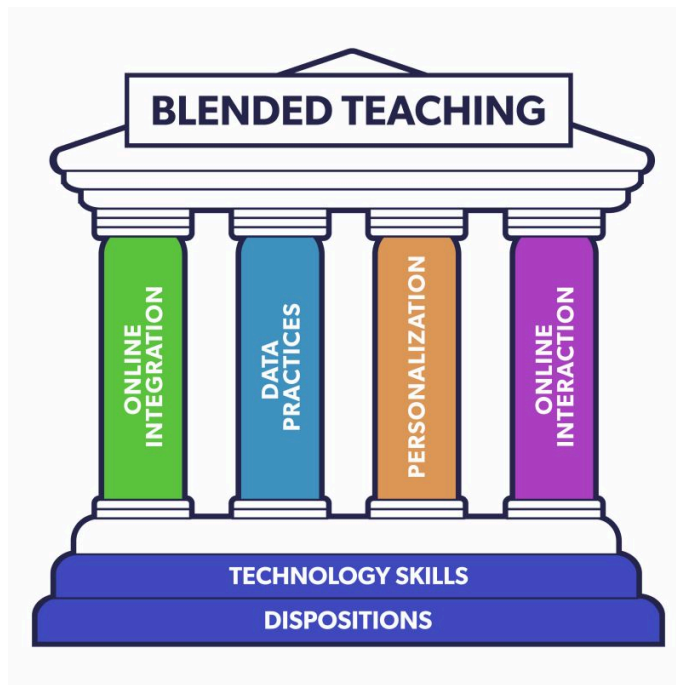
The purpose of this book is to provide rich examples of the four blended teaching competencies from a disciplinary perspective. The first three chapters of the book provide definitions and an overview of the blended teaching framework. Subsequent chapters are organized into sections that focus on blended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

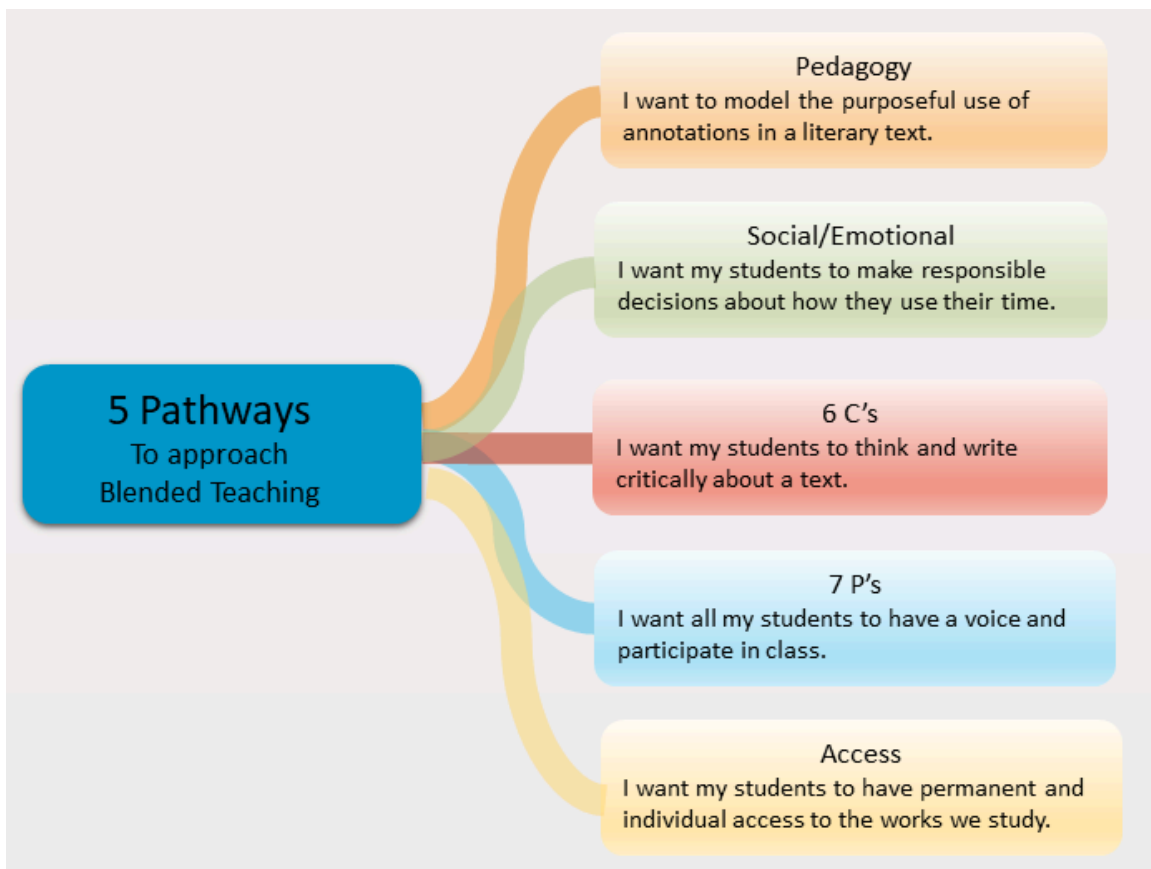
This book is a follow-up to [K-12 Blended Teaching: A Guide to Personalized Learning and Online Integration \(Volume 1\)](#). Volume 1 took a competency-based approach to planning and implementing blended learning. The competencies in Volume 1 were organized into the following areas: Online Integration, 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.

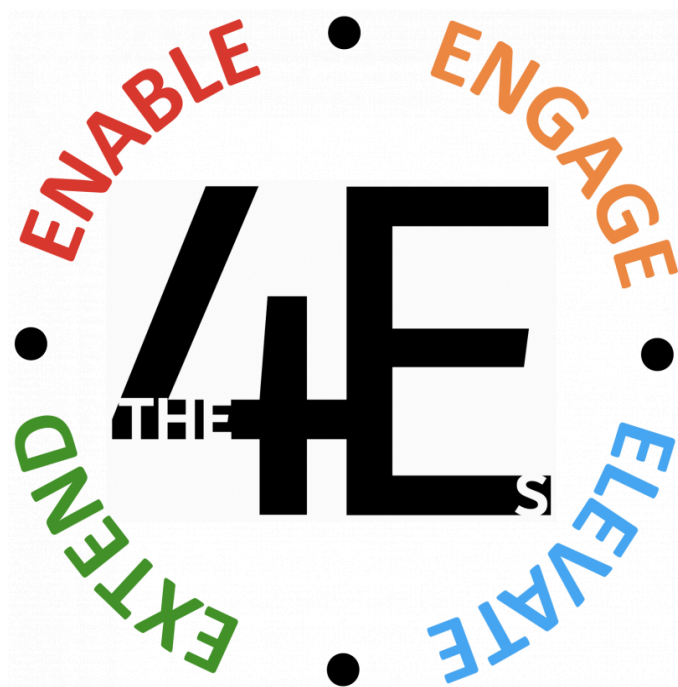


New Content in Volume 2

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.

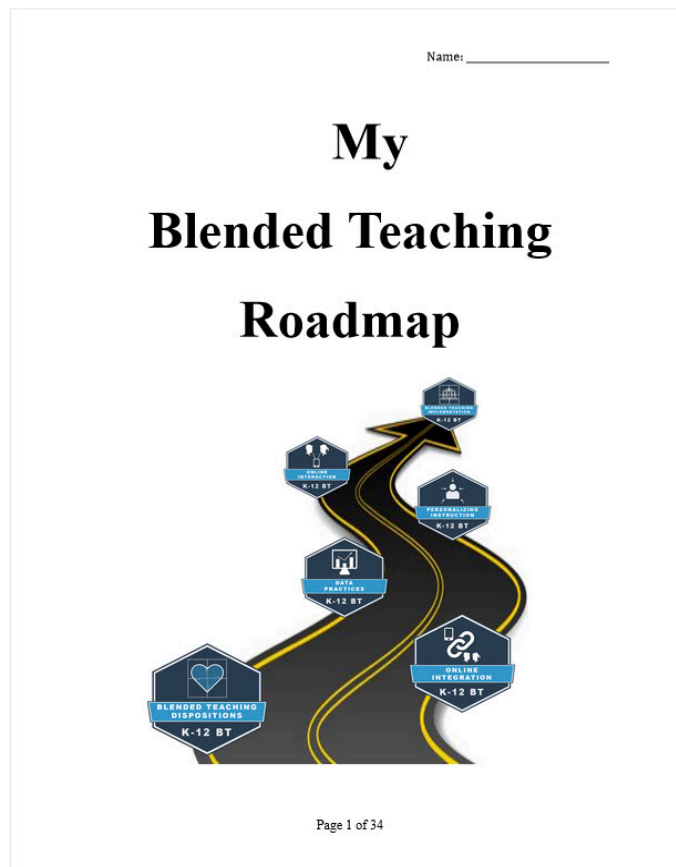
Each chapter of this book is filled with **teacher quotes and videos** about teachers' experiences with K-12 blended teaching. Chapter 4 of this book introduces the teachers who contributed practices to the book. Our hope in creating this book is that it can largely be seen as a book created through 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!

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General Introduction to Blended Teaching

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

Introduction to K-12 Blended Teaching

K-12 Blended Teaching Competencies

Evaluating Blended Teaching with the 4Es and PICRAT

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Introduction to K-12 Blended Teaching

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



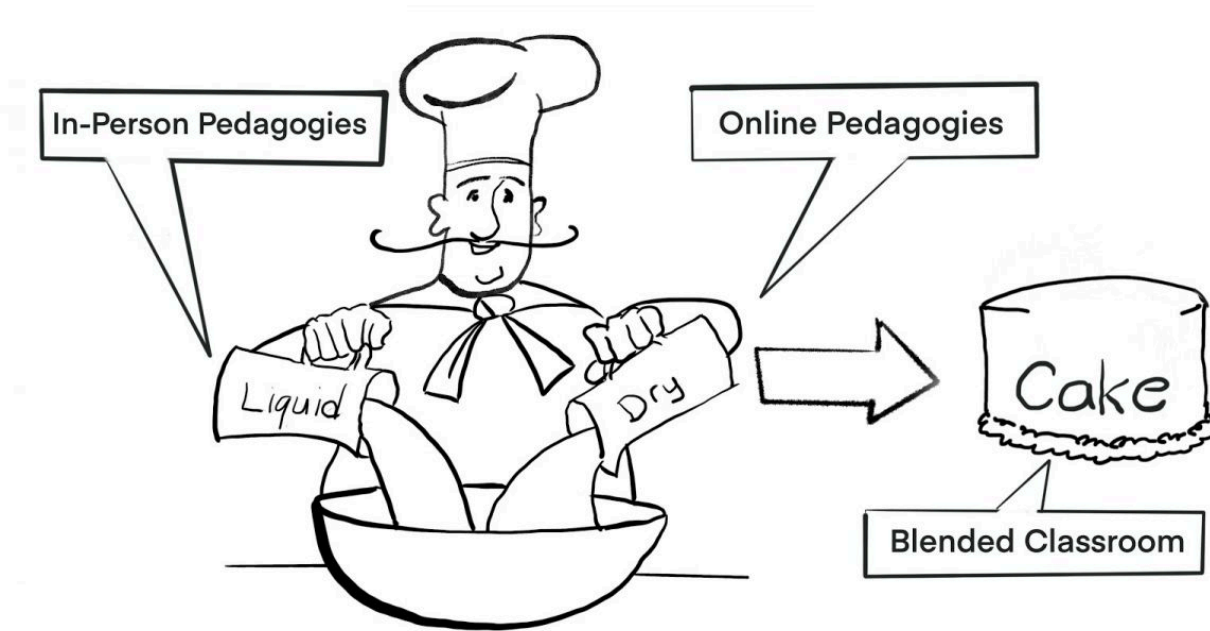
1.1 Blended Teaching

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

	<ul style="list-style-type: none">• 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	<p>A teacher:</p> <ul style="list-style-type: none">• 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	<p>A teacher:</p> <ul style="list-style-type: none">• 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	<p>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.</p> <p>A problem of practice could be recognizing and trying to address limitations in your implementation of one or more signature pedagogies in your discipline.</p> <p>Examples:</p> <ul style="list-style-type: none"> • 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	<p>Students may struggle in areas of social emotional learning, such as self-management, self-awareness, responsible decision making, social awareness, and relationship skills.</p> <p>A problem of practice could be recognizing and addressing areas of growth in students' social and emotional learning.</p> <p>Examples:</p> <ul style="list-style-type: none"> • 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	<p>The 6 Cs of Deep Learning are character, citizenship, collaboration, communication, creativity, and critical thinking.</p> <p>A problem of practice could entail trying to increase one or more of these C's in your instruction.</p> <p>Examples:</p> <ul style="list-style-type: none"> • 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	<p>The 7 Ps of Quality Blended Teaching are participation, pacing, personalization, place, personal interaction, preparation, and practice with feedback</p> <p>A problem of practice could be recognizing and addressing a challenge in one of these areas.</p> <p>Examples:</p>

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.

