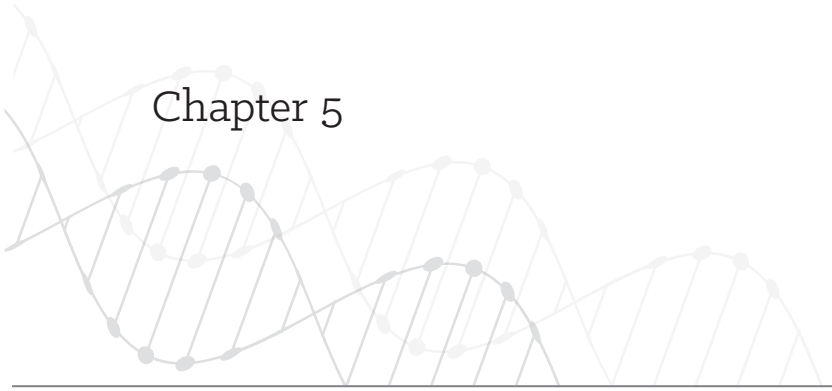

Chapter 5

Defining Enhancement

EDUCATORS OFTEN ASSERT that new or innovative technology tools enhance their students' learning. Yet, in reality it is unclear whether this assertion is true (Price & Kirkwood, 2010). One problem is that the term "enhancement" has not been clearly defined in its relation to education technology. Linda Price and Adrian Kirkwood (2010) describe the difficulty with defining the term as follows:

> Technology-enhanced learning implies a value judgment: the word "enhancement" suggests an improvement or betterment some way. However, it is rare to find explicit statements about its meaning. How does technology enhance learning—what is the "value added?" Although there are many examples of innovative uses of technology in learning and teaching it is not clear whether these actually enhance student learning. More readily observed is the use of technology to support or replace existing teaching practices, with limited evidence to confirm any enhancements to the status quo. To date there has been an over-emphasis on technological manifestations and this has led to the omission of pedagogical considerations (Beetham, 2007; Conole et al., 2008; Kirkwood, 2009). (p.771)

Knowing that terms can easily be tossed around, it is important that enhancement of learning through technology tools has a measurable definition. This chapter highlights some practical ways to define the characteristics of enhancement when it comes to integrating technology tools with learning.

Adding Value

One essential aspect of measuring enhancement is focusing on the value added in content-specific learning goals. Many content-area experts agree that technology should move beyond engaging students in learning and actually change the learning experience so that it is improved over traditional methods (and not just an expensive substitution). One such example is the Technology Principle from the National Council for Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics, which states, "Teachers should use technology to enhance their students' learning opportunities by selecting or creating mathematical tasks that take advantage of what technology can do efficiently and well—graphing, visualizing, and computing" (NCTM, 2000, p. 25). Price and Kirkwood (2014) found that "enhancement" could be defined under three types of improvement on traditional teaching methods: operational improvement (e.g., providing greater flexibility for students or making resources more accessible); quantitative change in learning (e.g., increased time-on-task or student improvement in test scores); and qualitative

change in learning (e.g., promoting reflection on learning and practice or helping develop a richer understanding of content).

Experts in the four major content areas (social studies, ELA, math, and science) seem to agree that opportunities for *operational improvement* by building knowledge based on students' prior knowledge, skills, and interests is important for better comprehension of the content (NCSS, 2016; National Council of Science, 2007; Anthony & Walshaw, 2009; Duke & Pearson, 2002). Consequently, technology should support opportunities to leverage students' skills and interests into content learning. Examples of this would be integrating technology tools that help to either differentiate or personalize instruction to add value to learning. In addition, content experts call for integrating technology tools that allow students to develop a more sophisticated understanding of the content by eliciting higher-order thinking skills, such as inquiry and reflection (NCSS, 2016; National Council of Science, 2007; Anthony & Walshaw, 2009; Duke & Pearson, 2002). An example of this would be students testing their own scientific hypothesis by engaging with Google Earth's Timelapse and Layers features to analyze and gather evidence of what environmental change looks like over time and ask questions about why it is happening.

Scaffolds and Supports to Deepen Learning

Technology should create opportunities for students to move beyond engagement with content; that is, technology should somehow aid, assist, or scaffold students' learning in ways that improve on traditional methods. At this level, learning can become differentiated, personalized, and more relatable to the learner and the technology is helping students think more deeply about content with higher-cognitive skills.

