

Empowering Students Through Personalized Learning



Co-designing Instruction With Students

Learner choice is a defining feature of personalized learning (Patrick, Kennedy, & Powell, 2013), setting it apart from the related concepts of individualized and differentiated learning. Although these related concepts imply some change in instruction based on learner skills, knowledge, or performance, only personalization implies that the learner is an active agent in the decision-making process.

In its National Education Technology Plan, the U.S. Department of Education (USDOE, 2010) defines personalized learning as “instruction that is paced to learning needs, tailored to learning preferences, and tailored to the specific interests of different learners. In an environment that is fully personalized, the learning objectives and content as well as the method and pace may all vary” (p. 12). In this definition, personalization encompasses both differentiation and individualization but adds learner interests as a specific element of personalization.

The International Association for K–12 Online Learning (iNACOL) is more explicit in including learner choice as part of its working definition of personalized learning, defining it as “tailoring learning for each student’s strengths, needs, and interests—including enabling student voice and choice in what, how, when, and where they learn—to provide flexibility and supports to ensure mastery of the highest standards possible” (Patrick et al., 2013, p. 4). Adding to these features, Redding’s (2013) model of personalized learning emphasizes interpersonal relationships and explicitly includes motivation as well as metacognitive, social, and emotional competencies:

Personalization refers to a teacher’s relationships with students and their families and the use of multiple instructional modes to scaffold each student’s learning and enhance the student’s motivation to learn and metacognitive, social, and emotional competencies to foster self-direction and achieve mastery of knowledge and skills” (Redding, 2013, p. 6).

Although these features—varying time, pace, place, content, goals, instructional methods, and especially learner choice—define personalized learning, it is also important to note that instruction can be more or less personalized, involving different levels of

choice within different aspects of an instructional episode. For the purposes of this chapter, an instructional episode will be defined as any activity undertaken to reach a learning goal. Breaking down an instructional episode into relatively standard parts can help to both define personalization as a continuum of choice and serve as a framework for thinking about how to design and implement partial or complete systems for personalizing learning.

Within instruction, what can be personalized? Any instructional episode involves key parts and aspects, including (a) types and features of learning activities; (b) where the learner engages in these activities—at home, at school, or elsewhere; (c) the pace of instruction; (d) the amount of instruction and practice; (e) the instructional goals or objectives; and (f) the standards by which learning or performance will be evaluated. In what is typically thought of as traditional, standard, teacher-directed instruction, the teacher or educational system specifies each of these factors. All learners may go through a fixed instructional sequence at a fixed pace with a fixed amount of instruction and practice in an attempt to reach standard objectives with performance evaluated against standard criteria. At the other extreme is completely self-directed learning. Here, the learner may set her own learning goals and her own criteria for meeting them. She may select her own preferred method to reach them and move at her own pace at home or at school, with an amount of instruction and practice that she deems necessary to meet her goal. In between these two extremes are variations on differentiated, individualized, and personalized learning.

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In an individualized program, for example, the goals, standards, and activities may be set, but the pace and amount of instruction may vary based on individual learner performance. In a personalized system, the teacher may select from a fixed set of learning goals but work with the learner to choose appropriate and preferred learning activities to reach those goals (see USDOE, 2010, for definitions that differentiate among these three concepts).

Why would a school want to develop a system of personalized learning? First, it can support lifelong learning when implemented with student training in developing self-regulated learning (learning-to-learn) skills such as (a) selecting goals, (b) identifying criteria to indicate when a goal is achieved, (c) selecting learning activities, and (d) monitoring learning to determine whether the selected activities are working and how much more work is required to reach mastery. Each of these skills can be taught in a well-developed personalized learning system that includes explicit, systematic instruction focused on building and using these skills as students advance across grade levels. Explicit and systematic teaching of self-regulation strategies may incorporate scaffolding and teacher models or demonstrations as well as guided and independent student practice with feedback. Activities should be carefully planned and should systematically build on prior knowledge and previously taught skills (see Zumbrunn, Tadlock, & Roberts, 2011, for an overview of self-regulated learning and teaching strategies for developing it).

A second reason for implementing a personalized learning system lies in its potential to increase motivation and learning. Some studies have shown that even very limited choice over seemingly irrelevant factors within a learning activity can increase motivation and learning (see, for example, Cordova & Lepper, 1996). When choice is implemented

within a mastery-based system, motivation and learning may be further increased. In mastery-based systems, learners work at their own pace to meet learning goals and move on once they've met a specific criterion on an assessment of the learning goal. Mastery-based systems that include proactive goal selection and learner-involved formative assessment can support learners in developing growth (vs. fixed) mindsets and learning-goal (vs. performance-goal) orientations, both of which predict important outcomes, such as academic achievement, persistence, and resilience in the face of setbacks. With a growth mindset, learners believe that their effort will result in learning and performance gains (rather than believing they are either good at something or not). With a learning orientation, learners' focus is on learning and mastering challenges rather than demonstrating ability or lack thereof (Dweck, 1986; Dweck, Walton, & Cohen, 2014; Grant & Dweck, 2003). Within a well-developed personalized learning system, learners can regularly see their skills and knowledge grow as a result of their effort.

However, learner choice related to factors affecting instruction, such as the best learning method to use or the amount of instruction and practice necessary, requires that learners know what they know, what they don't know, and how to best go about gaining the necessary skills or knowledge—abilities often referred to as “metacognition” (see Redding, 2013, on metacognitive skills and how to support their development in the classroom). This is a tall order even for adults (Dunning, Heath, & Suls, 1994), and without well-developed self-regulation skills, learner choice is likely to have a detrimental effect on learning (Kirschner & van Merriënboer, 2013).

How can the positive effects of learner choice be maximized while minimizing risk that learners will not be able to choose in their best interests? By designing models in which teachers and learners co-design instruction, with learners making choices coached by a teacher and informed by knowledge of current and desired skills. In this type of model, learners not only work on the knowledge and skills related to the instructional materials but also on self-regulated learning skills—learning how to learn. Three components are important in such a system: (a) detailed maps that link learning goals to standards, specify the skills and knowledge necessary to meet learning goals, and show hierarchical relationships among goals; (b) continuous formative assessment that involves the learner in a proactive manner; and (c) a systematic, explicit focus on developing self-regulated learning skills, with learners gradually taking on more responsibility in determining what they need to learn, how they can go about learning it, and measuring their own skill mastery to determine whether their chosen method is working for them. Self-regulated learners choose challenging learning goals, select learning strategies to help them reach those goals, and continuously monitor their learning to determine whether the learning strategies and methods that they have selected are working and make changes when they are not (Zimmerman, 1990). Here, the goal is to help learners develop mastery over the process of learning as well as the products (skills and knowledge).

Implementing a fully personalized learning system is a major undertaking often requiring cultural shifts in the way students and educators view learning and school (see Berger, Rugen, & Woodfin, 2014, and Mechner, Fiallo, Fredrick, & Jenkins, 2013). However, personalization can also be implemented in differing degrees and within different parts of the learning process. The following sections describe issues related to personalized learning in each aspect of the instructional episode and how that aspect may be co-designed with the learner.

Co-design Within the Instructional Episode

Each part of an instructional episode—from setting goals to evaluating progress and achievement—can involve differing degrees of learner choice. Although learner control over all aspects of learning may not be optimal (Kirschner & van Merriënboer, 2013), co-designing instruction with learners can help to increase learning and motivation (Ames, 1992; Corbalan, Kester, & van Merriënboer, 2006, 2008, 2009), and learners at all levels can play some role in setting their learning goals, selecting activities to reach those goals, and monitoring their learning as they work to achieve mastery.

Setting Learning Goals

Learning goals are fundamental to a personalized learning system, although the degree of learner choice in selecting goals may vary. For example, whereas young learners may have very limited choice in which goals to pursue at any given time, older learners may be offered more choices. Goal choice may also be constrained by standards and learners' current skill level within a particular area. To personalize learning around learning goals while ensuring that all learners master the necessary fundamental skills, it is important to develop goals that are (a) clearly aligned with standards, (b) well-defined so that they are specific and measurable, (c) written in terms of what learners will be able to do upon mastery, and (d) depicted in a manner that makes the relations among them (e.g., prerequisites or component skills) clear. Goals with these attributes are more easily communicated and understood and can make goal setting, activity selection, and progress monitoring easier for both students and teachers. In addition to fundamental skills that all learners should master, the scope of learning goals may also include advanced goals for learners who have a particular interest in or facility for the area.

Standards, Goal Definition, Relations, and Scope

A detailed goal map can guide both teachers and learners in choosing appropriate learning goals. Beginning with standards helps to ensure alignment between standards and goals. To be most useful, however, goals should *not* be equivalent to standards. Instead, goal analyses should be conducted in order to analyze the standards (and perhaps other sources) for the purpose of creating clearly defined learning goals. Goal analysis is a process in which a larger, more general goal is analyzed to clearly outline what achievement of that goal would look like and what skills, knowledge, or attitudes it would be necessary to develop in order to achieve the goal (the process of identifying the necessary skills, knowledge, and attitudes is often called *instructional analysis*). As a simple example of the process, imagine that one of the goals for an elementary science class is that students understand the concept of *density*. An analysis of this goal would first focus on defining what exactly is meant by the term “understand.” In other words, if students *understand* density, what will they be able to *do*? Will they be able to calculate the density of a material given its mass and volume? Will they be able to create a conceptual model of density? Will they be able to employ density as an explanation of a phenomenon? Will they be able to state the definition? Will they be able to do all of these things?