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K-12 Blended Teaching Competencies

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

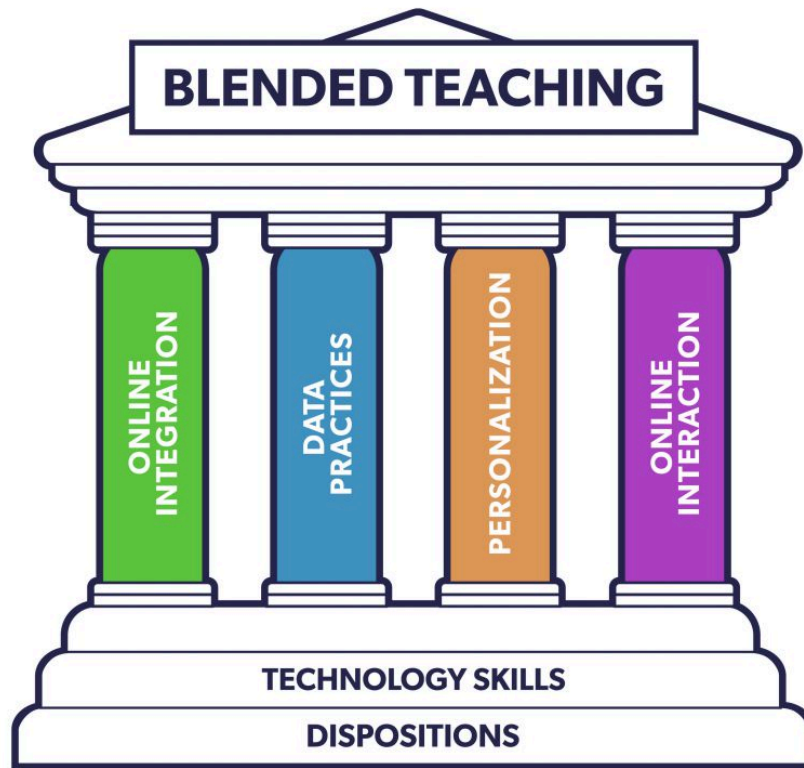


2.1 Blended Teaching Competencies

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>

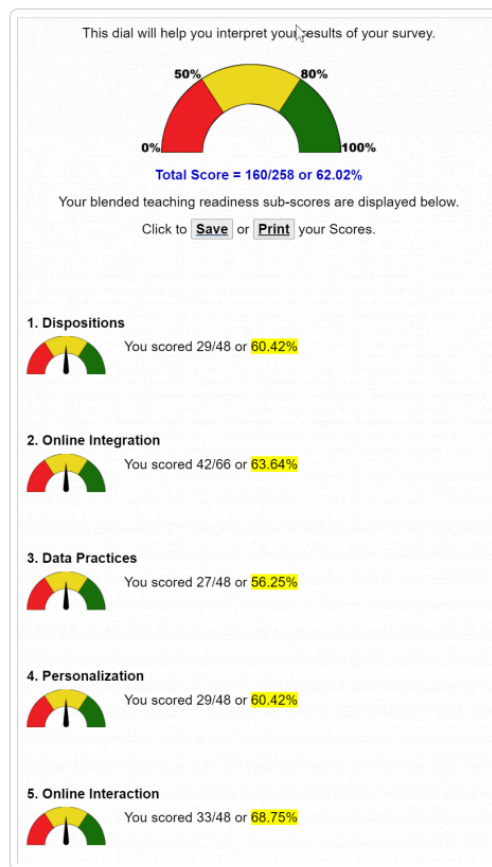


Check out how ready you are for blended teaching?

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

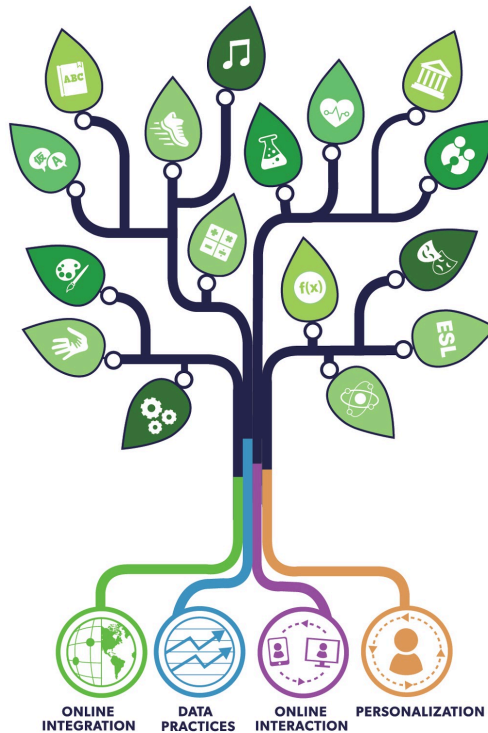
Example results from the Blended Teaching Readiness Survey



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



In the following sections we will briefly outline these four core blended teaching competencies, and in each of the following chapters we will provide specific examples of these competencies. Many of the sections below include questions for you to think about. Think carefully and honestly about your answers, perhaps writing them down. Then notice where you are already strong and where you have room for improvement. These thoughts can guide your process as you begin blending.

2.2 Positive Dispositions and Technology Skills

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?](#)

2.2.1 Student Ownership and Agency

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.

- How do I feel about students making some of the decisions about their learning?
- Do I feel I could learn to help students become more independent of me and more able to create their own learning agendas?

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.

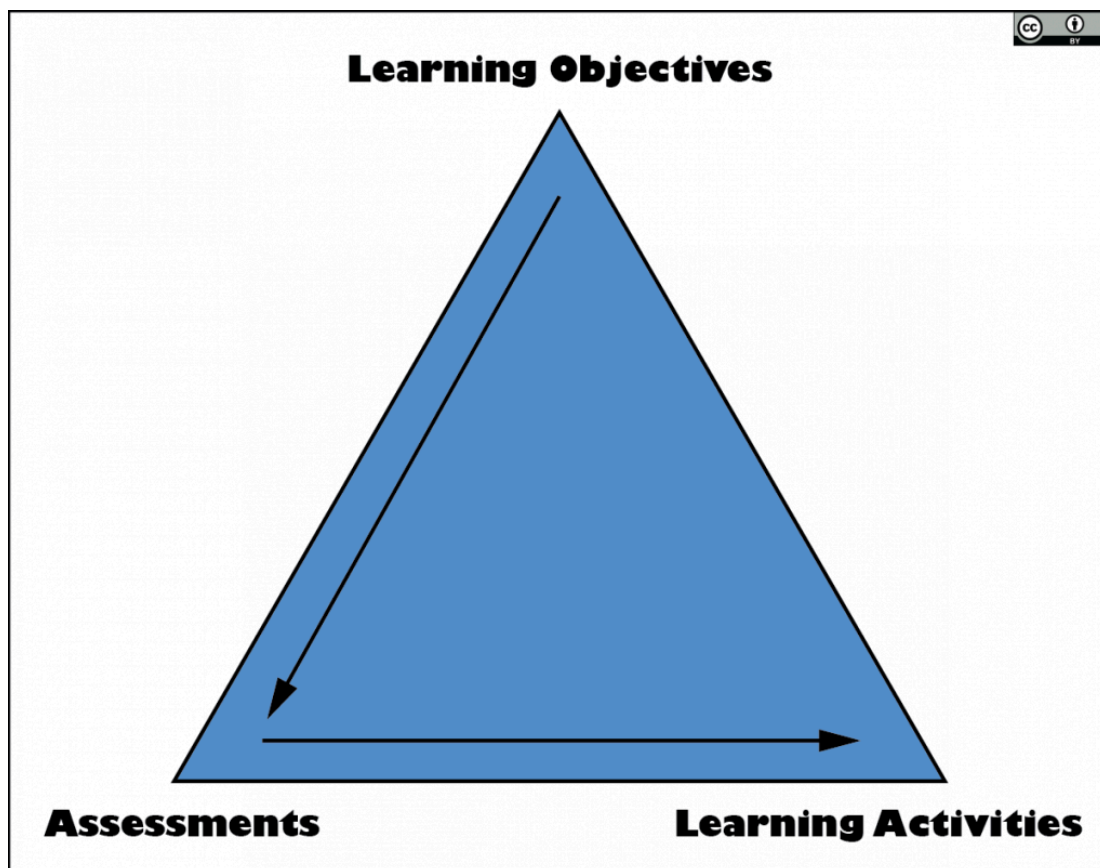
Read more about [personalization](#) in K-12 Blended Teaching (Volume 1).

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



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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



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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



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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-

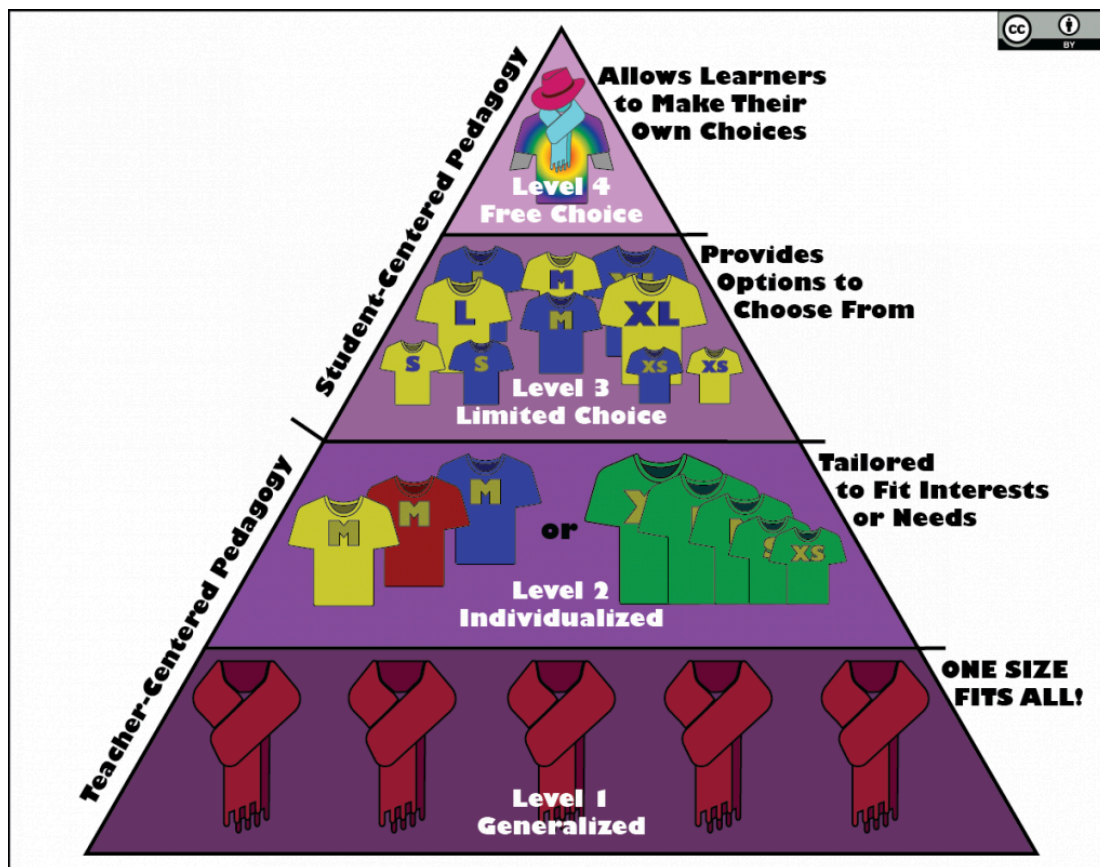
based questions (What do you like to do in your free time?) (Graham et al., 2019). The answers to questions like these can be used to develop a more student-centered classroom.

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



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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.