The Triple E Framework defines enhancement as technology adding value to students' traditional understanding of learning goals through scaffolds or other supports. The technology or tool:

- supports students in *developing a more sophisticated understanding* of the content (higher-order thinking skills);

- creates ways *(scaffolds)* to make it easier to understand concepts or ideas;
- and creates paths for students to *demonstrate their understanding of the learning goals* in a way that they could not do with traditional tools.

A Look at Tools That Promote Enhancement

Table 5.1 lists possible instructional strategies to use when features of enhancement are organically part of the tool. One example is software that differentiates the same content based on reading levels to allow students to read the same content as their peers but at their "just right" reading level. Table 5.1 also lists strategies teachers can use to create enhancement around the use of the technology tool when enhancement is not present within the tool. For example, students working with a "drill and practice" piece of software could be given a checklist of higher-level probing questions to stop and ask each other as they work.

Table 5.1 Enhancement Take-Away Strategies

Characteristic of Enhancement	When Instructional Strategies for Enhancement Are Built into Tool	When Instructional Strategies for Enhancement Are NOT Built into Tool
Scaffolds to reach more sophisticated understanding through higher-order thinking	Opportunities exist for inquiry learning, to investigate an idea, collect data, and show understanding. Tool has built-in ways for students to reflect (and use higher-order thinking) on what they are doing on the device, not just consume knowledge.	Students participate in classroom discussions or turn-and-talks to construct hypotheses and new ideas from what they are learning through the tool. Students practice reflective thinking strategies and self-questioning. Tool allows visual representations of thinking (graphic organizer).

Characteristic of Enhancement	When Instructional Strategies for Enhancement Are Built into Tool	When Instructional Strategies for Enhancement Are NOT Built into Tool
Added value beyond traditional tools (differentiation and personalization)	The technology allows teachers to easily differentiate learning (e.g., assign students to reading level groups, allow students to get synchronized individual feedback based on their mathematical problem-solving). The technology allows teachers to personalize learning for each student's interests (e.g., students can choose to pursue a problem based on their interests, students can choose a way to share their knowledge based on their skills).	Teachers give students checklists or support sheets based on their learning level. Teachers assign students to work in similar interest teams around the technology. Students can select "just right" tools. Tool allows students a choice in how to represent their work.

Note: Strategies for "outside of the tool" are explained in detail in Chapter 9.

As mentioned in previous chapters, most educational technology is not built with educational experts or research in mind. However, there are some tools that promote enhancement. Table 5.2 includes a few examples of technology tools that have enhancement characteristics organically built into the tool.

Table 5.2 Technology Tools That Promote Enhancement

Name of Tool	Value-Added Supports or Scaffolds	Advantages over Traditional Tools	Content Area	Cost
Classkick & Formative	Both apps allow teachers to set up activities for students and synchronously watch and participate in learning activities with students. Activities can be set up based on student learning or interest levels.	Teachers can vary activities in the classroom for students based on learning levels, and they can watch and participate in real time as students are working.	ALL	Free

Continued

Name of Tool	Value-Added Supports or Scaffolds	Advantages over Traditional Tools	Content Area	Cost
Kaizena (kaizena.com)	Website provides synchronous editing and feedback between students and teachers, and allows real-time collaboration on documents, writing, and research. Feedback can be created via text, audio recording, video, and/or links.	Feedback is real time so students can revise their work as they are involved in the writing process. Teachers can easily differentiate instruction and type of feedback with this tool.	ALL	Free
Imagistory	An early literacy app set up for children to co-construct a story with others based on images and audio.	Young children work together to build and record a story. They are able to easily listen to an audio recording of themselves telling their story aloud.	ELA	Free
Google My Maps	A mapping tool where students co-construct maps in real time. Students can work with others to add video, images, points of interest, and more to their interactive maps.	Students are able to easily co-construct a map that can be modified or updated based on real events, people, or places. They also can share the map with others and edit anytime!	ALL	Free
TweenTribune (tweentribune.com)	Articles posted by the Smithsonian are differentiated based on students' reading Lexile levels.	The technology allows for easy differentiation of the same content.	ELA	Free

Scenarios of Enhancement

Here are three questions, developed as part of the Triple E Framework, to ask when measuring for enhancement of learning through technology tools.