To conduct a goal analysis:

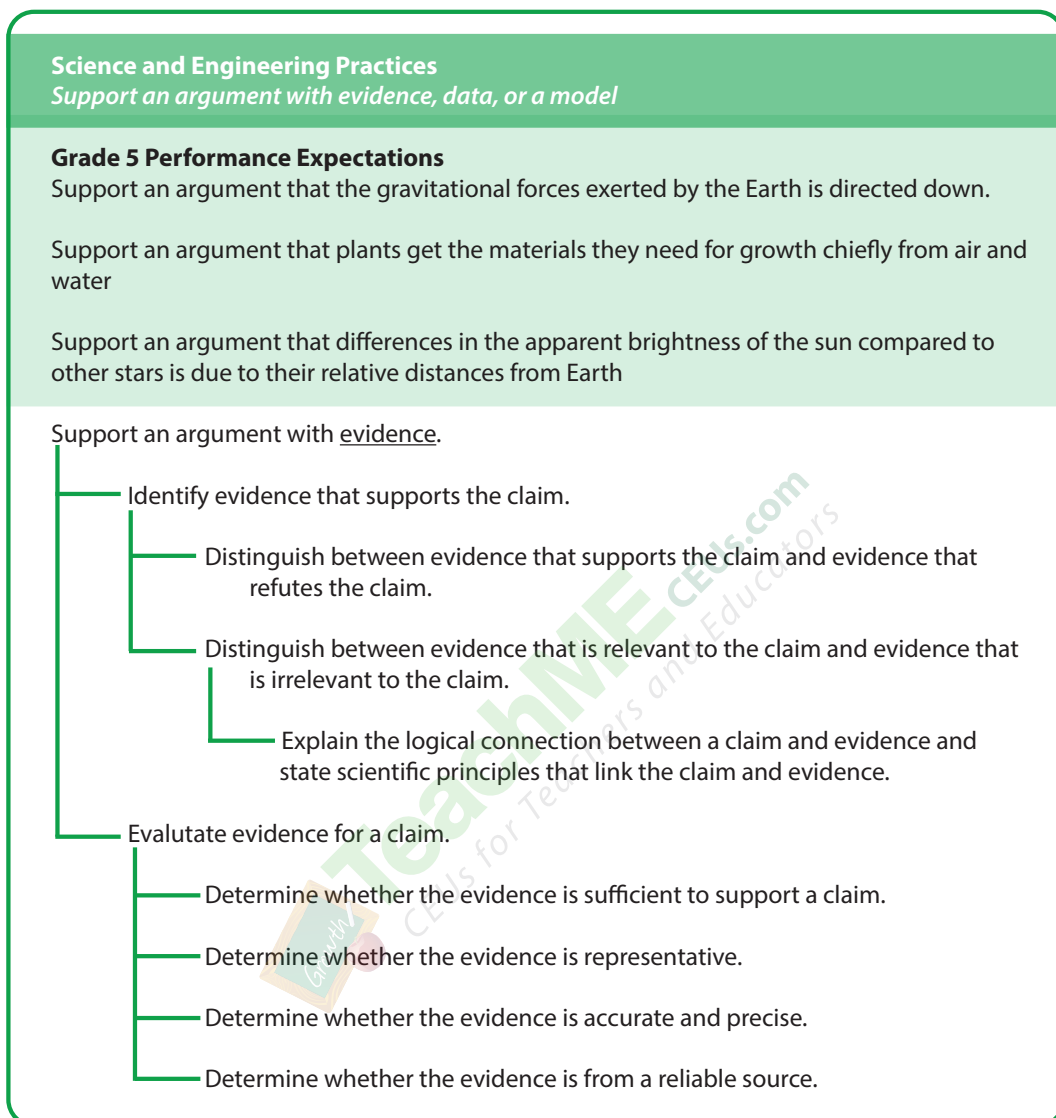
1. Write down the initial goal statement—for example, “understand density,” “read with understanding,” or a specific standard.

2. Make a list describing what someone who has reached the goal can do—for example, “calculate the density of an object,” “create a conceptual model of density,” “retell the main events of a story,” or “answer questions that require an inference from the text.”
3. Review the list to ensure that each description is clear and truly describes what the goal means. Ask yourself, “Am I sure that another teacher would be able to write an assessment of the goal based on this statement that would accurately measure everything I intend?” If not, clarify the goal further.
4. Create the final list of goals by writing the goal statements in complete sentences.
5. Ensure that your list is complete. Ask yourself, “If a student were able to do all of these things, would I agree that the student had mastered the goal?” If the answer is no, work to figure out what is implied by the initial goal statement that is not in your final list (Mager, 1997).

In addition to clarifying what a goal means, analysis of goals can be useful in deriving learning goals from statements of standards because a single standard may encompass a number of skills and an array of knowledge. Analyzing each standard into multiple, more specific goals can help to clarify the standard and make it easier to align assessment, instruction, and practice (see Mager, 1997, for a step-by-step description of the goal analysis process.).

After you’ve clarified your goals through goal analysis, think about what component skills and knowledge students will need to master in order to achieve the goal. Analysis of the goal in these terms is often called *instructional* analysis and portrays the component knowledge and skills in terms of their hierarchical relationships. Figure 1 illustrates a partial instructional analysis of a standard that could be used to construct a goal map based on the Next Generation Science Standards (NGSS Lead States, 2013). This analysis is based on the science practice of “supporting an argument with evidence, data, or a model,” and focuses on using evidence to support a claim. Grade 5 performance expectations related to the practice across content areas are listed below it. Below those is a partial analysis of using evidence to support a claim. To read the analysis, first read one line and then read a connected line below it in the pattern: “in order to _____, students will need to be able to _____.” For example, in order to “support an argument with evidence,” students will need to be able to “identify evidence that supports the claim” and “evaluate evidence for the claim.” In order to “identify evidence that supports the claim,” students will need to be able to both “distinguish between evidence that supports the claim and evidence that refutes the claim,” and “distinguish between evidence that is relevant to the claim and evidence that is irrelevant to the claim.” In order to distinguish between relevant and irrelevant evidence, students will need to be able to “explain the logical connection between a claim and evidence and state scientific principles that link the claim and evidence.” This analysis shows that, while basic skills related to working with evidence cut across subject areas, science practice and science content are connected in that—to identify relevant evidence for a claim—the student will need relevant subject matter knowledge and skills in making logical connections between claims and evidence in that subject area.

Figure 1. A Partial Analysis of the Next Generation Science Standards, Identifying Embedded Component Skills and Knowledge



Note. A portion of this analysis was conducted for Outthink, Inc. Used with permission.

The process in Figure 1 also suggests how such an analysis can support work across and within grade levels. For example, when just beginning to learn these skills, students might focus more energy on mastering each of the component skills (for example, by practicing distinguishing relevant from irrelevant evidence across a variety of relatively simple or familiar content). Once these skills have been mastered, they may be incorporated into the broader task of supporting an argument. The full skill set can also be taught across grade levels by increasing the complexity of the arguments and the level of subject matter while still employing the entire skill set at an appropriate level.

A clearly defined learning goal allows both the teacher and learner to evaluate work and determine when the learner has reached the goal. It also allows the teacher and learner to

work together in identifying appropriate activities to help the learner work toward that goal. For example, although identifying learning and evaluation activities for “understanding density” might be unclear to both teacher and student, being able to state a definition, perform a calculation, or build a conceptual model are more straightforward.

It is important to note that, although a goal should be specific, it should not be trivial. A risk in writing for specificity is writing the intended meaning out of the goal. Care should be taken to write goals that are both specific *and* meaningful (see Tiemann, 1971, for a description and example of this process; see Berger et al., 2014, for descriptions of writing and using learning goals or *targets* within a personalized learning system). For example, although the three performance expectations in Figure 1 specify particular arguments to support, it is unlikely that the true goal is to support only *those* claims with evidence. Rather, educators hope that the skills involved in supporting an argument would transfer to a variety of claims in addition to those encountered in school (provided that the learner has the requisite content knowledge). Specifying the component skills involved in supporting a claim with evidence can help ensure that the necessary general skills are gained and applied across a variety of content areas.

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More specific goals also allow for project-based or problem-centered group work in which learners joining a group may have different levels of skill mastery. By understanding where students are in terms of skill mastery, groups of students with complementary skill sets can be created for larger projects requiring a combination of skills. Learning and problem-solving activities can occur flexibly within individual, small-group, and large-group activities. For example, students who each have differing levels of skill in math, problem solving, argument, and science content knowledge could each use their respective skills to solve a problem more advanced than an individual could solve independently.

By linking goals with standards, the fundamental skills necessary for all students to master should be identified. However, extended goals—goals that build on the fundamentals but that are not required for all students to master—may also be available for advanced students to work on if they have mastered the necessary prerequisite skills and have a particular interest or aptitude in an area. Extending the scope of potential learning goals beyond those required allows for additional personalization as students have an opportunity to extend their skills as their particular interest and aptitudes allow. An extended scope may also motivate students to master lower level skills in order to attain higher level and potentially more interesting goals.

Table 1 lists a sample of performance expectations from the Next Generation Science Standards along with related goals based on the analysis shown in Figure 1. All of these goals are relevant to the standard related to supporting an argument with evidence and can be repeated across grade levels. While the topic areas and complexity of the subject matter increases across grade levels, the goals in this case would remain essentially the same. Performance expectations such as these with related goals may make up part of a goal map in order to link standards and goals within and across grade levels.

Table 1. Sample Performance Expectations from the Next Generation Science Standards and Related Goals Derived from Goal/Instructional Analyses

Next Generation Science Standards Performance Expectations	Related Goals*
2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	State what you would expect to happen if the claim was true.
3-LS2-1. Construct an argument with evidence that some animals form groups that help members survive.	Explain what would make you believe that the claim is true and why.
3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	Given evidence, state whether it makes you believe that the claim is true or false and why.
5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.	Given data, state whether it is relevant to the claim and why or why not.

*Note: All of the related goals apply to each performance expectation.

Goal setting with students: Interim goals and learner choice

Goal setting for a particular student requires knowledge of the student’s current achievement level because goals should be challenging yet achievable. In addition to selecting an appropriate goal toward which to work, goal setting may also involve further break down of a selected goal into interim goals. For example, if a defined goal is to read at a particular rate with fluency and accuracy, the specific student goal selected may not be that particular rate but an interim rate based on the student’s current reading rate. For example, an interim goal might be to increase reading rate by 1.5 times the student’s current rate. Interim goals such as these can help ensure that students see continuous improvement in their skills as a result of their effort (see Lindsley, 1992, for an example of continuous progress monitoring).