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Evaluating Blended Teaching with the 4Es and PICRAT

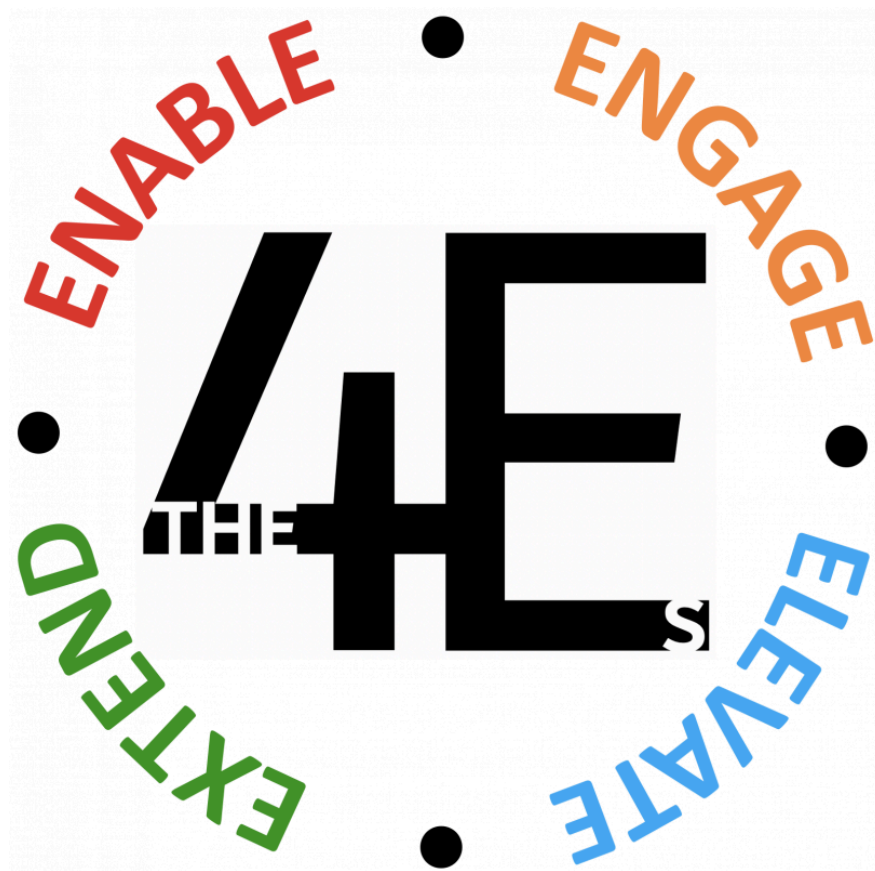
Jered Borup, Charles R. Graham, Cecil R. Short, & Joan Kang Shin

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

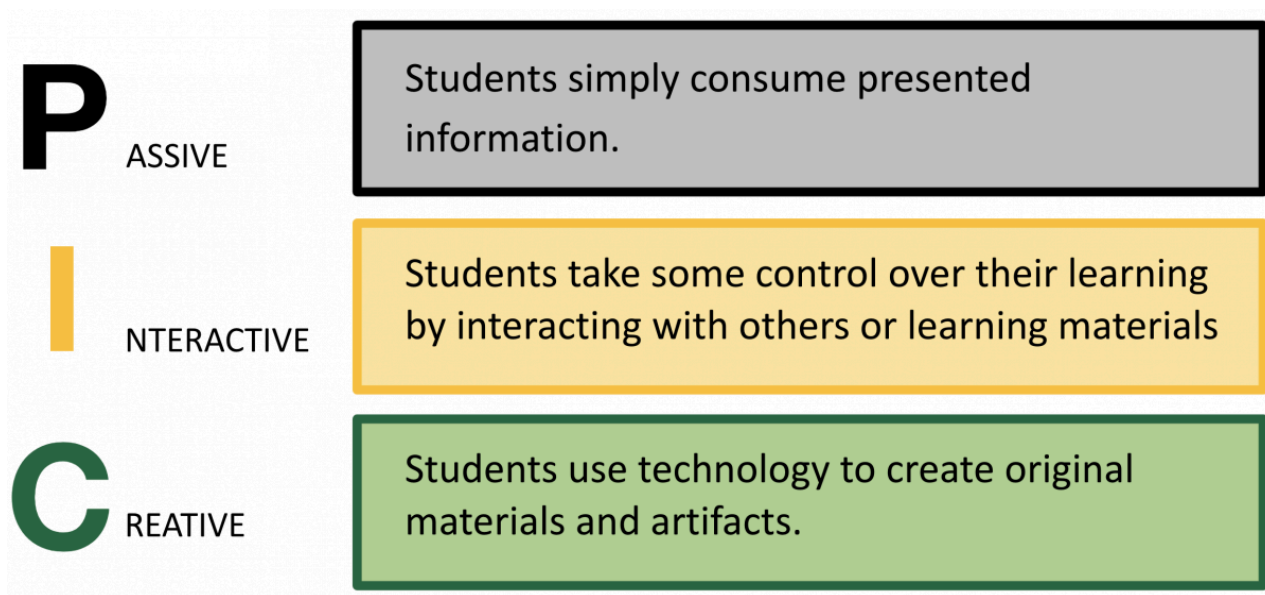


"Engagement" created by Jered Borup using images from Pixabay, CC BY SA

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



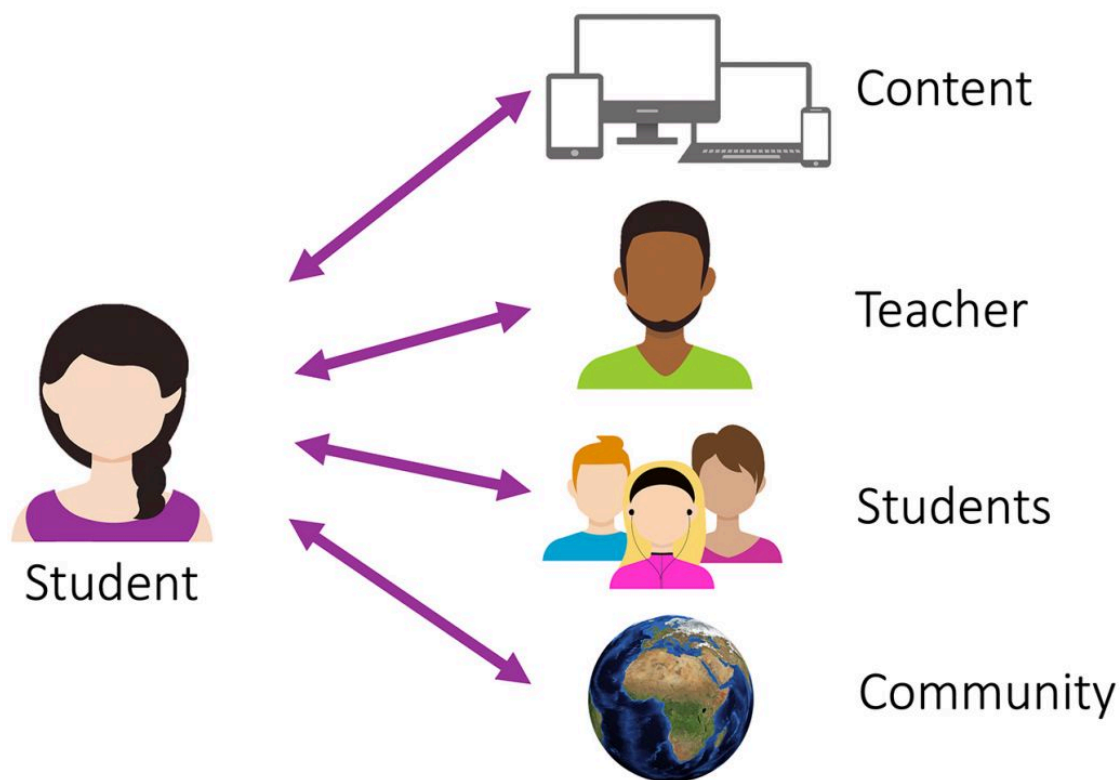
Passive learning examples include students watching a video, listening to a podcast, and attending a lecture. In some ways, these passive learning tasks represent the lack of engagement because they don't require or even allow for students to make meaningful choices or contributions.

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
<ul style="list-style-type: none"> • Watching a video. • Listening to a podcast. • Reading an online article. 	<ul style="list-style-type: none"> • Playing educational games. • Participating in an online discussion. • Asking a virtual guest speaker questions. 	<ul style="list-style-type: none"> • 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

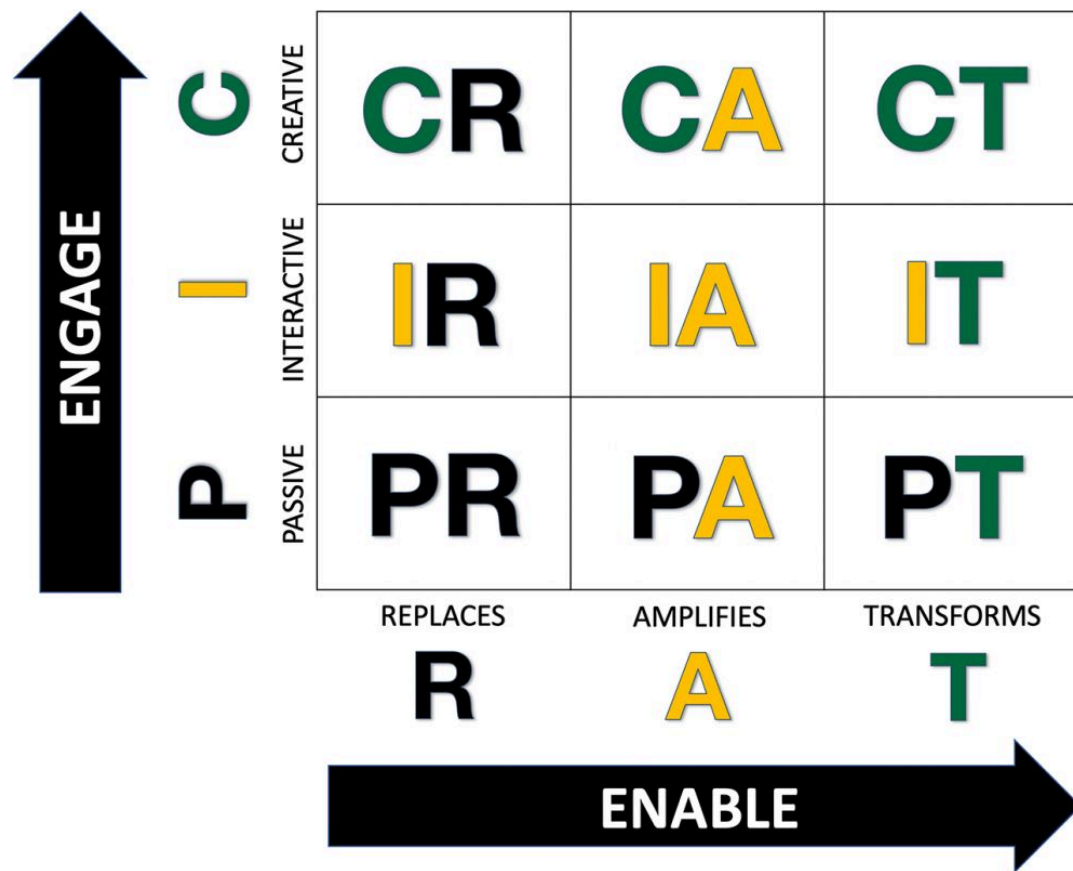
NO-Tech Activity CREATIVE ACTIVITY Students color and label a paper map of the continents. INTERACTIVE ACTIVITY Students engage in a classroom debate to demonstrate persuasive techniques. PASSIVE ACTIVITY Students listen to an in-person lecture to learn new concepts.	Students label an online map and 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