1. Does the technology tool aid students in developing a more sophisticated understanding of the content (higher-order thinking skills)?
2. Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?
3. Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional tools?

Using the three questions, consider if enhancement is present in each scenario.

Scenario 1

A second-grade teacher presenting a unit on ecosystems gives student pairs iPads that are preloaded with software for exploring various ecosystems in 3D. The software uses authentic images and live webcams from real ecosystems around the world, allowing students to click and tap on animals and plants in the ecosystems to learn more about them. The software also has a recorded notebook feature that lets students audio record oral observations, paste in images from the software, or type their scientific observations.

Learning Goal: *Students will develop a hypothesis around what types of plants and animals live in different ecosystems and record their hypothesis with evidence to corroborate their thoughts.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   Yes. Since the software can explore authentic ecosystems as students tap and swipe on plants and animals, it allows them to personalize their learning experiences according to their interests in the ecosystems. They can also record and reflect (using higher-order thinking) on their observations based on live webcam feed.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   Somewhat. Since the software allows students to explore authentic ecosystems as they tap and swipe on plants and animals (and view the live webcam), it provides them with a better understanding than what they might get from simply looking at a picture in a textbook. It would be even better if there were pre-defined probing questions built into recording pieces to support their reflective thinking.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   Somewhat. The scientific notebook feature allows students to record their observations in a way that is comfortable for them and possibly even copy, paste, and organize data. This could be done with more traditional pen/paper but would probably take longer and be less sophisticated in organization. The live webcams do allow students to observe authentic ecosystems rather than relying on videos or images.

Scenario 2

A teacher asks students to use math software on individual desktop computers. The software allows the teacher to program differentiated learning paths for each student so that when they log in, they are working in their individual zones of proximal development (ZPD). The software uses simulations and videos with short-answer explanations rather than "drill and practice" questions, and it lets the teacher provide immediate feedback (synchronously) as students take different assessments in a game-like format.

Learning Goal: *Students will be able to show their understanding of how to calculate the surface area and perimeter of geometry shapes by participating in mathematical assessment of geometric figures.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   No. While the software can differentiate learning, the students are only using "drill and practice" skills and lower-order thinking. They are not

being asked to use analysis, synthesis, creation, or other higher-order cognitive skills.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   Somewhat. The software gives immediate feedback in the form of hints and tips on how to solve the problems, and it differentiates the learning for each student based on their ZPD. However, it would be different for students to generate their own ideas in this "drill and practice" software.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   Yes. It would be very difficult and time-consuming for a teacher to give immediate feedback in a classroom where students are all working on differentiated lessons in their ZPD.

Scenario 3

A social studies teacher is conducting a lecture by projecting a slideshow on static presentation software. The lecture is on visual inquiry, and the students are listening to and watching the presentation without technology in their hands; only the teacher is using technology.

Learning Goal: *Students will understand how to do visual inquiry on images from the Revolutionary War time period. They will be able to understand the skill of visual inquiry and apply inquiry to any image.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   Somewhat. The presentation tools include sharing options for multimedia (such as images or videos) that could help students understand the content better than using a textbook. However, the students are not being asked to engage in higher-order thinking through the technology tools. The teacher could structure a discussion that elicits inquiry questions and reflections on the content.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   Somewhat. The presentation tools include sharing options for multimedia (such as images or videos) that could help students understand the content better than using a textbook. But it would be difficult to differentiate or personalize content for each learner through one static slideshow.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   No. Students can take notes with paper and pencil during the lecture. But because they are not hands-on with the presentation technology, they cannot demonstrate their understanding in a nontraditional way.

Scenario 4

A kindergarten teacher focusing on early literacy goals of writing capital letters has each student come up to the interactive whiteboard to trace letters with the whiteboard pens.

Learning Goal: *Students will be able to recognize letters and properly write capital letters.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   Somewhat. The whiteboard tool allows students to trace specific patterns of letters and watch others do it with potential feedback, but this could be done on a regular whiteboard or blackboard rather than an interactive whiteboard. Students are not being asked to engage in reflective or creative practices through the tool itself.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   No. This could be done with paper and pencil or on a blackboard. If the teacher changed the tracing experience to meet each student's writing level, then that might better meet this learning target.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   No. This could be done with paper and pencil and may be better that way because a finger or marker is not as easy to use as a traditional pencil for students learning to write.