For younger students, goals may be set that can be achieved in shorter time frames; for example, an interim goal may be met in a single activity session. More advanced learners may work on extended goals that take significant time and effort to achieve and may contain several interconnected parts. For advanced students undertaking performance or production goals, co-creating rubrics with the student by analyzing expert or advanced-level performance can help to more fully define the goal and aid in progress monitoring and self-evaluation. After standards of final performance are agreed upon, interim goals may be created and set at challenging yet achievable levels by considering the ultimate goal (expert performance) in combination with the students’ current performance level. Even young students can play a part in selecting interim goals, and as students advance, they can take on more responsibility in identifying and selecting their own interim goals.

Selecting Activities to Reach Goals

Results of studies investigating the effects of learner control on learning have been equivocal, with some studies finding benefits, some finding no effects, and others finding detrimental effects (Schnackenberg & Hilliard, 1998; Williams, 1993). One reason that learner control may result in poorer outcomes is that learners do not have the skills necessary to make informed choices regarding their own learning (Williams, 1993). First, to make informed decisions, people need to be able to accurately judge their current state of knowledge. However, in general, people are often poor at making this evaluation, often overestimating their knowledge and skill (Dunning et al., 2004; Williams, 1993). To reach a selected goal, learners will need to engage in learning activities designed to help them achieve that goal. Choice in activity selection may be informed by both learner preferences and how effective a particular activity or type of activity may be in helping the learner to reach that goal and may involve choice related to differences in simple surface features or significant differences in instructional type or strategy. Because making an informed choice about instructional type or strategy is often difficult—requiring knowledge about the content area that a novice may not have, knowledge of how a learner’s current skills may influence success in an activity, and knowledge of how effective different instructional strategies are in helping learners acquire different types of skills—teacher coaching is particularly important in making an informed choice when factors other than surface features differ among possible activities.

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Surface versus instructional differences in activity type

Choice in activity may involve surface features (e.g., two computer-based programs that both teach the same skills in the same ways but differ in their game-like elements, characters, or similar features) or features fundamental to learning. Although choice of surface features may not have a great effect on learning progress, choice related to instructional factors may have a significant effect. For example, a learner may attempt to learn a concept by reading about it or by reading followed by a classification or analysis activity related to identifying or analyzing instances of the concept. Based on research on concept learning, classification or analysis of examples and non-examples should result in greater learning than reading only (Tennyson & Park, 1980). Thus, when choosing activities that involve instructional differences, coaching by the teacher as to what type of instructional activity may be best suited for achieving a particular learning goal can be important. However, learners may still be able to choose learning activities based on their preferences when activities differ only in surface features.

Selection versus design and resource use

Another issue in choosing activities is whether to select from activities readily available or to design new activities. More advanced students may choose to develop a unique learning sequence by selecting a number of different resources available in print, on the web, or via other sources. For example, a student might look up instructions and work examples in a textbook, watch a Khan Academy video, search for other relevant information available on the Internet, and work with the instructor and other students to discuss and solve problems. Because learning from resources is more challenging for learners

with lower prior knowledge, self-directed, resource-based learning activities may best be used by more advanced students who already have acquired knowledge of the subject area and skills in resource use (Kirschner & van Merriënboer, 2013).

When selecting activities, it is important to identify those that align well with the learning goal. For example, if a student's goal is increasing fluency in recalling math facts, a suitable learning activity might involve engaging in computer-based math games that require learners to recall math facts under some time pressure or that reward fast, accurate recall. If a student's goal is solving math word problems, then different activities would be most appropriate unless the student is struggling with word problems because of a lack of prerequisite skills in math fact fluency.

Finally, when possible, information about activities should be used in determining what activity might be best for a particular student working on a particular goal. This information may come from the publisher (e.g., information on necessary prerequisites, characteristics of target learners, and results of any studies that have been done) or from information gathered from prior use (e.g., have students like this one succeeded in this activity in the past; has it helped students achieve this goal?).

If choice of activity involves more than choice of surface features, then teacher input regarding the most appropriate learning activities for that learning goal is warranted. Because students are likely to be novices both in the subject and in optimal learning activities for different learning types, the expert input of a teacher is invaluable. However, when multiple activities are appropriate for similar learning outcomes and when learners are more sophisticated in terms of prior knowledge, skills in learning from resources, and monitoring their own learning to determine whether what they are doing is working, learner preference may play a larger role in activity selection and planning.

Monitoring Learning: Formative Assessment

In formative assessment, information on student performance is gathered and used, not to evaluate the learner, but to evaluate whether learning methods and strategies are working for that learner. If learner performance indicates that specific methods or strategies are not working, a different learning method or strategy is indicated. Here, the focus is on evaluating the effectiveness of the learning activity during the learning process rather than on evaluating final learner achievement. As noted by Black and Wiliam (2009),

Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited. (p. 9)

There may be several reasons why a learning method or strategy is *not* working: (a) the activity itself may be poorly designed and therefore not effective, (b) the activity may be misaligned with the learning goal and therefore not teaching what the assessment is measuring, (c) the learner may be missing some prerequisite skills that the activity assumes are in place, or (d) the activity may not be effective for some other reason related to learner and activity characteristics. If a learner is not showing progress with a particular activity, then a different or modified activity should be tried and evaluated.

Studies have shown that students engaging in learner-controlled instruction who receive information on their mastery level do better than students in learner-controlled conditions

who do not receive such information (see Williams, 1993). When learners take an active role in measuring their own progress and use that information to continue or change what they have been doing to reach their goal, they are practicing important skills involved in self-regulated learning (Nicol & Macfarlane-Dick, 2006). Formative assessment can also be a potentially powerful tool in helping students adopt learning (vs. performance) goals and a growth (vs. fixed) mindset, predictors of learning and perseverance (Grant & Dweck, 2003). Although formative assessment can be conducted by the teacher or program, as often occurs in individualized and differentiated instruction, a *personalized* learning system with emphasis on active student involvement in gathering and interpreting performance information can help to encourage application of self-regulated learning skills (Andrade, 2010; see also Berger et al., 2014; Lindsley, 1992, for examples of learning systems focused on progress monitoring and formative assessment systems that feature high student involvement).

Mastery Learning: Pace and Practice

When learning pace is set by the teacher or system, learner achievement must vary. When learning pace is variable and the signal to move on is mastery rather than a set period of time, time varies rather than achievement, and more students are able to reach higher achievement levels (USDOE, n.d.). Under the right instructional conditions, all students can achieve at higher levels (Bloom, 1968, 1974, 1984).

A fully personalized instructional system with a focus on continuous formative assessment and learner choice with teacher support in which students move at their own pace in meeting their selected goals is a type of mastery-based learning system. Mastery-based learning systems can result in increased student achievement (Kulik, Kulik, & Bangert-Drowns, 1990) and can support the development of positive motivational factors such as learning goal orientations and growth mindsets (Ames, 1992; Covington, 2000). In this type of system, assessments that show a lack of mastery indicate that more practice or a change in learning strategy or instructional materials is necessary to successfully reach the learning goal. The idea that learners can master learning goals with effort combined with the right learning methods illustrates the growth mindset and supports a learning goal orientation in which students persist in learning and mastering challenges.

Designing a System

A school where each student is motivated and engaged in mastering challenging learning goals matched to his or her skills and interests is one where most students would love to learn, where educators would love to teach, and that communities would love to see. People have been imagining and writing about such a system since at least the late 1800s (Keefe & Jenkins, 2002).

However, setting up such a system is a challenge—one that requires cultural shifts in school systems and that will only result from focused experimentation. The process of designing this type of system is parallel to the process of co-designing learning. First, goals for the system—criteria by which it would be evaluated as being successful—should be discussed and clearly outlined. Second, methods and strategies to reach those goals should be identified. These methods and strategies might be inspired by or borrowed from others or designed from first principles. Third, continuous progress monitoring regarding a number of measures needs to be undertaken as new things are tried. The design process is not cheap or quick, but it is invaluable for innovation and is necessarily

iterative. When designs fail (and they will, again and again), that evidence is not evidence for the claim that “personalized learning systems are not effective,” just as a student failing is not evidence that “the student is dumb.” Rather, it is evidence only for the claim that what was tried did not work. A “mastery learning” perspective would indicate that you modify what you did and try again. Just as a student’s instruction can be co-designed with the teacher, learning systems and school cultures can be co-designed with students, faculty, administrators, and state agencies (see Brown, 2009, for a description of design thinking).

Although a schoolwide personalized system might be the ideal, this analysis also illustrates that single instructional episodes can be more or less personalized in different ways. Small, informal, localized experiments with these factors within a classroom or subject area can help build personalization into the curriculum at a smaller, more manageable scale while offering the opportunity to try out different methods and strategies and assess their effects. In this way, the system can grow via a bottom-up, organic process as different practices are tried and effective practices are identified and implemented on a wider scale.

Action Principles for States, Districts, and Schools

Action Principles for States

- a. Provide resources for the design, development, and testing of co-designed personalized learning systems. Resources may include funding for design research as well as for development and dissemination of key principles and processes.
- b. Identify and develop evaluation measures that capture the range of criteria for judging a “successful” system. For example, student measures may focus on learning motivation and learning-to-learn skills as well as achievement in subject areas.
- c. Set an expectation that districts will continually experiment in order to reach goals. Districts should report successful and unsuccessful experiments as each provides information on what worked and what did not work (see Mirabito & Layng, 2013).
- d. Identify “showcase” districts that can serve as examples of design processes as well as outcomes.
- e. Embrace failure as a learning mechanism. Failure in experimentation should not be punished because innovation is unlikely without failure, and failure offers important information on what did not work. To mitigate the consequences of large-scale failure, a model with multiple local, small-scale, limited-duration experiments with frequent monitoring and adjustment should be adopted.

Action Principles for Districts

- a. Offer professional development in design thinking for teachers and school administrators.
- b. Reward thoughtful experimentation and consistent implementation of design processes within schools.
- c. Celebrate achievements without punishing failures. Failure is likely when trying something new and is important for innovation.