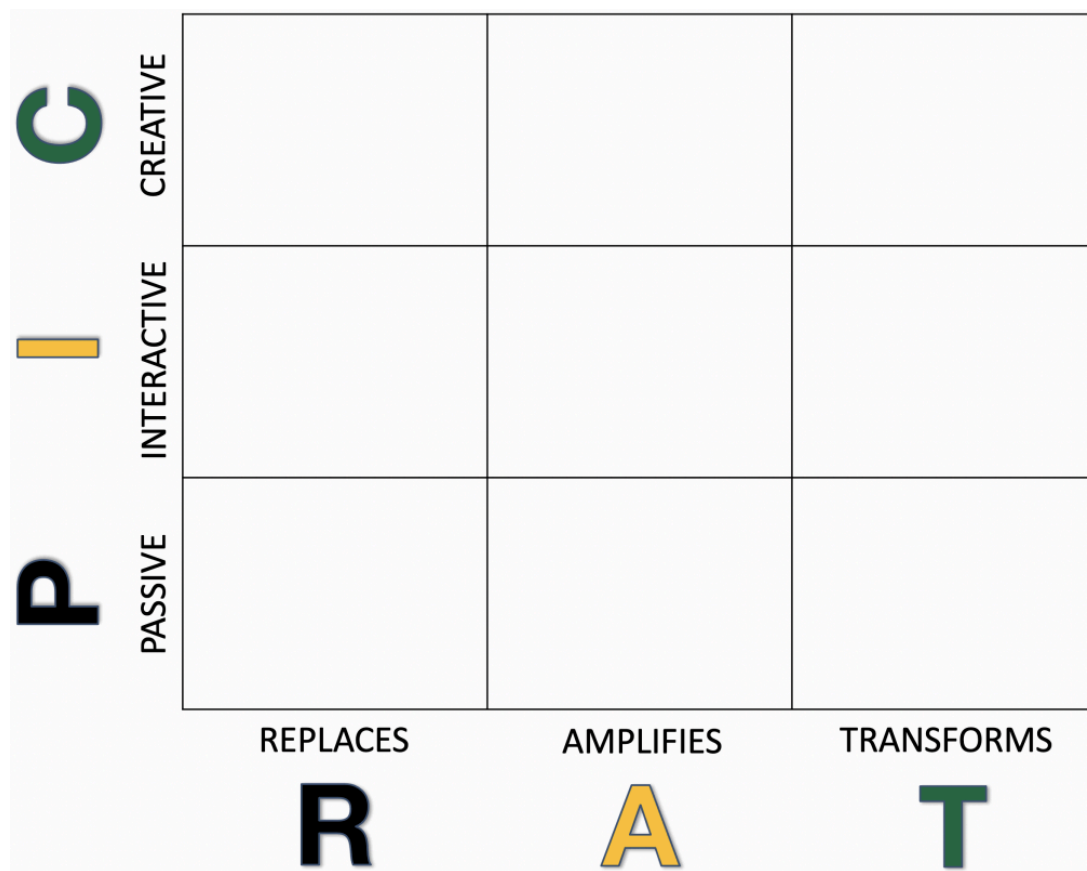
The PIC-RAT Matrix



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

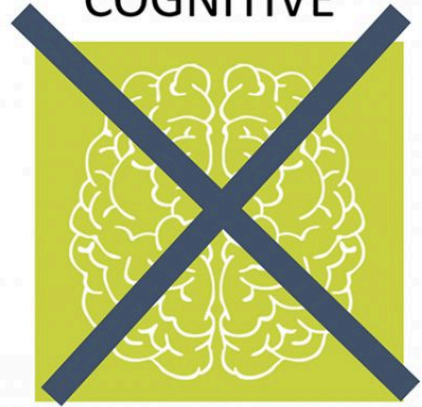
BEHAVIORAL



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?

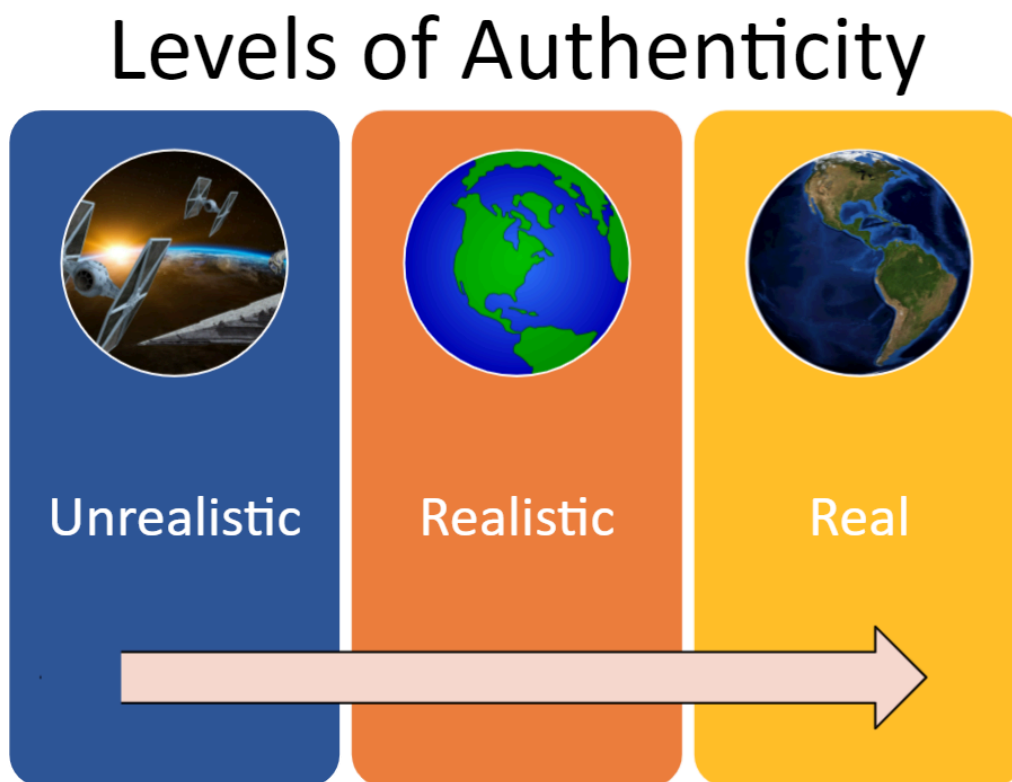
In addition to creating learning activities aligned with the course learning objectives, teachers' blended learning strategies can elevate students' learning to also include real-world skills that benefit students beyond the classroom. For example, the Partnership for 21st Century Learning stresses the 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—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.

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Discipline Specific Blended Teaching

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



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Math: Intro to Blended Teaching

Michelle Jensen, Cecil R. Short, Whitney Keaton, & Qi Guo

4.1 Purpose



The purpose of this chapter is to help you prepare to design and implement blended learning within the secondary math 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. Math teachers can benefit from examples of blended teaching in math classrooms. As a result, this set of chapters is geared towards providing examples of blended teaching that are specific to the secondary math classroom.

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



4.2 Meeting the Math Blended Teachers

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

Meet Your Teacher: Rachel Peterson (2:20)



Meet Your Teacher

Rachel Peterson
~ Math Teacher



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Meet Your Teacher: Mikki Stuart (1:30)



Meet Your Teacher

Mikki Stuart
~ Math Teacher

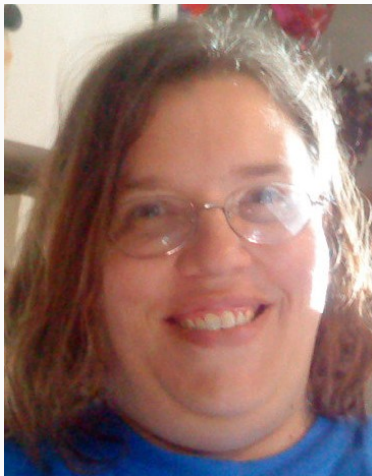
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Meet Your Teacher: Dawn Schlink



Here is what you should know about Dawn

- Middle School Math Teacher
- Additional experience in Special Education and Elementary Education
- Over 15 years of teaching experience
- 4 years of blended teaching experience

Dawn enjoys teaching in a blended classroom because it allows her to work one-on-one and in small groups more often. This leads to closer relationships with her students and allows her to support deeper learning.

Meet Your Teacher: Sandy Chalke



Here is what you should know about Sandy:

- Middle School Math Teacher
- Originally from India and began her teaching career there
- 18 years of teaching experience
- 4 years of blended teaching experience

Sandy loves blended teaching because it opens up opportunities for student ownership, it's easier to manage, and she can better support struggling students.

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Math: Why Blend?

Michelle Jensen, Cecil R. Short, Whitney Keaton, & Qi Guo



5.1 Blending in Math

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: Blended Learning to Increase Engagement (2:28)



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

Blended Learning to Increase Engagement

Mikki Stuart

~ Math Teacher



Online Integration

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

Teachers Talk: Staying Current

Rachel Peterson



Teachers Talk: Making Teaching Fun Again



Sandy Chalke

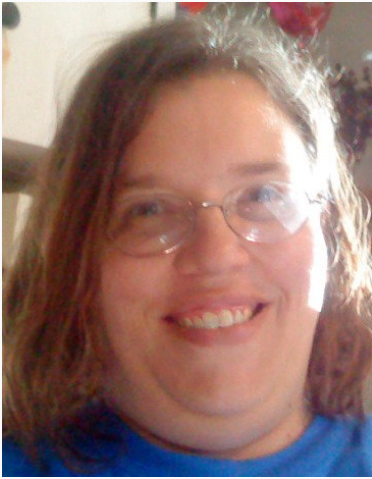
I have so much energy. I'm like 40, 45 right now, but I feel like a brand new teacher every year. I'm like, wait, what am I missing? Is there something to learn? I'm extraordinarily motivated, constantly looking for new ways to challenge and motivate these kids. I think it's refreshing!

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).

Teachers Talk: Preparing Kids for the Future



Dawn Schlink

We're trying to prepare kids for the future, but the tech is going to change. It's not going to always be the same, so giving them the skills of being able to look for answers and resources and figure out something on their own, I think, is very beneficial.

Teachers Talk: Deepening Learning and Making New Connections (4:10)



Deepening Learning and Making New Connections

Mikki Stuart
~ Math Teacher



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

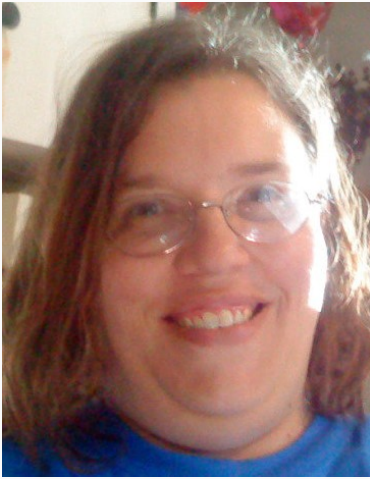
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[Watch on YouTube](#)

Reflection Question: How does Mikki Stuart help her students deepen their learning and make connections?

Teachers Talk: Advantages of Blending



Dawn Schlink

The computer takes care of so much of the differentiation. I used to feel like I was making eight different lesson plans for the same class. I've enjoyed being able to generalize my teaching and really spend more time meeting the needs of individual kids. I really feel like I have better relationships through blended learning, because I have time to really sit down with kids on an individual basis. I'm getting to know them and getting to know what they're able to do better.

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

Table 1

Examples of Multiple Purposes for a Blended Math Activity

Blended Example	Blended Purpose
Allows students to connect algebraic and graphic representations in a virtual space.	Learning Effectiveness: Using technology to manipulate algebraic and graphic representations allows students to come up with their own conjectures and test them. They are much more likely to remember mathematical rules if they are the ones discovering them.
	Access & Flexibility: Students can access and interact with the learning content anywhere, anytime.
	Increased Efficiency/Cost: By modeling and manipulating equations and graphs in a virtual space, students master and retain concepts much faster than they do with direct instruction. Teachers save time by lecturing less and using engaging digital activities more.
Creates a space for discussions that involve all class members and facilitates meaningful mathematical discourse.	Learning Effectiveness: Written discourse encourages use of proper mathematical vocabulary and provides evidence of understanding of mathematical terms and concepts. Online discussions also build life skills such as collaboration and communication.
	Access & Flexibility: Online discussions allow all students to voice their ideas, including students that struggle to fully participate in class discussions. Dominant students do not take over the discussion. Online discussions give everyone the opportunity to participate, because they have time to discover what they think and to write about it, creating more robust, reflective, and divergent discussions.
	Increased Efficiency/Cost: Online discussions efficiently give every student a voice.

Blended Example	Blended Purpose
	They also free up classroom time for other activities.
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 where they are already proficient. They don't have to wait for other students to catch up or worry about falling too far behind.

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



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 math chapters.