- d. Collect and disseminate case studies from district schools that illustrate design processes, what worked, what did not work, and what unexpected outcomes may have resulted.
- e. Develop clear goals for schools to reach that include process as well as product criteria for the school, classroom, and student levels.

Action Principles for Schools

- a. Create detailed goal maps aligned with standards that clearly define knowledge and skills and the relationships among them. Goal analysis is a challenging but invaluable process for defining goals that are specific enough to work with yet still capture the spirit of the intended outcome.
- b. Design a system for continuous formative assessment that involves the student. Continuous, proactive self-assessment can empower learners and keep them actively engaged in working toward their goals.
- c. Move toward a mastery-based system. Although mastery-based systems can be challenging to implement because of their conflict with time-based instructional systems, even limited mastery-based systems can help students see their progress and achieve goals they may otherwise not have achieved.
- d. Develop and implement a learning-to-learn curriculum. Learning-to-learn or self-regulation and metacognitive skills support informed student choice in personalized systems and can help students develop the skills necessary to become lifelong learners.
- e. Work on developing a schoolwide culture focused on key values of mastery and autonomy.



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Flipped Learning as a Path to Personalization

Digital technology is rapidly becoming ubiquitous in schools. One-to-one computing and bring-your-own-device (BYOD) initiatives are helping to ensure that each student has a device with which to work. Although these technologies can support personalized learning, they haven't yet transformed our schools into 21st-century utopias where students engage in interactive, individualized learning applications and access information in order to collaboratively solve problems while teachers roam the learning space, coaching and mentoring as their engaged and self-directed students happily work.

In fact, there have been some large, public failures. Consider, for example, Los Angeles Unified School District's \$1.3 billion iPad initiative in 2013. Experts suggested that part of the reason this initiative failed so spectacularly was that it put technology first. Without a clear plan in place, the district purchased iPads not to solve a problem but simply for the sake of incorporating the technology (Lapowsky, 2015).

A technology's potential for improving education lies in its usefulness as a tool for reaching particular goals, and models incorporating technology can help to focus its use for goal achievement. Blended learning models in particular incorporate technology as a key component for reaching specified goals (Horn & Staker, 2015). One blended learning model—flipped learning—has a very simple goal: to maximize the value of in-class time (Bergmann & Sams, 2014). Although fundamentally simple, this model can help to empower teachers and enable them to begin incorporating aspects of personalized learning into their classes.

Blended Learning

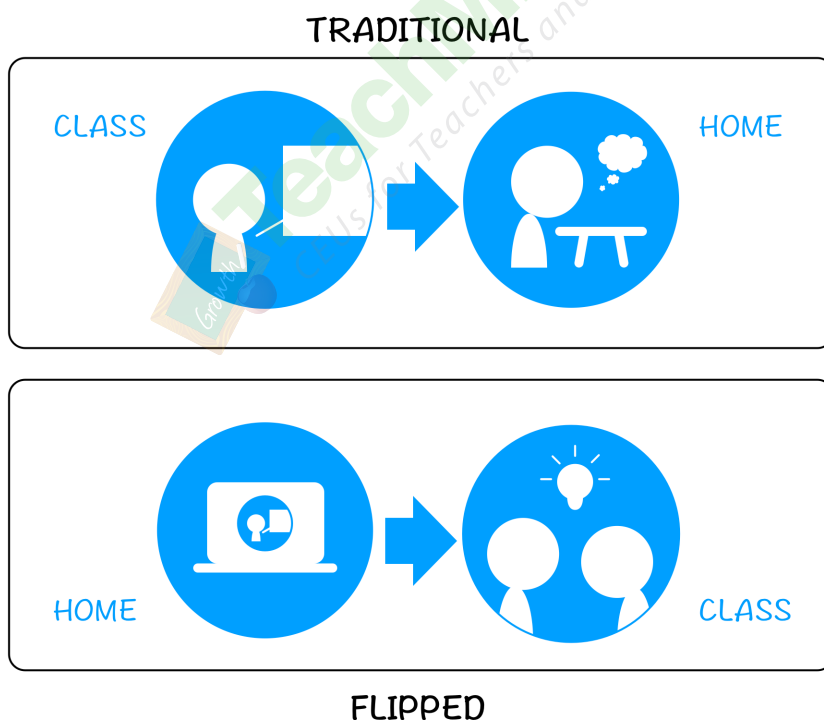
Blended learning “blends” online and face-to-face instruction. The Innosight Institute has defined blended learning as “a formal education program in which a student learns at least in part through online delivery of content and instruction [with] some element of student control over time, place, path, and/or pace AND at least in part at a supervised brick-and-mortar location away from home” (Staker & Horn, 2012, p. 3). Students might engage in online learning at a station within a classroom, in a computer lab at school,

or at home; they might engage in online learning as part of a class or take some courses online and others in a more traditional classroom setting (see Staker & Horn, 2012, for a taxonomy of blended learning models).

The Flipped Model of Blended Learning

The Flipped Learning Network—an organization dedicated to “providing educators with the knowledge, skills, and resources to successfully implement Flipped Learning”—hosts over 25,000 educators in its online learning community. The Flipped Learning Network has defined flipped learning (see Figure 1) as “a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter” (2014).¹ Started as a grassroots movement and capable of being implemented by individual teachers with minimal support (Bergmann & Sams, 2014; Horn & Staker, 2015), the flipped model has become increasingly popular in both university and K–12 settings. In a 2014 survey of 2,358 teachers conducted by Sophia Learning and the Flipped Learning Network, 78% of teachers reported flipping a lesson, and 93% of those who flipped their classroom did so on their own initiative (Sophia Learning & Flipped Learning Network, 2015).

Figure 1. Traditional and Flipped Classroom



¹ Here, direct instruction refers to a general teaching method often involving lectures or demonstrations by the teacher, rather than the more specific, highly interactive teaching method by the same name (for more information on this more specific instructional method, see the National Institute for Direct Instruction at <http://www.nifdi.org>).

Jon Bergmann and Aaron Sams, two chemistry teachers from Woodland Park High School in Colorado, are widely credited with developing and popularizing the flipped classroom, although others have also proposed inverting the traditional classroom—homework model (e.g., Lage, Platt, & Treglia, 2000; Mazur, 2009) and the model shares similarities with other mastery-based, student-centered approaches (e.g., Bloom, 1984). Bergmann and Sams observed that, because of sports and other activities, students were often missing classes, and teachers were spending substantial class time catching students up. Sams and Bergmann reasoned that instead of spending their time reteaching material for students who missed class, they could simply record their lectures and refer students to the videos. That proved successful, and students in their classes further extended the use of the videos for reviewing before exams. Sams further observed that students most needed him when they had difficulty with homework. Instead of using class time to lecture—which students clearly could get via a posted video—Bergmann and Sams decided to use class time to offer individualized help, thus giving rise to the flipped learning model (Bergmann & Sams, 2012). Others—perhaps most notably Saul Kahn and Kahn Academy—have helped to support and popularize this model. Rather than a top-down initiative or “best practice” recommended by researchers and mandated by school districts, flipped learning began with and has spread primarily among teachers—teachers who were looking for a way to more easily connect with their students, increase the value of class time, and spend more of their time with students really *teaching* and less time talking at them in “information delivery” mode (Bergmann & Sams, 2014).

Supporting Personalized Learning With a Flipped Model

The flipped learning model has great potential for supporting personalized learning: “instruction that is paced to learning needs,

tailored to learning preferences, and tailored to the specific interests of different learners” (U.S. Department of Education, 2010, p. 12). Personalized learning involves “tailoring learning for each student’s strengths, needs, and interests—including enabling student voice and choice in what,

how, when, and where they learn—to provide flexibility and supports to ensure mastery of the highest standards possible” (Patrick, Kennedy, & Powell, 2013, p. 4). In addition, “personalization refers to a teacher’s relationships with students and their families and the use of multiple instructional modes to scaffold each student’s learning and enhance the student’s motivation to learn and metacognitive, social, and emotional competencies to foster self-direction and achieve mastery of knowledge and skills” (Redding, 2013, p. 6).

Trying to incorporate personalization into a traditional teaching model in which teacher lecture or presentation consumes the majority of class time can be challenging. Content presentation to a whole class often does not allow for flexibility in learning pace, place, or method, and when class time is used for content presentation, less time is available for building relationships and focusing on metacognitive, social, and emotional competencies. The key question to consider when implementing a flipped model is: “What is the best use of face-to-face time with students?” (Bergmann & Sams, 2014, p. 3). The benefits of the flipped model lie in its usefulness for maximizing the value of teacher–student time. By modifying how class time is spent, the flipped learning model can support personalization in several ways:

● *Trying to incorporate personalization into a traditional teaching model in which teacher lecture or presentation consumes the majority of class time can be challenging.*

- a. The pace of content delivery can be adjusted for each student's needs because content is always available to be paused, considered, and reviewed.
- b. Teacher's expertise in both teaching and content—for example, assessing a student's current skills and knowledge and selecting targeted and appropriate practice opportunities based on that assessment—can be put to better use when more class time is free for individualized work.
- c. With more class time available, teachers can also engage in more one-on-one interactions with students, which can help teachers and students build relationships and help teachers gain a better sense of each individual student's interests, strengths, and areas needing improvement.
- d. Students have increased opportunities to actively engage in instructional content during class (Bergmann & Sams, 2012, 2014; Lage, Platt, & Treglia, 2000), and increased class time may also offer a greater opportunity for teachers to explicitly teach skills such as critical thinking, communication, and collaboration (Horn & Staker, 2015).

Fundamentally, flipping a class is a means to support student-centered learning and can help to enable individualized, differentiated, and personalized instruction as well as mastery and competency-based approaches (Bergmann & Sams, 2014).

The Teacher's Role in the Flipped Model

Much of the potential benefit of the flipped model centers on a shift in teacher roles. In a traditional model, the teacher delivers the majority of the content in class and may spend most of class time presenting information and modeling skills. In the flipped model, the teacher spends less class time delivering content and more time taking on the role of coach, tutor, and mentor. The teacher may also present content as needed and may create videos or other resources for students to engage in outside of class, but these activities are not central to the teacher's role. Instead, the teacher can spend time evaluating student work and providing feedback during class while the student is actively working (Bergmann & Sams, 2012)—activities that are often completed outside of class in a traditional model.