5.3 Common Challenges to Teaching/Learning Math

Teachers Talk: Difficulty Connecting Algebraic and Graphic Representations



Rachel Peterson

One of the biggest gaps in math instruction is not being able to connect an algebraic representation with a graphic representation. But if students can use technology to manipulate both, they can start to come up with their conjectures and test them. That's way more powerful than me telling them what the equation is and what to do with it and how to graph it. It's just so much easier for them to see and remember if they're the ones manipulating and making conclusions. I can give them all the rules, but they're not going to remember any of them. But if they're the ones who manipulate and prove or disprove each other, then they're going to remember.

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 to 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

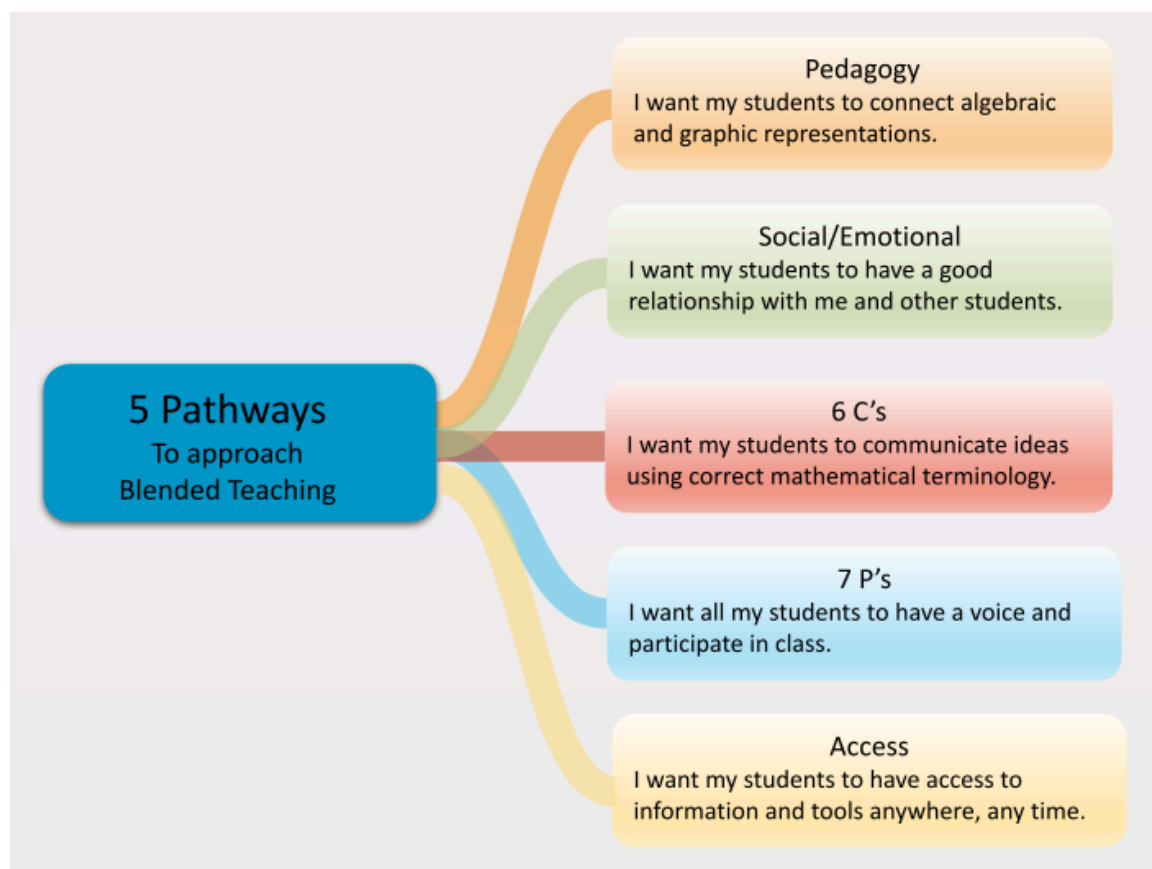
Definition: Problem of Practice

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 5.2. 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 Math



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 begin exploring what online approaches may be combined with your in-person approaches to make a better experience for your students and you alike.

Teachers Talk: Student Engagement



Sandy Chalke

Students are less engaged when they don't have control of their learning. I gave one student I worked with a lot of opportunities. I think with blended learning he had a way to choose how he wanted to learn. Sometimes he would even go to the quiet room, and he would just listen to my videos and finish his tasks.

Teachers Talk: Blending to Encourage Mathematical Discussion (1:40)



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

Blending to Encourage Mathematical Discussion

Rachel Peterson

~ Math Teacher



Online Integration

Licensed under CC BY



[Watch on YouTube](#)

Reflection Question: How does blended teaching encourage mathematical discourse?

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 math 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](#).

In the next chapter you will begin to explore [online integration and management](#) in your blended teaching.

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Math: Online Integration & Management

Michelle Jensen, Cecil R. Short, Whitney Keaton, & Qi Guo

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



6.1 Online Integration and Management in Math

Online integration is at the very heart of blended teaching. It has to do with how you combine your in-person math 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 math 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 online 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.

Before you start, consider this advice from experienced blended teachers—think big but start small. Small beginnings allow you to scaffold your own process, focus on specific pedagogies and activities, see the benefits and drawbacks, and make improvements on a small scale without becoming overwhelmed by the process.

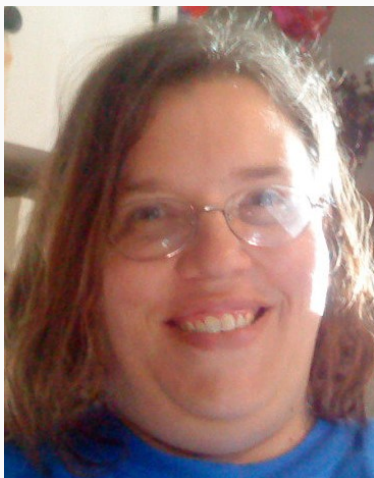
Teachers Talk: Managing a Blended Learning Math Class



Mikki Stuart

I think classroom management partially comes from creating a culture or environment where discovery is encouraged and wanted. I want students to know this is the way our class environment is going to be. Everyone shares. Every idea is valid. But creating that culture is one of the biggest challenges and one of the most important things.

Teachers Talk: Using Flexible Groups



Dawn Schlink

When you're doing blended learning and you're wanting kids to work in groups, it really means a lot of flexibility. I can't always put these four kids together because sometimes these four kids may be really good with algebra, but maybe not with geometry. You have to constantly be able to move kids around. This also means that you really need to know their names very quickly because it's not like you're using your seating chart.

Teachers Talk: Changing It Up



Rachel Peterson

I've taught a lot of co-taught classes—a lot of students with special education services. Breaking up your time segments in a class is super important, and doing something different that's hands-on is super important. I think it's good to just change it up a little bit. When I first started being brave enough to try things, it was for engagement. It's not something they expect that they'll be doing in math class, so they're super excited about it.



6.2 Planning for Integration

You can take that first small step 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.

In the examples below, Mikki Stuart and Rachel Peterson discuss how they decide what activities to have students do online.

Teachers Talk: Selecting Online Activities



Mikki Stuart

Sometimes we want something that is more task based, that is going to get them to think and maybe come to conclusions that we just don't want to tell. I could stand up and teach a five-minute lesson on exponents and cover everything, but it's just not going to stick. We want those things that are going to let them explore and come to that learning on their own. Then there are times when we just post a very direct instruction video, "Okay, if you didn't get it, here's another thing. Watch it again. See if it clicks. You can watch it as many times as you need to." Other times we want the online activity to solidify the knowledge, instead of discovering it.

Teachers Talk: Combining Online Activities with In-Class Discussions



Rachel Peterson

One of the most powerful uses of technology is the ability for students to explore and manipulate equations and graphs in a visual way that isn't possible to describe in words and draw on a whiteboard. When we're looking for patterns and trying to describe change with mathematical representations, technology makes it a million times better and easier to understand, because you can actually see it real time. Using online tools in addition to in-class discussions or whatever else you're doing is powerful—just that one little piece! I would never want to go back to drawing things on a chalkboard. It's like imagine and then erase the line and imagine this and then you change that. It's just not as powerful! Ultimately my goal is that I want them to explore and make a conjecture, and then I want them to discuss where they agree or disagree with other students. I really am a fan of student discussions, especially table discussions and small group discussions. You can still do that while they're doing their own manipulations with technology. But I don't want everything to be done individually online. I would only move the discussion online if there are many, many options for a correct conjecture. I may have students discuss online so they can read many, many different ideas. You can't have a discussion in class where they're going to hear many ideas because there's too many. But online, they can. Sometimes it's hard for them to articulate in writing. So to be able to talk about it first and then write about it is helpful. Rather than saying, okay, look at this then write about it, students need to talk about it. I don't seem to get quality responses, unless they can talk about it with each other first.

Consider a teacher that has identified a problem of practice: I want my students to be able to connect an algebraic representation and a graphic representation.

Here are some ways the teacher could combine online and in-person activities.

Table 1

Planning for Online Integration: Student-Content

Student-Content Interactions

Online Activities:

1. Students use an online platform to repeatedly manipulate algebraic equations and observe how the corresponding graphic representations change and vice versa. Students repeatedly manipulate graphs and observe how the corresponding algebraic equations change.
2. Students use digital tools such as Endnote or Google Docs to record patterns in their observations.
3. Students practice applying new understanding by solving problems and receiving immediate feedback online until they are confident in their ability to solve these types of problems.

In-person Activities:

1. Students reflect on their ideas and use them to make conjectures about mathematical rules, writing them in a notebook or on a worksheet.
2. Students continue to work on individual practice problems on a worksheet.

Connection: The students will use what they discovered during online exploration to inform developing understanding of mathematical rules and then practice applying these rules.

Table 2

Planning for Online Integration: Student-Student

Student-Student Interactions

Online Activities:

1. Students will work together in group discussion boards to share observations and make conjectures about mathematical rules they are beginning to see during individual online exploration.
2. Students see others' thinking processes and discuss possible mathematical rules that extend beyond the examples they are exploring to arrive on absolute mathematical rules.

In-person Activities:

1. Students meet in person, in small groups, to continue to discuss and solidify mathematical rules.
2. The students will explore other situations where the established rule might apply.
3. Students prepare to present their findings with their peers.
4. Students share and discuss the solutions to their individual practice.

Connection: The work the students do online ensures that every student gets a chance to share his or her initial ideas. By collaborating online to determine mathematical rules, each student's voice can be heard and the loudest or most charismatic student doesn't dominate or direct the group's thinking. In person, students are able to work together in real-time to plan how they will present their findings to their peers.

Table 3

Planning for Online Integration: Student-Instructor

Student-Instructor Interactions

Online Activities:

1. The teacher will leave feedback on the discussion board, asking questions about students' thought processes and suggesting ideas to consider.
2. The teacher will give feedback on each group's plan by leaving comments on a group Google Doc.

In-person Activities:

1. The teacher will rotate and meet with individuals and groups throughout the process to correct misconceptions, make sure each student understands the mathematical principles that are being explored and discovered, and ensure students are staying caught up on practice exercises.

Connection: The teacher guides learners to establish and solidify their understanding of mathematical rules and supports them as they apply these rules to new situations or problems.

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 math chapters.



6.3 Selecting a Blended Teaching Model

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

Station Rotation (6:09)



[Watch on YouTube](#)

Individual Rotation (5:16)

Flipped Classroom (3:35)

Flipped Classroom (5:49)

Lab Rotation (1:49)

Teachers Talk: Using Station Rotation



Sandy Chalke

In class I show my students interactive videos. We rotate among Socrative, Kahoot, and in class notes. At the end of the week the project is to work with a partner and cooperative learning groups to come up with a poster. The poster has to do something with the scenario that's given.

Teachers Talk: Changing to a Different Format



Rachel Peterson

It's very cool to see the benefit of changing to a different format where kids can play with things and explore. I'm seeing all the light bulbs go on, and students get really excited about their learning. It's so great!



6.4 Deciding What To Do In Person in a Math 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 math concept that has proved difficult for students to understand in the past, like graphing exponential functions. You want them to practice this concept in person because you know they will have many individual types of questions. Answering those questions and correcting

misconceptions in the moment that they come up can keep students from getting stalled in the process and keep energy high. It also helps assure that students don't have to back up and redo work.

Similarly, you may want to launch a new concept in person. You want students to get excited about the topic and begin thinking about the possibilities. Once they've had this beginning, they may be more ready to practice independently or participate in an online discussion.

Perhaps you are good at connecting mathematical concepts to real life situations, and your students enjoy hearing you describe these applications in person. You might want to step through applying mathematical concepts in person, practicing 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 allow the kinds of activities you want in the in-person space, to best use the affordances of the online space, and to make meaningful connections between the two modalities. Answers to the following questions may help you decide.

- 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 pace, path, time, place, or goals 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 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 of the instruction and activities online?

Teachers Talk: Strategically Choosing Whether to Explore or Solidify Online (5:11)

Reflection Questions: How does the teacher in this video determine what activities will be done in person? What are some techniques that she uses that would work well in your classroom?

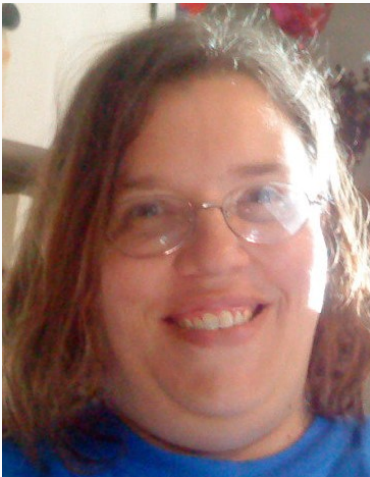
Teachers Talk: Deciding What To Do Online and In Person



Sandy Chalke

It all depends on the students. I actually ask the students, "What do you want to do? How will you be more successful?" At the beginning, when we do the bell ringer, I just pause for a minute and I explain the concept. Then I ask the students, "How many of you feel comfortable taking notes online?" Sometimes students who are not motivated say yes, and I give them a chance. And then I say, you know what I really want you to do is sit with me and listen. So then I actually go back and look at my assessment and see who needs that extra support instead of just sending them on their way.

Teachers Talk: Switch It Up



Dawn Schlink

Sometimes kids get tired of the technology. Blended means really and truly blended. Even though students love technology, they do not want to be on the computer for an entire class period.

Teachers Talk: In-Class Discussion to Solidify Online Exploration



Mikki Stuart

After using Desmos (a digital tool specifically used in math instruction), we have really great discussions of things that the students notice and are able to connect to prior learning. Students make awesome connections in our discussion after having that really visual tool where they were able to kind of look and explore at their own pace.

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 4Es frameworks provides 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 its impact on traditional practices.

For a complete explanation of the PIC-RAT framework, See 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 an in-depth discussion of the PIC-RAT and 4Es of evaluation, review [Chapter 3](#) of this book.

Teachers Talk: Desmos and Geogebra



Rachel Peterson

Desmos and Geogebra are essential for mathematics, I think. They're just built for math, so there's a lot of ready-made things. That saves a lot of time.

Teachers Talk: Using the Online Space to Explore and Investigate (3:09)

Reflection Questions: How does the the teacher in this video evaluate online activities to help her make instructional decisions?



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 in 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.

General:

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: Classroom Management When Blending (4:12)

Reflection Question: How does the teacher in this video manage students in a blended classroom?

Teachers Talk: Engaging Students While Working One-On-One with Another Student



Rachel Peterson

When I'm going around talking to students individually, it's very powerful and meaningful. But when I'm doing that, if they're not doing something online, then I'm not getting the data from that. I'm having to ignore everything else going on. But if the rest of the students are completing something online, I also have that data and I can go back and look at that. I'm kind of double dipping there.

Table 4

Blended Learning Routines

Blended Learning Routines—Teacher Tips

Student Movement	<ul style="list-style-type: none"> • Will you have activities that require the movement of students (such as in a station or lab rotation). <ul style="list-style-type: none"> ◦ Will students be moving all at the same time? ◦ At different times? ◦ Plan an efficient way to facilitate those movements. • You may have students do three things when coming class: <ul style="list-style-type: none"> ◦ Open their grading portal and check their grades. ◦ Open their email. ◦ Open the class website to see if there are any new posts. • Be very clear. Make few rules but enforce them well.
Hardware Management	<ul style="list-style-type: none"> • Use of cell phones (some teachers collect them so they don't have them in class; others let them use them for assignments). • Keep Chromebooks or other hardware charged. (If devices are kept in the classroom, students don't take them home.) • Establish a routine for making sure computers are charged into the right charging station. • Create checklists. • Make assignments or class roles for hardware management. <ul style="list-style-type: none"> ◦ Make sure computers are plugged in and charging. ◦ Sanitize computers. ◦ Keep a log of damages or problems. • Assign specific computers to specific desks or specific students; this increases accountability. • Teach how to hold and carry devices; practice.

Blended Learning Routines—Teacher Tips

Software Management	<ul style="list-style-type: none">• Explain how to turn on the computer, log in, and access the internet or specific tools.• Practice using the LMS, opening it, finding assignments, checking grades, submitting assignments, etc.• If you have specific formats you want students to use when submitting assignments, teach them what they are.• Create checklists for students to follow.• Teach students how to download, upload, and organize files.• Model and practice any management strategies or procedures that you teach your students.
Student Questions	<ul style="list-style-type: none">• Teach them where to find answers before they ask you.• Outline specific ways to contact you outside of class and how to address you politely.• Teach them how to use email.• Establish “expert” students that other students can turn to for help.• Create instructional videos or review pages students can access when they have common questions.
Classroom Configuration	<ul style="list-style-type: none">• Decide what kinds of activities you do in your classroom. Are there classroom configurations that will support those activities? For example:<ul style="list-style-type: none">◦ Create a comfortable space for reviewing online lessons, instructions, and materials.◦ Create a space for collaboration, where students can talk together.◦ Create a quiet space for working on assignments or other thoughtful activities.◦ If you have fewer than 1-to-1 devices, create a space for working with the technology.
Off-task Behavior	<ul style="list-style-type: none">• Use software that allows you to monitor what is on the screen of each student.• Teach them to monitor themselves.• Create guidelines for students who may stray away from what they're supposed to be doing on their computers, such as shutting down the computers and using paper again for a day.• Walk around the classroom, both to be available for help and to give quiet reminders to stay on task.• Remember that even “good” students can get off task at times.• Utilize your LMS or other software to keep track of online behavior.• Have a place near you that’s easily observable and accessible and away from other students if you need to monitor some students more closely.
Other	<ul style="list-style-type: none">• Help students develop time management skills so that they use their time as efficiently as possible.

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

Math teachers say they typically spend four to six weeks at the beginning of the year establishing routines and expectations and teaching students how to use the technology. 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.

As you begin to blend your math 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.

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Math: Online Interaction

Qi Guo, Whitney Keaton, Michelle Jensen, & Cecil R. Short

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



7.1 Online Interaction in Math

Math classrooms can thrive on interactions with and between students. Both in-person and online interactions and feedback provide students with ways to share and support their insights, give and receive feedback, and present both written and oral opinions and positions on math inference in a polite and evidence-based manner.

Teachers Talk: Using Discussions to Practice Math Language



Rachel Peterson

In math, it's important for students to express their ideas using correct terminology and vocabulary. They don't get an opportunity to do that very much. When it's spoken, we tend to let them get away with saying things incorrectly or we correct it for them. But when it's written and it's permanent and you can see it, they tend to edit more. They think, "I'm writing this, I'd better make sure it sounds good and I'm using the right words." If you want to try something, a discussion board is a really good and easy place to start. Perhaps in the last 10 minutes of class, you ask students to answer a discussion and respond.

7.2 Student to Student Interactions

Teachers Talk: Using Online Discussions to Increase Participation and Build Relationships (3:42)

Reflection Questions: How can you use online discussions to enhance students' participation and interaction?

Manipulating, observing, exploring, measuring, calculating, analyzing, and inferencing are at the heart of math classes. Conversations around these activities can help students to build critical thinking skills, express themselves, listen and civilly respond, and revise their opinions or understanding when needed.

There are many technologies that support online discussions. Here are a few of them and how they can be used in math. (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 tracked, reviewed, and 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. This tool can be great for sharing procedures or projects.
- [Flipgrid](#): a video discussion board. Instead of using a text-based discussion, Flipgrid allows students to post and respond with video, which can increase social presence for the class (the sense of nearness and community within the discussion). Flipgrid also allows students and teachers to create and share screencast videos. Again, this can be great for sharing procedures and processes, and even responding with videos of revised or alternate processes.
- [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 or oral skills.
- [VoiceThread](#): A video/audio tool that allows students to add pictures or text to a project, give feedback on ideas, and explain their work. It can also be used to make instructional videos with interactive abilities (that can also be turned into quizzes), and create situations where students think aloud about their analytical processes and share their videos with each other.
- [Google Docs](#): A collaboration tool, where students can write and receive feedback and suggested edits on what they've written and where students can collaborate on projects.
- [Google Slides](#): Similar to Google Docs, Google Slides allow students to individually or collaboratively create presentation slides. Google Slides is also increasingly used to generate quick ideas and brainstorm, with each student or group of students having one slide. This can be a great way to introduce problem or project-based learning into a lesson. Students can create a slide showing their ideas for solving a problem, then students can work together in a group combining their slides to come up with the best or most popular method.

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.

Here are some ideas that are relevant to a math classroom. Note that some of these discussions start in the online space and end in person, some start in person and end online, and some may even bounce back and forth between the two modalities.

Table 1

Online Discussion Ideas

	In-person	Online
Introduce new concepts/theorems/formulas etc.	<p>2. In a full class explanation (with video backup) explain the new concept.</p> <p>3. In different stations, have objectives, pencil and paper, and graphs available for students to manipulate, draw, observe or compare.</p> <p>4. Ask students how they visualized or organized their thinking. Ask if they had a preferred method for thinking through the new concepts.</p> <p>5. Ask students to reflect on the important information/quantities/numbers in the problem?</p> <p>6. Have students post videos of their manipulations and explain their rationale as a new response to their initial discussion board post.</p>	<p>1. In an online discussion have students write an equation or equations to represent a problem or situation requiring the new concept. What math tools or models do the students think can be used to solve the problem?</p> <p>7. Let students review others' responses, and ask them, do your peers' equation/approach make sense to you? Is there another equation/approach available? Which model/approach is more efficient and effective to solve this problem—their initial attempt or their revised attempt?</p>
Review concepts/theorems/formulas	<p>1. In person review the concepts/theorems/formulas students just learned, and ask students if one value is changed in this problem, how this could affect the situation and solution?</p> <p>2. Demonstrate to students either in person or online some other ways to solve the problem.</p>	<p>3. In an online discussion board, post a similar question to each group, and have students write their solution as the first post.</p> <p>4. As a second post, have students review others' first responses, and have students consider responses such as the following: Does your peer's solution make sense to you? Do these different solutions express the same or different ideas? Explain any connections to your original post. Can such different solutions both be correct? If you think your peer's solution is wrong, why do you think this solution is wrong?</p>

	In-person	Online
Apply the concepts/theorems/formulas	1. Review the concepts/theorems/formulas again and ask students to come up with a similar problem as they have solved previously.	2. Ask students to write their problem in a discussion board as the first post. 3. Assign students to solve another peer's problem within their group. 4. Have the student who provided the initial post grade their peer's solution. Was their peer's solution and process what they expected? If not, what was expected? If it was to be expected, were there any other ways to solve the problem?
Observe, predict and summarize math patterns	2. In person have students meet in a group different than the one they will communicate with online to compare: What patterns they saw in the given set of data? What those patterns might tell them? Whether they think they can reasonably predict what additional data might suggest? 5. Let the students reply their peer's assessment and summarize by answering, is there a summary or shorthand way of expressing these recurring patterns?	1. Provide a data set online that is accessible to all students. After a few minutes of reviewing the data set give students a brief amount of time to record their initial impressions in an online discussion. 3. In the discussion board have students write their predictions. Did they get these by counting or calculating? 4. Review their peer's predictions and assess them by answering if they are correct in all cases? If yes, why do they always work? If not, why? And do you have a question for their peer group?
Identify common mistakes	4. In person, use the data gathered from looking at student responses in the online discussion to create small groups for review or facilitate a whole-class review of misconceptions or problematic misunderstandings.	1. Show students some problems that commonly have mistakes or that can be solved in a better way than what students commonly attempt. 2. In the online interaction, have students identify the mistakes in the problems or brainstorm better methods. 3. Ask students to respond to their peers' ideas relating them to their own.