Flipped Models: Variations on a Theme

In flipped models, student learning activities and problem solving are central, with content playing a supporting role (Bergmann & Sams, 2012, 2014). However, there is not just one “flipped model.” Several variations exist which can be implemented in ways that best meet the needs of the teachers and students in a school or individual classroom.

Flipped Classroom 101 to Flipped Learning

Any flipped model implementation will lie on a continuum. At the most basic level, a teacher can flip a lesson by recording his or her in-class presentation and having students watch the video as homework. In class, students do the homework that they would have been assigned. This is what Bergmann & Sams (2014) refer to as “flipped classroom 101.” In their view, it serves as an entry point to class redesign and is where many teachers begin. However, this is just the first step in moving toward a flipped learning model that focuses on personalized learning and mastery.

In a “flipped learning” model focused on personalized learning, student projects and problem solving are central to the classroom-based learning experience. This shift in focus may also be accompanied by a shift in perspective, from projects serving as practice in applying the content covered in class, to projects serving as the driver for finding and consuming content: rather than applying content in a project as a means to learn and practice that content, students find information and learn concepts, principles, and processes in order to successfully solve a problem or complete a project. In this model, teacher-created content may no longer be the main source that students use to gain skills and knowledge. Although the teacher may provide a selection of resources, using specific resources may not be required; mastery is the goal, and students may select the best or preferred way to gain the necessary skills and knowledge (Bergmann & Sams, 2014).

A flipped classroom may lie anywhere between the flipped classroom 101 model and a fully personalized, mastery-based, project-centered classroom.

This shift in focus and perspective—from a content-centered classroom where projects serve as practice in applying the content learned, to a project-centered classroom where projects serve as the driver for finding and consuming content—can also be viewed in terms of Bloom’s taxonomy. In a content-centered classroom, students start by remembering information and understanding concepts and principles, then applying them to different situations and problems. In a problem-centered classroom, students focus on creating, evaluating, and analyzing. In doing so, they require knowledge and understanding of the fundamental concepts, principles, and procedures related to their work; students work at lower levels of Bloom’s taxonomy as needed to support their work at higher levels. This is a sort of just-in-time content learning to support problem-solving and project-based work (Bergmann & Sams, 2014).

A flipped classroom may lie anywhere between the flipped classroom 101 model and a fully personalized, mastery-based, project-centered classroom. In practice, classroom redesign that starts on the more basic side of the continuum may gradually move toward a more personalized model over a period of years as components supporting personalization are added.

Mastery Versus Time-Based Progression

Variations in flipped models can accommodate both traditional time-based instructional schedules and the more flexible schedules required by mastery learning. In a traditional time-based progression, all students move at the same pace but their outcome performances differ. In a mastery-based schedule, students acquire knowledge and skills at different rates, but each student is required to meet a minimum standard before moving on (Bloom, 1968, 1974). The flipped learning model described by Bergmann and Sams (2014) is a mastery model.

Flipped Lessons Versus Flipped Classes

Implementing a flipped model is not necessarily all or none. A teacher may decide to implement a flipped model as her standard class structure, but she might also flip her classroom only a few days a week or for particular units. A survey of 2,358 teachers conducted by Sophia Learning and the Flipped Learning Network (2015) found that, while only 5.4% flip their classroom every day, 20% flip three or four times per week, and 24% flip less than once per week.

Additional Benefits of the Flipped Model

As discussed above, the flipped model supports personalized learning by allowing students to work at their own pace and by freeing up class time which can then be used more effectively by teachers and by students. Additionally:

Students who need the most help can get the most help. In a typical lecture-style class, the best students are often the ones who participate most and therefore receive the most teacher attention. In a flipped model, struggling students will more likely receive the most teacher attention as they practice and apply what they have learned in class. Students who need help can get it, and all students have a greater opportunity (and necessity) to be actively involved during class (Bergmann & Bennett, 2013; Bergmann & Sams, 2012).

Students and teachers can get immediate feedback on their work. Rather than completing homework and then waiting a day or more for feedback, student work is evaluated in class. Teachers can probe understanding on the spot, diagnose student misconceptions, and recommend additional resources. If the student shows mastery, next steps can immediately be discussed and decided upon (Bergmann & Sams, 2012). Importantly, teachers also get immediate feedback on how well their explanations were understood by the student and can elaborate or modify their instruction accordingly. This two-way feedback for both students and teachers can have a powerful effect on learning (Hattie, 2009).

In a typical lecture-style class, the best students are often the ones who participate most and therefore receive the most teacher attention.

Students have more time for collaboration and interaction. With class time focused on student work, there may be more opportunity for student–student interaction and collaboration. Students who understand the content can also help those who are struggling (Bergmann & Sams, 2012).

Students can more easily predict and schedule their homework time. When homework focuses on applying what students have learned in class, that homework may require very little time and effort for some, while others may labor over it. Students (and teachers) may have difficulty predicting how much time will be required. However, when homework involves watching and taking notes on a video or interacting with instructional software, the variability in time spent should decrease and be easier to predict for both teachers and students. This predictability can be important for students who need to schedule their homework time around extracurricular activities, part-time jobs, and family obligations (Bergmann & Sams, 2014).

Students learn to take responsibility for their learning. In a flipped learning model incorporating mastery, students are required to master the content rather than simply get by. Instead of cramming for a quiz in order to get a good grade, students must work to truly understand concepts and principles in order to apply them to problems and projects. In essence, they need to take responsibility for their own learning. Taking on this responsibility can be frustrating for students who have previously focused on achieving the minimum academic requirements. However, when learning rather than getting a grade becomes the focus, it can serve students well in school and in their lives beyond school (Bergmann & Sams, 2012).

Students are required to learn time-management skills. In a flipped learning model incorporating mastery, students need to schedule their work so that they master the material in a reasonable amount of time. Time-management skills—when explicitly taught, supported, and practiced—can be an added benefit of a flipped learning model (Bergmann & Sams, 2012).

Individualization, differentiation, and personalization become possible. Individualization, differentiation, and personalization all refer to models in which instruction is modified based on the needs and/or preferences of learners. For example, in individualized instruction, the pace of learning may differ among learners. In differentiated instruction, the method of instruction might be tailored to learner preferences (for definitions of individualized, differentiated, and personalized instruction, see U.S. Department of Education, 2010). All flipped models involve some individualization (minimally, in terms of the pace of content delivery; Staker & Horn, 2012). In a flipped learning model, greater opportunities for personalization and differentiation exist. Where projects and problems are the central focus, students may have a choice of projects and how they learn the supporting content—by reading, watching presentations/demonstrations, working through interactive simulations or other educational software, or some combination of activities. Gifted students may choose advanced projects and content aligned with the learning goals and objectives (Siegle, 2014). And, because the teacher spends little class time delivering content, he has more time to respond to individual students. Students may work in collaboration with the teacher in determining how they will demonstrate mastery on an objective or set of objectives (Bergmann & Sams, 2012).

Students' repertoires are less likely to be incomplete. In a flipped learning model incorporating mastery, students must master a minimum number of skills at the designated level. This means that they should *not* have gaps in their skill sets that will make later learning more difficult—an important outcome in subjects like math, in which skills build upon one another.

At-home content delivery allows for family interaction. Where videos are used, a flipped model can increase parent participation in students' schoolwork and allow them to see what their child is learning. It even offers the opportunity to learn along with their child (Bergmann & Bennett, 2013; Bergmann & Sams, 2012, 2014). In Bergmann and Sams's (2014) *Flipped Learning*, a fifth-grade teacher tells a story about the parents of one of her students using the videos as a way to learn English.

Resource use can be optimized. The flipped model also offers the opportunity to make the most of resources. Since it is unlikely that all students will be working with the same materials at the same time, fewer materials may be needed. Additionally, because the teacher is no longer responsible for delivering all content, he can use his limited time for more frequent and more meaningful interactions with students. Given greater optimization of classroom resources and more time for the teacher's personal attention for each student, it may be tempting to increase class size under the flipped model. But larger classes may negate some of the benefits of this model; as the number of students increase, the resources and the teacher attention available to each child would necessarily decrease (Bergmann & Sams, 2012).

Some Criticisms, Drawbacks, and Challenges of the Flipped Model

Of course, just as there are benefits to the flipped model, there are criticisms, drawbacks, and challenges as well.

The flipped model relies on lecture-based teaching. One criticism of the flipped model is that it still relies on the lecture, an ineffective teaching tool (Ash, 2012). Although lectures and presentations do have a legitimate place in learning—particularly when they are short and well-structured and when students have the necessary experience, background knowledge, and motivation to learn from them (e.g., Schwartz & Bransford, 1998)—this is a valid criticism of courses based on lecture (see Freeman et al., 2014). However, this is not a fair criticism of the flipped model itself because the model does not require that students watch videos of lectures or demonstrations. The defining attribute of the flipped model is its concern for class time and how that class time is spent. Work outside of class may involve watching videos, but it may also involve reading or engaging with interactive instructional programs. In addition, while transitioning to a flipped model may involve recording lectures and having students watch them as homework, this may serve only as an initial step in modifying the class structure for flipped learning.

The defining attribute of the flipped model is its concern for class time and how that class time is spent.

Content delivery doesn't occur at an optimal time. Some research has shown a benefit of hands-on exploration activities prior to reading or listening to a lecture (e.g., Schwartz, Case, Oppezzo, & Chin, 2011). The flipped model seems to do the opposite—learners first engage with content and then work on projects or problems related to it (Plotnikoff, 2013). However, there is no inherent order to the model. Especially in the flipped learning models focused on mastery and centered in projects and problems, content delivery may happen whenever the need arises. That could very well be after the learner is already heavily involved in hands-on activities related to the content.

It makes the teacher less important. This concern may stem from the belief that content presentation is a teacher's main responsibility or method of teaching. The idea that technology might replace teachers may also feed into this concern (Tucker, 2012). However, in the flipped model, the teacher is even *more* important than in a traditional model because she is assessing every student's progress and providing individualized feedback and coaching. This mode of teaching requires a great deal more expertise in both course content and effective instructional methods than does traditional lecture-based teaching (November & Mull, 2012). At any given time, individual students may be at different levels of understanding and in different places within the curriculum. Therefore, the teacher must have mastery of the content sufficient to allow him to identify student misconceptions, offer explanations, and provide targeted problems or exercises to help each student move forward. Because in a flipped learning classroom this is done on the fly, a deep mastery of the material is necessary as the teacher moves from student to student, providing the feedback, explanations, and practice that each student needs at that time. In addition to content expertise, an effective teacher will need skills in identifying student misconceptions and errors, diagnosing why they might be occurring (for example, is it an issue with the current material being learned or an issue with a prerequisite skill not having been sufficiently mastered?), knowledge of instructional strategies sufficient

to choose a potentially effective method based on the reasons for the student error, and the ability to create or identify a probe to formatively assess whether what the teacher did resulted in improved student understanding.

The work to produce videos or other instructional content requires teachers to do too much work. Producing videos or other instructional content is a significant amount of work. It takes time and a certain comfort with technology to produce the content, and expertise in the pedagogical and instructional design skills to make the content interesting and effective for students. However, not every teacher needs to create all the content for her course. First, a great deal of content is already available online, so teachers can start by locating resources and building a content library. Second, teachers may team up to create content, or a few teachers who have a special interest and skill in producing content might create the majority of it. Finally, when beginning to implement a flipped model, teachers can start by flipping a few lessons or a unit and create new content over a few years rather than all at once. Students can also find and recommend sources that have helped them learn the content (November & Mull, 2012).

Not all students have Internet access. Although the majority of students (82.5% according to the 2013 American Community Survey; see Horrigan, 2015) have broadband access at home, this access varies by income. For example, almost a third of families who make less than \$50,000 per year lack high-speed Internet access at home. About 40% of all families in the United States with school-aged children fall into this category (Horrigan, 2015). Although this digital divide is a significant concern that impacts some out-of-class activities that rely on Internet access, such as interactive activities and simulations, alternative access—for example, videos burned to DVD or content loaded onto a flash drive or mobile device—can increase students' access. Students may also be able to access content before or after school or during study halls (Bergmann & Sams, 2012; November & Mull, 2012).

It adds unnecessary homework. For students who do not already have homework assignments, a flipped model may mean an increase in homework time. However, the amount of time spent will likely vary less across students than it does for traditional homework and therefore be easier to predict (Bergmann & Sams, 2014).

Students cannot ask questions while interacting with content. Some may be concerned that students are not able to ask questions in real time during out-of-class content delivery (Milman, 2012). However, students can write down their questions for discussion during the next class period. If the content is being delivered via a learning management system, a discussion board or other place for students to ask questions can also be set up (Bergmann & Sams, 2012).

Students and parents don't like it. Incorporating a flipped model will not magically turn students into eager, self-directed learners. In fact, transitioning from a traditional class structure to a flipped model can be a big and unwelcome change for students. A mastery model in particular can be challenging because it will likely require more work from students—not necessarily in terms of time, but in terms of effort. For those who are used to doing just enough to get by, this transition can be especially difficult. Because the teacher's role is likely to be very different from what students and parents are used to, some may also perceive the teacher as no longer teaching. However, building in time for students to adjust, incorporating explicit instruction and support in time-management

and metacognitive skills, and proactively providing parents with an explanation of and rationale for the new method can help change these perceptions and ease the transition for students (Bergmann & Sams, 2012, 2014).

Teacher Characteristics Necessary to Support a Flipped Learning Model

For teachers who are used to doing planned lectures and demonstrations during class time, implementing a flipped model will feel very different. It also may require new skills, as their classroom work is redirected from delivering content to spontaneously diagnosing and remediating student errors and misconceptions. Bergmann and Sams (2012) list four characteristics that teachers should have in order to implement a flipped mastery model: (a) content expertise that enables the teacher to quickly switch among topics and fully understand how the content is interconnected, (b) the ability to assist students at different levels of mastery and working on different learning objectives, (c) a willingness to research answers with students, and (d) a willingness to allow students to drive their own learning.

The last two characteristics—willingness to research answers with students and willingness to allow students to drive their own learning—might be summed up as “an attitude of inquiry.” In other words, the act of learning is the center of the classroom and the teacher and students take part in the learning activity together. The teacher doesn’t view himself or herself as a disseminator of knowledge, but rather a partner and guide in the learning process. This attitude of inquiry can be extended to the teaching practice itself: questioning, learning about, and trying out new instructional methods and evaluating the effects of those methods will help ensure that teachers are continually improving upon their teaching processes.

Effectiveness of the Flipped Model

The flipped learning model seems to have the potential to support personalization and increase student learning and motivation—but is it effective? That is a difficult question to answer. And—perhaps—not the right question to ask. Research on this model is just beginning, and much of the research done thus far has focused on university rather than K–12 settings. Although some case studies have shown promising outcomes (Bormann, 2014; Hamdan, McKnight, McKnight, & Arfstrom, 2013), many studies have failed to show significant achievement gains over a traditional model. Bormann (2014) reviewed 19 studies investigating the flipped model and found that most studies did *not* find significant differences in student achievement. However, implementations differ among studies, as do differences between the flipped and non-flipped classes being compared. Because the flipped model is not a single “thing” with a standard implementation, it is difficult to draw conclusions from the research conducted thus far.

Does this mean the model shouldn’t be implemented? Not necessarily. Three considerations are important for determining whether this model is worth trying in a specific classroom or school.

First, instead of asking whether this model—in general and across all its many variations—is “effective” (however that is defined), ask whether or not it might be an effective model for meeting specific goals. What is the desired outcome? Increased student achievement? Increased student engagement? Increased teacher satisfaction? More opportunities for students to engage in higher level learning activities—problem solving, analyzing, evaluating, and creating?

Second, it is important to consider the development process used when first employing the model. It's unrealistic to expect that a first attempt at implementing a new model will be successful without planning for considerable change and fine-tuning based on what works well and what doesn't work in a particular context. Flipping a lesson or a unit in a class can serve as a useful start to examining how students respond to the model, where it should be modified and how, and whether student achievement and/or motivation is affected.

Finally, will the flipped classroom improve some fundamental aspect of teaching and learning? There is nothing magical about the flipped model itself, only what the flipped model allows teachers and students to do that they could not do in a more traditional model. For example, to what extent do current in-class activities include components that increase learning and motivation? If not at an optimal level, what could be added, changed, or removed in order to increase these components? Is the flipped model a tool that would allow teachers to more easily make some of these changes? If a teaching model already affords active and meaningful student learning and quality interactions among students and between students and the teacher, then the flipped model may not add anything new.

For example, Jensen, Kummer, and Godoy (2015) compared a flipped model to a non-flipped model. In the non-flipped model, students learned basic concepts and principles in class and did application exercises outside of class. In the flipped model, students did the reverse: They learned the concepts initially outside of class, and then worked on applying those concepts during class. The results showed no difference between the flipped and non-flipped versions on unit posttests. However, when looking at how the actual learning activities differed between the two models, one would probably not expect any difference. Both versions used a 5-E learning cycle with the following five phases:

- 1. Engage:** Students are introduced to the material in a way meant to spark their interest—for example, by presenting a puzzling phenomenon.
- 2. Explore:** Students can freely explore the material by looking for patterns and making hypotheses.
- 3. Explain:** The instructor introduces terminology for the concepts that students have been exploring.
- 4. Elaborate:** Students apply these concepts to novel situations.
- 5. Evaluate:** Students' understanding of concepts is evaluated by formative and summative assessments.

In the non-flipped version, students went through the *engage* and *explore* phases in small groups using a structured guide to assist them in looking for patterns, making hypotheses, and analyzing data. Because both the instructor and teaching assistants facilitated these phases, students received immediate and individualized feedback. Rather than a lecture typical of a traditional teaching model, the *explain* phase was interspersed in the small-group work and involved brief, whole-class discussions clarifying concepts and introducing terms. The *elaborate* phase involved solving novel problems as homework.

The flipped version involved online, individual work during the *engage* and *explore* phases. Students were still encouraged to find patterns, make hypotheses, and analyze data; however, they were unable to discuss with others or work directly with materials. Instead, they watched a video of someone else working with the materials. They did

receive immediate feedback online after answering questions. In class, the instructor first answered questions students had from the homework; then, the *elaborate* phase was completed in class, with students working in small groups to apply the concepts to novel situations. The instructor and teaching assistants were available to interact with students and provide immediate feedback during this time.

The only difference between the flipped and non-flipped versions in this study was whether students initially encountered the concepts outside of class or in class. Both versions seemed to be rich in opportunities for active learning and in interactions with the instructor and other students, but one could argue that the flipped version was less rich because the students lost the opportunity for initial exploration and discussion of the material. Instead of exploring it themselves and engaging in discussion, they watched others working with the material and did not have the opportunity to engage in discussion. Given the argument that the flipped model has its advantage in freeing up class time to increase active student learning and engagement, there doesn't seem to be a strong argument for flipping a classroom already rich in these elements. Further, in this case, some interaction was even lost in the flipped model, as student interaction during the engage and explore phases was transformed into student observation.

This analysis is not meant as a criticism of this study. The authors were specifically attempting to control for active learning in both versions; therefore, this design was entirely appropriate for this purpose. However, this analysis is meant to illustrate that the potential benefit does not lie in the flipped model itself, but instead in the opportunity for increasing the quality of student interactions that we know can effectively raise student learning and engagement.

The Real Value of the Flipped Model

Asking whether a flipped model is or is not superior to a non-flipped model is the wrong question. Rather, will a flipped model allow a school or a class to more easily add components that support student learning and engagement? The flipped learning model may be beneficial to the extent that it allows for an increase in these components.