[The Big List of Class Discussion Strategies](#), compiled by Jennifer Gonzalez, is a longer list of ideas that could be adapted for online mathematical interactions, including Socratic seminars, gallery walks, affinity mapping, etc.

Teachers Talk: Discuss Ideas Online and Validation



Rachel Peterson

I really love having students discuss an idea online. They make a conjecture and then respond to other people. It's like, "Oh, I didn't think of that." or, "I don't agree with you because of this." and then they're arguing, but in a constructive way in the discussions. It's really great to read because some of them were right on and some of them were almost there and some of them weren't there at all. Then other students will tell them, and say, "oh yeah, you're right because if I do this..." They're exploring and testing each other's theories until they come to a consensus.

One of the features I really like in the math learning tool Desmos is that it will show students others' answers because students always want that validation, such as "Was I right?" "Am I thinking what others are thinking?" "Am I the only one thinking this?"

An online discussion is most effective when the expectations and instructions are clear. For a review of how to create an effective online discussion prompt, see 5.2.2 [Building Community and Setting Expectations](#) and 5.3 [Designing and Managing Online Discussions](#) in *K-12 Blended Teaching (Volume 1)*.



Blended Teaching Workbook

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 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 mathematician stories on a class or course web page, including a summary of the biography of the mathematician, what they have discovered or contributed in the math world, how we can apply it in a real-world context, and what they liked about the mathematician or were impressed by him/her. They could post some texts, pictures, or videos they collected. You might have a day to let them present their favorite mathematician stories.
- Create a page for students to contribute to a collection of their common math mistakes in a Google Sheet. Have them write the questions, the correct answer, and the correct steps for solving the problem. They could also include their wrong answers or steps, and what caused their made mistakes. This could create a great crowd-sourced resource for studying!
- Create an "I found" page for students to explore math phenomena in the real-world, daily life, or nature. Students could take pictures of their collection and connect the objects they found with the math concepts or patterns, such as Fibonacci sequence and the stamen of daisy and pine corn thread. 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. This could be used to introduce future classes and engage future students.
- Have students look for or create some math games that can be used for review and share them in a Google Doc. Each student can come up with a game, write the rules, and what math skills can be strengthened by playing the game. In class, those who complete their coursework early could take turns playing a game in this gallery. The student who came up with the game that classmates decided to play could lead the group of students or the whole class (depending on how many people are required in the game) in playing that game.

Teachers Talk: Power of Peer Interactions



Sandy Chalke

One of the challenges is that some students don't like to talk. But when I give them an opportunity such as a discussion board, they wouldn't be quiet.

Another thing I love about blended teaching is that it opens up opportunity for student ownership. I can have the ones with higher ability help me and become tutors for kids who need support. And that makes review or tutoring more manageable for me.



7.3 Teacher to Student Interactions

Teachers Talk: Using Online Interactions to Support and Build Relationships with Students (3:37)

Reflection Questions: Mrs. Stuart talks about three kinds of interactions. What are they and how could they benefit your classroom?

Interactions between students and the teacher are also important in a math class. Experienced blended teachers often report that their interactions with students online have strengthened relationships and contributed to student growth. Below are some ways that 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.
- Provide feedback. Students appreciate and need feedback. Teachers find that giving some types of feedback online is much easier than feedback with traditional paper and pen.
 - 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 a project, you can give very specific feedback then allow your students to improve the assignment. Your LMS may 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, it can be easier to correct a misunderstanding or provide a process in video with a visual reference or guide. Tools such as [Mote](#) (a Chrome extension that allows teachers to quickly add audio recordings to Google Documents and Google Classroom grade book) can transform traditionally written feedback into audio feedback. 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 different times when text, audio, or video feedback may be effective and you may try to use all three throughout the year.
 - Traditionally when students are working in the classroom, teachers walk around to provide feedback, check progress, and promote on-task behavior. When students are working online during class, you can still walk around the classroom, answering questions and giving verbal feedback as needed. However, you can also monitor student activity using online software and you can communicate with students using the online space to avoid awkward confrontations or prevent them from feeling called out for their misunderstandings.
 - Schedule one-on-one meetings with students to discuss their progress and provide feedback. The online space can be a reference point for such meetings, providing valuable data sources to guide the conversation.
 - Some online systems and tools, Google Docs, for example, allow you to monitor students' behavior or progress when working. You may be able to pull up as many documents or progress tabs as your computer will allow and give real-time feedback as they are writing. Students are more likely to revise their work when they receive feedback during the process of completing their assignments.
 - In your feedback, share personal examples related to their progress or misunderstandings. Let them get to know you as you work to help them learn about complex ideas.
- Explain to students your process for receiving emails from class members. Encourage them to email you with questions. Explain when you will be available to look at emails, and answer them as promptly as possible.
- Email students who are not in class, letting them know that they were missed and how they can access valuable learning materials.

Teachers Talk: Many Ways to Interact with Students



Mikki Stuart

There are so many ways I can communicate with students online. With Canvas I can email students after a quiz to send a quick message to them. I have the option to email the students that have taken it and those that haven't. "Hey guys, you've got to get this taken by this time. If you need any help, reach out to me. I'm here for you." When I communicate with students online they aren't as afraid as when they are surrounded by peers in a classroom. There is more anonymity for them and it's safer. My students think, "Oh, Mrs. Stuart is following me and cares!"

Discussions are nice because I can reply right away to a student when I see a misconception. I can read through each one and I can see, "Oh, this one's a little off. Think about this." Or I can reply, "Yeah, great thinking!" Just being able to give that response to them individually has been really fun.

I've also utilized Canvas announcements. It's been really nice because some things have been math related and instructional but some have just been to connect with the students. I started doing Google forms and surveys asking things like, "What's your favorite activity?"

Teachers Talk: Follow up with More Students



Rachel Peterson

The students that I think the most about, and come to mind first, are those students that are blenders in the classroom. They're not the loud one or the misbehaving one. They're the students that don't ever say anything and do their own things but wouldn't tell me if they didn't understand something, and I wouldn't necessarily notice because there are so many of them. But online, all of a sudden, everyone becomes equal. So then I can see when a student has a misperception that I can address, where I probably wouldn't have noticed before. Even if they're not reaching out to me, I can reach out and give them individual feedback.

I can think of several students where that's the case. They did something or said something or had some sort of misperception that I would not have noticed, otherwise. Sometimes someone used to do something for quite a while incorrectly, and I didn't notice. Or they have one little thing that's not correct, but if they fix that thing then everything else is fine, but they feel frustrated and stuck way back here when they're really not. It's easier to see evidence if that's online.

The online space significantly increases opportunities for interaction between students and content, 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, instructional interactions, 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 begin.

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Math: Data Practices

Whitney Keaton, Cecil R. Short, Qi Guo, & Michelle Jensen

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



8.1 Collecting Data in Math Courses

Teachers Talk: Data Provides Real, Actionable Information About Student Learning (3:58)

Reflection Questions: How are you already collecting data in your own classroom? Do you have access to any tools or programs that allow you to determine which students may need some intervention?

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 can provide information students can use in setting and evaluating goals. Technology has greatly expanded the way data can be recorded, collected, organized, and used in a timely and efficient way. Teachers can easily and quickly collect technology, and the data can be used to enhance their pedagogy, group students, plan remedial and extended activities for students who need them, and target specific needs of individuals, groups, and the whole class.

Teachers Talk: Various Ways to Collect Data



Sandy Chalke

I usually do a small station rotation.... Some kids will probably read a book, some kids will work on a worksheet, some kids will go online and do the interactive activity, some kids will sit with me and make sure that they understand the day's learning goals. So basically that's my check. Are you understanding the concept? Do you have any questions? Can I help you?

Teachers Talk: Choosing What Data to Collect



Rachel Peterson

I think one of the things I really have liked is being very strategic on what I want a record of and what I want automatic data from— not just so that I know who did it and who didn't do it, but so that I can see exactly what students are thinking. When you're in class and you're walking around seeing who gets what, you can kind of gather some information that way. I like having it housed somewhere, where I can go back to it and provide individual feedback.

In order for data to be helpful, you have to organize it in a meaningful way. You may want to use subjective and objective 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

Desired Data	Ways to Gather the Data Using Technology
	weakness in math, what they want from your class, what they are nervous about in the class, the types of assessments and activities they prefer, etc. This data can also consist of socio-emotional data gathered from check-ins, student surveys, or platforms like Rhithm that can track a student's mood, how much sleep they typically get at night, or when they last ate a full meal. It can be important to 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 proofs and theorems, their computing skills, or their ability to apply the algorithms and proofs that they have learned to solve real-world problems. This data can also come from state-mandated tests. Collecting and then analyzing mastery data can help you know what most students have mastered, where students need remediation, and where learning materials may need to be improved. You can then work on changing instruction guided by the data you have collected and analyzed. Training in using the grade book, quiz statistics, mastery trackers, or other performance trackers may be necessary to gather mastery data.
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?

	weakness in math, what they want from your class, what they are nervous about in the class, the types of assessments and activities they prefer, etc. This data can also consist of socio-emotional data gathered from check-ins, student surveys, or platforms like Rhithm that can track a student's mood, how much sleep they typically get at night, or when they last ate a full meal. It can be important to notice and take notes of students' participation, interest in various topics, friends, attention, outside interests, interaction with others, clues about home life, etc.
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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.



8.2 Utilizing Data in Math Courses

Tracking data can help Math teachers improve student learning and their own teaching. Because data can help you know your students' skill levels in a large number of math 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 example below, notice how the teacher uses data. Think of ways you could improve your class by collecting and analyzing data.

Teachers Talk: The Importance of Offering Feedback (2:55)

Reflection Questions: How does this teacher give feedback in an online setting? Do you think that the methods she uses are also relevant in a traditional classroom?

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 algebra 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." That student may also need more support before they can work accurately on their own. Various data types can help you to understand what contributed to a student's "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 various facets of your instruction.

8.2.1 Mastery levels in a Math class

Teachers Talk: Mastery Data and Remediation



Rachel Peterson

We use a standards-based grading system in my math department. It's super clear and easy. I can see what standards students have and have not mastered. We are constantly looking at who has passed this essential and who hasn't yet and then adjusting in class instruction or doing some targeted interventions depending on how many students need intervention.

Because the math curriculum requires students to think critically and solve complex problems, it can sometimes be difficult to measure mastery. How do you decide when a student's understanding of a math word problem meets the requirements for mastery of critical thinking and analysis skills? Likewise, how do you determine where a student's mastery lies in a multi-step process where any number of errors could occur.

This is where both data practices and personalization can help. A close analysis of such things as student work, written and verbal explanations of math concepts, the ability to explain their reasoning, etc. can help you find strengths and weaknesses in your students' mathematical and analytical skills. For example, one person may be strong at solving for a missing variable in an algebraic equation but weak at explaining how this concept is useful in an authentic scenario. Another may be strong at organizing data but is weaker in representing the data visually. Maybe the student needs to improve in understanding about what a word problem is asking as opposed to completing the necessary mathematical expression represented by the word problem. Maybe the student needs help using math 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: Many Ways of Using Data (4:39)

Reflection Questions: How does the tool this teacher uses check for student mastery? What is she able to do with this data once she collects it?

8.2.2 Using data to help improve pedagogy

Teachers Talk: Data Practices—Remediation



Mikki Stuart

I've been able to get a better handle on where students are academically by using technology and really utilizing digital reports. I can see when a student misses several questions in a row and they're just not getting it. I know who to reach out to. I know how to help them. In a quick conference, we can identify the error and they're able to move forward.

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.

Ideas: Using Quiz Data

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 math 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 geometry 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 parallelograms. 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.

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 math 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 assessments.

Example 3: Using Data to Answer Questions

Using data you can to ask and find possible answers to a lot of different questions:

- 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 concept and another class didn't?
- A: We didn't have time for the online activity in one class. When the teacher went back and did it in the other class, their scores improved.
- Q: The data shows that my morning class struggles to understand core concepts. Why?
- A: You may have to experiment to find the answer to this one. You may realize that these students needed to have some physical movement that early in the morning, even if it wasn't education-related movement. Afternoon classes, however, could be tired from the day and just want to listen and work quietly. You may have to adapt your approach for both classes.

Example 4: Using Data to Group Students

Teachers Talk: Grouping Students Based on Data



Mikki Stuart

As I regularly look at the quiz and test results, I rearrange the seating chart several times so that I have a couple of strong and a couple of weak students at the table together to support each other.