Although it is often portrayed as a model in which students watch lectures outside of class and do their homework during class, this characterization is unfair and doesn't take into account the model's many variations. The fundamental goal of the flipped model is simple: to maximize the value of student-teacher time. Perhaps the real value of the model is in encouraging teachers and administrators to think deeply about this issue and begin experimenting with class structure.

Action Principles for States, Districts, and Schools

Action Principles for States

- a. Provide resources for classroom redesign, including funding for design research, research dissemination, professional development, and resource development.
- b. Provide resources for conducting evaluations that capture outcome measures related to multiple success factors, including academic achievement, time management and self-regulation/metacognitive skills, student engagement and motivation, and teacher satisfaction.
- c. Establish goals and outcomes without mandating specific resources, technologies, or methods.

- d. Encourage local experimentation by individual districts and schools in order to reach goals. Celebrate success and support problem solving without punishing failures.
- e. Assist in dissemination of successes, best practices, and lessons learned across districts and schools.

Action Principles for Districts

- a. Offer professional development, coaching, and other resources to support teachers in employing effective practices—for example, how to design more effective instructional resources and learning activities, how to explicitly teach metacognitive skills, or how to diagnose and remediate student errors.
- b. Do not mandate specific technologies or methods. Provide resources, but allow teachers to experiment with what works best in their own classrooms.
- c. Compensate teachers fairly for redesigning their classes.
- d. Support experimentation and sharing of successes and failures. If goals have not been reached, assist schools in problem solving.
- e. Plan for implementation of the model to take several years. If a school is moving from a traditional model to a mastery-based model, this shift will likely involve a cultural shift for the school and a fundamental shift in how both teachers and students approach school and learning.

Action Principles for Schools

- a. Start small. Redesigning class structure is a years-long process, but a teacher can begin the process simply by flipping a single lesson or unit.
- b. Allow plenty of time for planning, design, implementation, and collaboration. Each day of in-class work needs to be planned carefully to result in optimal learning and engagement, and activities will need revisions and fine-tuning after they've been tried. Provide additional time for teachers to collaborate in designing their lessons and solving problems together.
- c. Assign a dedicated IT person to work directly with teachers on the technology and workflows required to more easily create and post learning resources.
- d. Proactively inform parents about the flipped model in order to ease concerns.
- e. Don't punish teachers for trying things that fail. Instead, work to develop a culture that supports experimentation and the open sharing of goals, successes, and failures with both administrators and fellow teachers.

Empowering Students as Partners in Learning

In 2011, Mid-continent Research for Education and Learning (now McREL International) was awarded an Institute of Education Sciences grant to develop and study a program aimed at building middle school mathematics teachers' knowledge and skills for implementing high-quality formative assessment. The foundation for the professional development program, Learning to Use Formative Assessment in Mathematics with the Assessment Work Sample Method (AWSM), was built on authentic samples of student work, because reviewing and discussing student work helps teachers shift from thinking of teaching as something teachers do to a focus on learning as something students do (e.g., Hattie, 2009). Through our evaluation of the program's impact, we learned that the formative assessment practices supported by AWSM improved the class culture and encouraged students to take more ownership of learning, and during this process, connections between personalized learning and the formative assessment process advocated by AWSM began to materialize. In this chapter, the comprehensive definition of personalized learning described in *Through the Student's Eyes: A Perspective on Personalized Learning* (Redding, 2013) most clearly reflects the focus group statements voiced by teachers in the study. Thus the description, "personalization ensues from the relationships among teachers and learners and the teacher's orchestration of multiple means for enhancing every aspect of each student's learning and development" (Redding, 2013, p. 6) is used. This chapter discusses the challenges to mathematics teaching and learning, the AWSM professional development program, focus group feedback, and how the formative assessment process connects to personalized learning.

Challenges to Middle School Mathematics Learning

In the transition to middle school and during the middle school years, students' motivation for mathematics tends to decline from what it was during elementary school. At this age, students report less valuing of mathematics and lower effort and persistence in math problem solving than reported by students in earlier grades (Pajares & Graham, 1999; Valas, 2001; Wigfield, Eccles, & Pintrich, 1996). Middle school students also report lower

confidence in their mathematics ability than before (Clarke, Roche, Cheeseman, & van der Schans, 2014; Pintrich & Schunk, 1996), influenced in part by exposure to a larger peer group with whom they begin to compare themselves. They also perceive more competition in the classroom environment and more rigorous standards for evaluation (Eccles & Midgley, 1989).

A review of national assessment results provides another perspective on mathematics learning. Mathematics results on the National Assessment of Educational Progress (NAEP) in both Grades 4 and 8 have shown significant progress since 1990, particularly for Grade 4 students. From 2000 to 2013, Grade 4 proficiency levels increased 18 percentage points, while Grade 8 proficiency levels in mathematics increased 10 points. In spite of these improvements, in 2013, NAEP results showed only 42% of Grade 4 students proficient in mathematics, with Grade 8 proficiency levels at 35%. This difference between the two grades' rates of mathematics proficiency contrasts to a near parity in proficiency levels in reading for Grade 4 and Grade 8, 35% and 36%, respectively (The Nation's Report Card, 2013).

The tendency to oversimplify tasks is especially true when teachers work with lower achieving students (Zohar, Degani, & Vaaknin, 2001).

How students perceive themselves as mathematics learners can have an effect on teaching and learning at the middle school level. Students who are not confident that they can solve complex problems or who do not see the point of putting forth effort to do so try to avoid those tasks or pressure teachers to make the work simpler for them (Clarke et al., 2014). This lack of self-efficacy is a predictor of, among other things, lower math achievement outcomes (Pajares & Graham, 1999), and some middle schoolers attempt to engage in math learning only when tangible rewards are offered (Rowan-Kenyon, Swan, & Creager, 2012).

In this environment, middle school mathematics teachers can feel discouraged from giving students challenging and complex work. If they do so anyway and students encounter difficulty, some teachers oversimplify the task or tell students how to solve it (Clarke et al., 2014; Ferguson, 2009). The tendency to oversimplify tasks is especially true when teachers work with lower achieving students (Zohar, Degani, & Vaaknin, 2001). However, the common core state standards and other contemporary U.S. math standards require that students be able to solve complex problems and to explain their reasoning, so teachers need strategies to support students in these practices.

Formative Assessment Strategies

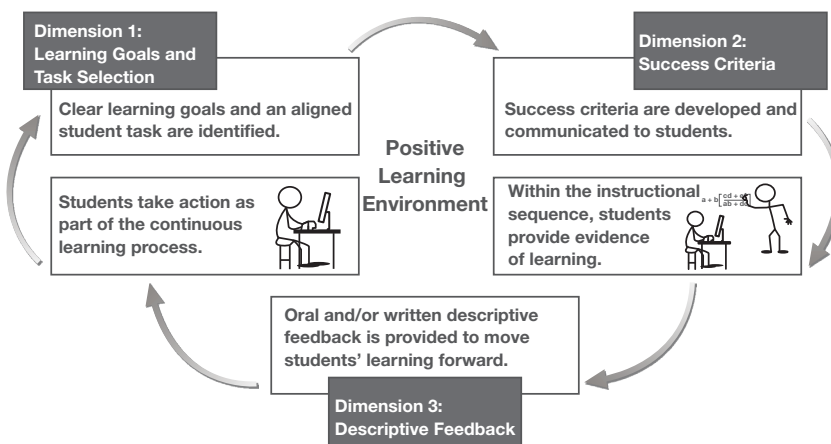
Formative assessment strategies can help students be more confident learners and can positively impact academic performance (Peterson & Siadat, 2009; Ruland, 2011; Wilson, 2009). Formative assessment is an evidence-based process of gathering information on three questions—(a) Where am I going? (b) How am I doing now? and (c) Where do I go next?—to support a learning cycle (Hattie & Timperley, 2007; Sadler, 1989). Therefore, the most important formative assessment practices involve (a) students' understanding of their learning target, (b) the criteria by which they will know how they are doing in achieving that target, and (c) the feedback they receive to help them understand next steps. Literature supports prioritizing these three dimensions of formative assessment.

The Assessment Work Sample Method Program

The Assessment Work Sample Method (AWSM) is a professional development program that builds middle school math teachers' understanding of the characteristics of high-quality formative assessment and increases their ability to use it. We were inspired to create AWSM following the results from previous research (Randel et al., 2011) on a program that did not change teacher practice in mathematics in part because it had few math examples. By contrast, AWSM provides professional development that builds formative assessment practices and skills specifically in math. The AWSM approach, adapted from a language arts study (Clare, Valdés, Pascal, & Steinberg, 2001; Matsu-mura et al., 2006), incorporates authentic student work samples that help ground teacher learning in daily practice. The work samples include a cover sheet that conveys the teacher's intended learning goals for the lesson, the type of student knowledge or skill to be developed, the criteria for meeting learning goals, and general information that will help reviewers understand the "what and why" of the assignment. Attached to the cover sheet are four pieces of student work, two pieces of work that met the teacher's intended learning goals and two pieces of student work that did not meet the intended learning goals. Professional development participants refine their understanding and skill for implementing formative assessment as they discuss these work samples, recommend revisions to improve the work sample, and connect the work sample to their own instructional practice.

The AWSM professional development is structured around nine face-to-face meetings, which include a two-day introductory workshop and eight sessions of about 45 minutes each. During part one of the introductory workshop, participants build their understanding of formative assessment as an instructional process. The connection of formative assessment to personalized learning begins to unfold as participants discuss why and how to create a positive classroom culture. They compare a growth-oriented mindset, the belief that intelligence can be developed (Dweck, 2006), to a fixed mindset, the belief that intelligence is static, and discuss implications for student perseverance on complex tasks. Participants also learn about the physical, social, and emotional factors that impact classroom culture. Figure 1 depicts the three AWSM dimensions with positive learning environment at the center.

Figure 1. AWSM Dimensions



In part two of the workshop, participants plan to implement formative assessment by examining authentic student work because it is in student work that student thinking is made visible (e.g., Hattie, 2009). In collaborative groups, teachers analyze the intended learning goals, success criteria, and student tasks from anonymous work samples to determine if these lesson elements are strongly aligned, partially aligned, or weakly aligned. Mathematical content as well as the inferred cognitive demand of both the learning goal and student task are reviewed and discussed. Through this analysis, participants clarify their understanding of AWSM Dimension 1 (learning goals and aligned student task) and Dimension 2 (success criteria; see Figure 1). These dimensions are considered the foundation for the formative assessment process because without clarity about what is to be learned and clear criteria for goal attainment, the feedback process can be derailed. Figure 2 is an excerpt from a work sample used in AWSM. It shows part of the teacher's cover sheet, the formative task, and one piece of student work.

Figure 2. Work Sample Used in AWSM

Teacher Cover Sheet

5. What were your learning goals for the students for this assignment? In other words, what skills, concepts, or facts did you want students to learn, practice or demonstrate understanding of as a result of completing this assignment? (Students will know and understand that: ...)

I wanted students to demonstrate an understanding of unit rates and be able to calculate unit rates fluently ... or be able to make comparisons when the rates were not the same.

6. Check the type of learning goal/target this assignment addresses (check all that apply):

- Knowledge (facts/details to be memorized)
- Skill (algorithmic procedures)
- Conceptual Understanding (reasoning, generalizing, explaining, etc.)
- Problem Solving within a Context (multiple procedures; solution strategy)

11. a. How was this assignment assessed? If there is a rubric, student reflection, etc., please attach it. If you are not attaching a rubric, please explain your criteria for determining if students met the learning goal of the assignment.

The rubric is attached (on back of assignment) and shows the assignment is worth a total of 5 points (which I doubled and told the students I would do ahead of time).

11. b. Did you share these criteria with the students? Yes No

3	2	1
Student shows an accurate comparison of costs of coffee pods at each of the three stores by calculating unit rates or other common ratios.	Student shows an accurate comparison of costs of coffee at two of the three stores by calculating unit rates or other common ratios.	Student calculates only one correct unit rate or common ratio.
	Student gives a clear written explanation for where the coffee should be purchased.	Student gives an unclear (or incorrect) written explanation for where the coffee should be purchased.

Formative Task

Mrs. H always tries to find the best deals in town before making purchases, especially when it comes to coffee (because she buys and drinks a lot of it)! She shops at several stores around Denver, including Bed, Bath, and Beyond, Safeway, and Costco. As she stops by each of these three stores this weekend, she takes note of the prices they are currently charging for pods of French Vanilla Coffee. Safeway is currently carrying her favorite brand in a box that comes with 12 pods for \$9.12. Bed, Bath, and Beyond is selling the same brand, but their box is slightly larger (comes with 18 pods) and costs \$14.04. Finally, she notices that Costco is also selling that brand and comes in a much larger box with 32 pods for a cost of \$24.00. Where should Mrs. H buy the coffee and get the best deal in town? Please show your work and explain your thinking in the space below. You must give a mathematical and written explanation to convince Mrs. H.

Student work

Safeway ~ $\frac{9.12}{12 \text{ pods}} = \frac{x}{1 \text{ pod}}$

$$12 \overline{) 9.12} \begin{array}{r} .76 \\ \underline{84} \\ 72 \\ \underline{72} \\ 0 \end{array}$$

$x = \frac{.76}{1 \text{ pod}}$

B, B, B ~ $\frac{14.04}{18 \text{ pods}} = \frac{x}{1 \text{ pod}}$

$$18 \overline{) 14.04} \begin{array}{r} .78 \\ \underline{126} \\ 144 \\ \underline{144} \\ 0 \end{array}$$

$x = \frac{.78}{1 \text{ pod}}$

Costco ~ $\frac{24.00}{32 \text{ pods}} = \frac{x}{1 \text{ pod}}$

$$32 \overline{) 24.00} \begin{array}{r} .75 \\ \underline{224} \\ 160 \\ \underline{160} \\ 0 \end{array}$$

Way to go!
All of your calculations are correct, and your explanation is very clear 😊

Costco
I think Costco is the best place to buy coffee because it is the cheapest for one pod. At Safeway it is .76 for one pod. At Bed, Bath, and Beyond it is .78 for one pod. Costco is the cheapest because it's only .75 for one pod - 3¢ less than Bed, Bath, and Beyond and 1¢ less than Safeway.

The eight short sessions are organized as teacher learning communities (TLCs) with a facilitator who has both mathematics and formative assessment expertise. The first five sessions focus on Dimension 3 (descriptive feedback), and are structured to build teacher knowledge and skill for providing effective oral and written feedback to students. Participants learn that

feedback should be based on stated learning goals and success criteria established in Dimensions 1 and 2 and that general statements, such as, “Good job” or “Work harder,” do little to move student learning forward. Teachers also learn to resist providing student feedback which is too specific. At times, mathematics teachers provide step-by-step notations on how to correct an inaccurate solution. Unfortunately, this practice keeps the responsibility for learning with the teacher rather than with the student, whereas providing feedback that uses cues (“Remember our work with similar figures.”), questions (“How do you know the area is equivalent?”), and recommendations for next steps (“Check your notes from Tuesday.”) helps students determine next-step actions and thus take more responsibility for their own learning.

In Dimension 3, teachers also learn that students should be active partners in the feedback process, and it is through this process that the self-directed aspect of personalization is incorporated. It’s important to note that Dimension 3 is dependent on the clarity of criteria developed in Dimensions 1 and 2. These dimensions help teachers craft lessons that demonstrate clear alignment between the learning goal, student task, and success criteria, and this criteria is explicitly communicated to students. In Dimension 3, students gauge their own progress toward the learning goal by participating in peer- and self-assessment activities using the criteria developed in Dimension 2. Participants in AWSM implement peer- and self-assessment practices through an incremental process beginning with whole class activities, partner activities, and self-assessment activities. In the whole group activities, students compare a sample of work from an anonymous student to a set of criteria. Through discussion of the work sample, students begin to identify student work that meets or does not meet a set of criteria. As students develop skill for assessing work based on criteria, they participate in peer-assessment (feedback) activities. These activities tend to begin with identifying the presence or absence of criteria and then progress toward assessing a peer’s work for solution accuracy and quality of student response. In each case, student assessors identify both strengths and recommendations for improvement based on established criteria. Teachers monitor this process and use whole group debriefing activities to make sure students receive accurate feedback from peers. This process is designed with the ultimate goal of empowering students to objectively assess their own work based on a set of criteria so that they can monitor and adjust their own learning strategies to reach intended learning goals.

During the last three short sessions, AWSM participants bring work samples from their own students to share with colleagues. These TLC sessions offer a safe environment for teachers to discuss problems of practice and refine their own implementation of formative assessment.

Connections to Personalized Learning

Although AWSM was not intended to study personalization per se, comments from teachers during focus groups revealed a connection between the strategies espoused by AWSM and aspects of personalized learning. For example, teachers noted that classroom culture, particularly teacher–student relationships and student–student interactions, were more positive as implementation of formative assessment strategies became the norm. They also made comments that align with the personal competencies (cognitive, metacognitive, motivational, and social/emotional) described in *Through the Student’s Eyes: A Perspective on Personalized Learning* (Redding, 2013). In focus groups, teachers reported that students responded to formative assessment strategies with increased motivation, engagement, and persistence in math. Teachers reported that clearly

communicated learning goals and success criteria helped clarify their teaching and let students know what they should expect to learn. Furthermore, having clear learning goals and success criteria facilitated communication with students and parents, thus strengthening teacher–student–family relationships. Teachers indicated that formative assessment data helped them plan activities for students at various levels of mastery.

Teachers reported that engaging students in peer- and self-assessment activities increased student awareness of success criteria and developed a heightened sense of individual accountability for learning. For example, teachers gave students tracking sheets with success criteria to use in self-assessing their level of understanding relative to the learning goal so they could monitor their progress. One teacher said, “They’ll start on what they know, but then they actually take ownership of saying, ‘Oh, I haven’t mastered this.’ And then they start testing their own learning.”

At most schools, teachers said they were using peer assessment extensively. They described having students partner to discuss their approaches to homework problems or to go over in-class activities. One teacher commented that this technique made it easier for students to get help when they were reluctant to seek help from the teacher. Some teachers were initially concerned that students would be unkind to one another during peer feedback, and this turned out to be a problem when peer feedback was given in written, anonymous form.

...having clear learning goals and success criteria facilitated communication with students and parents, thus strengthening teacher–student–family relationships.

However, when teachers then tried structured, face-to-face peer assessment, it worked well: “I find when they verbally [provide] feedback to their peer, they’re much nicer, it’s more constructive, and it’s actually a lot more helpful.” When students gained experience with peer assessment, they participated in productive social interactions, and as student interactions progressed, teachers were more willing to reorganize classroom configurations and use flexible grouping strategies. More effective use of formative data also allowed teachers to differentiate student assignments so that students were assigned tasks specific to their learning needs, thus resulting in a more personalized learning experience for students.

Teachers in the AWSM study reported the same problems with student motivation for math (difficulty with engagement and persistence, especially with challenging problems) as reported by other teachers in the literature. Their students also were reluctant to be wrong, to show work, and to do work that was ungraded. The AWSM professional development program emphasized the role of class culture for a growth mindset and de-emphasized accurate solutions as the only measure of progress in mathematics. It helped teachers clarify learning goals and the criteria by which student progress would be measured. Additionally, it helped personalize learning through differentiated activities and empowered students to become partners in learning. At the conclusion of the study, participants shared some thoughts on the AWSM process:

- “I used to think formative assessment was about the teacher knowing where students are in the learning process. Now I know that formative assessment must include students so that they understand how to improve their own learning.”
- “I used to think I had to grade everything. Now I know I can provide descriptive feedback and allow students to take action.”

- “It’s the dimensions of clear learning goals and success criteria that have most impacted my instruction. I think I was always clear about what was being learned, but I needed to be more explicit about sharing this information with my students.”

AWSM investigators considering the next steps for this work intend to include more direct connections to the personal competencies of student cognition, motivation, and perseverance.





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