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 activities.



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](#).

Teachers Talk: Data Practices to Inform Future Instruction



Mikki Stuart

We use our reports to see how students are doing with a concept. It will guide where we go the next day. What still needs to be reviewed? What's good? Can we move on? I love that I can see which questions most kids are getting right and wrong. It helps me adjust and see that maybe some content needs to be taught better.

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 watching your students, evaluating practice problems, interacting with them, listening to them. 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. Data collection can open new ways of seeing.

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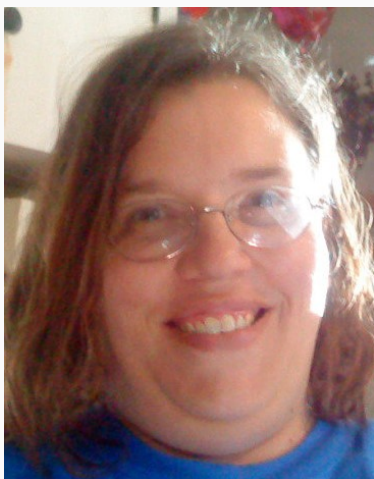
Math: Personalization

Whitney Keaton, Cecil R. Short, Qi Guo, & Michelle Jensen

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

9.1 The Importance of Personalization in a Secondary Math Classroom

Teachers Talk: Knowing Your Students Better



Dawn Schlink

I feel closer to my students. I feel like I know kids more on an individual basis because I've been able to work with them more individually. The thing about blended learning is that there's always a portion of my time during the day that is set aside for students to work at their own pace. And when they're working at their own pace, that means I can call students up or I can let students come up to meet with me. I can work with them and really get to hear their concerns, their misunderstandings, and that brings me closer to the student, and not just where math is concerned.

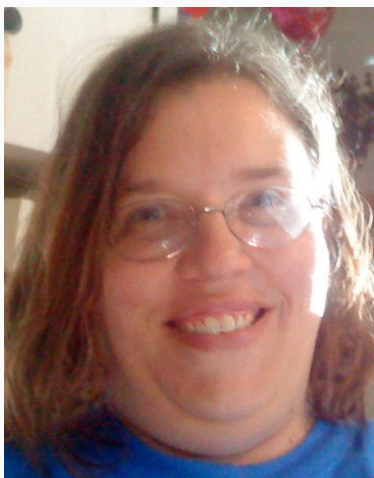
Within a blended learning environment, personalized learning is one of many instructional strategies. When we personalize learning for our students, we allow the instruction to be adaptable to individual students' abilities, interests, and needs. When we describe personalized learning, it is important to consider what part of 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 math classroom, personalization can take many forms and use a variety of strategies. When you allow students to have a choice in the pace and path of their learning by using instructional tools such as playlists, they are personalizing instruction. Allowing students to use inquiry skills to find their own path or method of solving a complex problem is also personalizing. You can personalize learning objectives by allowing students some choice in the research they do for a

project or the way they choose to approach a problem. You can also personalize learning by using problem-based learning when introducing new mathematical concepts.

Activities and assessments can also be personalized, when students decide how to meet the course's learning objectives and how they will demonstrate their mastery of mathematical 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 take some degree of control over their learning.

Teachers Talk: Importance of Differentiation in Math



Dawn Schlink

Differentiation plays a big part in how I blend, because the blended learning allows kids to move at their own pace. So some kids will be working on higher depth of knowledge level online because that's what they're able to do. Some kids won't, because some kids just don't get it yet.

Definitions: Differentiation vs. Personalization

Differentiation and personalization are similar but not the same. As you think about the activities and ideas in this chapter, decide if the activity is differentiated or personalized. Both have an important place in classrooms, but personalization with its extra emphasis on student (not teacher) choice tends to foster greater growth in areas such as student ownership and self-regulation.

Differentiation: The teacher tailors instructional materials, pacing, and path to address student needs. She makes significant decisions for and about the student.

Personalization: Students make their own decisions about their goals, time, place, pace, and path of learning, giving them increased ownership over their learning. In most cases, these decisions should still be guided by the teacher.

It is helpful to approach personalization and the idea of student control in two different ways: through allowing students to personalize along the dimensions of personalization and through allowing students to personalize the learning objectives, assessments, and activities we use in our teaching. Both of these can be personalized at different levels of student agency.

9.2 Dimensions of Personalization in a Math Classroom

One way to think about personalization is to examine the ways students can personalize their learning. The five dimensions of personalized learning are guidelines for ways we can allow our students to personalize their learning. These dimensions are goals, time, place, pace, and path. In the sections below, we will explore each of these dimensions.

Figure 1

Five Dimensions of Personalized Learning



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 some of their needs and proficiencies as math learners. This is where you can use the data you have gathered from the strategies mentioned in the Data Practices chapter.

Information from such sources helps you understand where students are in their mathematical abilities, skills, and aptitudes. Learning outcomes and standards give focus concerning where students are expected to be. The difference between where students are and the course outcomes is the place for student growth—and goals.

Goals are not goals if they are just aspirations. Writing goals 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 math 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 the SMART goal framework (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 or in groups for a short consultation.
- Use these conferences to review current data and areas of growth.
 - Discuss growth in content areas.
 - You may also want to allow students to practice making goals outside the scope of your learning outcomes, such as personal health goals, interpersonal goals, behavioral 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 to help students visualize progress.

An important aspect of personalizing learning is helping students to properly increase their agency as learners. In order to facilitate such growth, it is important to allow learners to control as much of the goal-tracking conferences as possible. Consider various ways to provide them with ownership over their own data, how that data is tracked, how it is analyzed, and how that data informs learner's goals.

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 partners revise the goals if necessary. They also report their progress.
- 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.

Chapter 2 refers to a taxonomy of learner 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 math classroom that reaches levels 3 and 4 of the Taxonomy of Learner Agency.

Table 1
Examples of Personalizing Goals in a Math Classroom

Learning Objective:
Students
will evaluate
algebraic
expressions for given
replacement values
of the variables.

	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	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

Learning Objective:
Students
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algebraic
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of the variables.

	Level 3 Personalization	Level 4 Personalization
	they are capable of given their past performance and encourages them to challenge themselves but ultimately leaves the goal and strategies up to them.	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 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.	Students are given the freedom to identify a learning behavior or habit that they want to focus their efforts on during the unit. The teacher gives them some possible examples of ways to improve their learning 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 choose to do.

Table 2 describes ways in which the learning path can be personalized in a math classroom at levels 3 and 4 of the Taxonomy of Learner Agency.

Table 2

Examples of Personalizing Path in a Math Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
Students will be able to solve trigonometric equations and inequalities.	Create a menu of learning activities about solving trigonometric equations. 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 activity in which students are given several scenarios in which they need to determine if the functions are equal or not. 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

Teachers Talk: Personalizing Pace and Demonstration of Learning (2:37)

Reflection Questions: How does the teacher in this video allow the students to work at their own pace and demonstrate their understanding? What advantages does this have for student learning?

Personalizing pace means allowing students to take more or less time to complete learning tasks based on their own knowledge, skills, and abilities, as well as their personal and family life circumstances. It often includes giving students a window of time on 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 (sports, school, play, family, and work obligations) and learn to plan for these situations. Table 3 provides examples of personalizing pace in a math classroom at levels three and four of the Taxonomy of Learner Agency.

Table 3

Examples of Personalizing Pace in a Math Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
The students will analyze a relation to determine whether a direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically.	The teacher assigns a checklist of activities the students will use to learn and practice this topic. The unit 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 checklist explained in the level three example, students are allowed to complete the entire intervention at their own pace, understanding that the course contains additional content that they must master for credit.

Teachers Talk: Individualized Pacing



Rachel Peterson

I think the most powerful thing that I've been able to use is pacing. If I have kind of a longer activity, maybe 20-30 minutes, that they're doing and working on using their devices at their own pace, not only can they do it at their own pace, but I'm free to go around and help students individually. I can't do this if I'm lecturing. If I'm lecturing, then it's at my pace. Right? And, that's never 100% good for everybody.

Teachers Talk: Videos for Personalizing Pace



Mikki Stuart

I thought, "Okay, what's one way I can do this differently?" I thought maybe they just need to review the content with more self-paced one-on-one instruction. So I created videos. I broke down our unit into three or four sections. I showed an example, and then I had students pause and do a new problem on their own and then come back to another screen where they could check their work.

Students worked individually at their own pace. If they didn't understand, they could rewatch the video. I had students taking notes on what they were doing wrong while other students were working on other things. The next day when they took the test it went from 25% of students not passing to 12% of students not passing. I think that's when I realized, some of these kids just really need that opportunity to go at their own pace. I realized that I was rushing some of these kids way too fast, because I'm a very fast-paced teacher. I think some of the kids didn't have the opportunity to internalize everything.

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 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 class. But because he can access his assignment later in the day, he is able to complete it and do a good job. Time is closely related to pace. Because students are not bound to a specific time to do an assignment, they

can increase or decrease their pace according to their own preferences, needs, and abilities. Table 4 provides examples of personalizing time in a math class at levels three and four of the Taxonomy of Learner Agency.

Table 4

Examples of Personalizing Time in a Math Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
Students will be able to use the relationships between angles formed by two lines intersected by a transversal.	A teacher does a large group lecture on this topic 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.

7-5.2.5 Personalizing Place

Personalizing place revisits traditional practices about where learning occurs. Because blended courses often include online instruction, students can choose to do activities at home or at school. In addition, they can access instruction when they have to miss activities because of illness, travel, or extra-curricular activities. However, another aspect of place is the configuration of the classroom. 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 be made more comfortable, inviting, and conducive to the kinds of activities that take place in a blended classroom. 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 Math Classroom

Learning Objective	Level 3 Personalization	Level 4 Personalization
Students will be able to communicate mathematical reasoning in oral and written forms.	Students are given the assignment to research a mathematician 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 the assignment to do an online presentation of a difficult math topic. 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 planning to personalize. 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 activities and assessments 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 use multiple representations of functions for analysis, interpretation, and prediction."

- Goals—Students can determine what analyses and interpretations 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 projects at home, or in a specified area of the school or classroom.
- 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

Teachers Talk: Showing Mastery



Sandy Chalke

If you don't want to do 20 problems don't do 20 problems. Just do five problems but show me mastery.

What do assessments look like in your classroom: An exam full of equations and math problems? A final project? Word problems requiring brief explanations? A presentation? Do all your students do the same thing? Do all of your students 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 ideas 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

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, exam, project, presentation, tutorial, guide, etc.

Students choose the topic of a project or other form of 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.

Teachers Talk: Allowing Choice of Products



Rachel Peterson

We did a project recently where they were creating an original work based on a mathematical equation. They have a lot of freedom in the creative aspect of it and the creation of it where they can use a number of different platforms. Maybe they want to create a PowerPoint or maybe they want to make a video or maybe they want to do something else. By giving them that freedom and allowing for creativity, we got much higher quality projects than I have in years past.



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 choose earlier.

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

9.3.2 Personalized Activities

Personalized activities are based on 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. The following examples provide some insights into how some teachers personalize the learning activities in their math classes.

Teachers Talk: Allowing Students to Work at Their Own Pace (including ideas for activities) (3:58)

Reflection Questions: How are the activities that this teacher mentions personalized? How are they differentiated? What is one activity or tool that you would like to try in your own classroom?

Teachers Talk: Differentiating Activities to Meet the Needs of All Students



Sandy Chalke

I used a storyboard project because I saw that one kid was just drawing in class. They like to draw. They sit and like to draw. So that's why I came up with the storyboard project where they can actually demonstrate how they use math in real life by just drawing and illustrating mathematical principles.

Table 7 provides examples of ways to personalize different learning activities in math.

Table 7

Personalized Learning Activities

Personalized Activities

Create a choice board or playlist of activities for exploring or reviewing a mathematical 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 mathematician and write about the discovery of a theorem or principle from that person's perspective. Share the writings in a discussion board and have the other students ask the mathematician 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 tool. It allows students to grow where they need to grow and in a way that is meaningful to them. It combines all of the competencies of blended learning: online integration, online interaction, and data practices to create a unique learning experience for each student. Throughout these chapters, you have learned how to use these competencies in a math context. Now it is up to you! You are ready for your first small step!

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Appendices

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

Appendix B: Research

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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.

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