Scenario 5

A social studies and mathematics teacher has students working in pairs to use a website that is tracking the live primary election results. The students are posting their predictions into a Google Sheets collaborative spreadsheet to share what they think will happen in the next hours of voting based on the real-time voting results. The students then set up the spreadsheet equation editor to calculate how far off their predictions were as the live results come in.

Learning Goal: *Students will be able to understand how to make predictions in mathematics.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   Yes. Because the website is real time, they can see immediately how the results are changing minute by minute. In addition, they are asked to use the numbers to create math expressions for prediction. Thus, there are higher-order thinking skills occurring through the tools.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   Yes. The website gives authentic and immediate results, which allows students to see results in real time. It also allows students to personalize their predictions by selecting particular candidates to follow or counties for results.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   Yes. It would be almost impossible for students to track real-time election results without the technology tools.

Scenario 6

An English teacher asks students to use a static ebook app on their iPads that explains how to write a five-paragraph essay. Each student has his or her own iPad and swipes through after reading each page. When students finish, they get their name on top of a leaderboard if they finish reading in under 15 minutes. Then the students start working on their five-paragraph essay (using pen and paper).

Learning Goal: *Students will learn how to write a five-paragraph essay.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   No. The ebook is not interactive, it's just a story, so students could have learned the same from the teacher lecturing. It is also easy for the students to skip content by swiping through quickly without reading. Since it is timed, students are likely to swipe quickly so they can get to the top of the leaderboard, but this often means content may be missed. Students are not being asked to use higher-cognitive skills through the tool.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   No. Because the content is static and not "clickable," it may actually be more useful if the students learned from their teacher and saw examples while pausing for questions.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   No. The teacher could easily lecture about a five-paragraph essay and do checks for understanding face to face.

Scenario 7

A fifth-grade teacher focusing on multiplying fractions asks students to each use interactive screencasting software on an iPad to show how they solve a problem. Students can record their own screens as they solve the math problem, and they can use the text and drawing tools simultaneously to show their mathematical thinking behind each step. The recording is sent to the teacher.

Learning Goal: *Students will understand how to multiply fractions and show their work.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   Yes. It allows students to create, show, and talk through their mathematical solutions while their work is recorded for the teacher to see and evaluate. The tool asks students to use higher-order thinking skills. They can also re-record.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   Somewhat. The software is not set up to make things easier or to differentiate for mathematics, but students do have a variety of drawing tools to choose from to demonstrate what they know.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   Yes. It would be very difficult to do this with traditional tools and record student thinking in this way. In addition, it would also be time-consuming for the teacher to individually sit down with each student and ask about their mathematical thinking.

Scenario 8

A ninth-grade English teacher studying memoirs and personal biographies asks each student to text message a six-word memoir and a short biography to an interactive website. The text messages are displayed anonymously on a website that the teacher projects.

Learning Goal: *Students will understand the difference between a memoir and biography by sharing examples of their own.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   No. Students are just sharing their memoirs.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   Somewhat. The technology makes it easier to share all the memoirs at once and archive them, but it does not differentiate for individual learners. Students can personalize their memoirs.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   Somewhat. It allows students to share anonymously and all at once, which would be more difficult with paper and pencil or even a chalkboard share out. However, students could write and share six-word memoirs without the aid of the technology.

Scenario 9

A fourth-grade teacher is using Google Hangouts to virtually host author Judy Blume conducting a book club discussion on her book *Tales of a Fourth Grade Nothing*. The students ask Judy questions and listen to her share ideas about writing and the novel.

Learning Goal: *Have a discussion with Q&A for author Judy Blume about different aspects of her book (both content and writing style).*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   Somewhat. They can talk directly to the author, get questions answered, and reflect as a group with the author. While they could write letters back and forth, the technology creates the opportunity for synchronous inquiry questioning, reflection, and feedback.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas?**

   Somewhat. It allows the students to talk directly to the author in order to gather their information rather than having to search the internet or other secondary resources. There is some limited personalization in which students can ask questions based on their own interests.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   Yes. There is a very slim chance that an author would come to their school. A virtual live meeting is something that can only happen with the technology.

Scenario 10

An 11th-grade science teacher is taking pictures of a class field trip to the chemistry museum and cutting them into a movie to show to parents and students.

Learning Goal: *Students will share what they learned about organic chemistry from their field trip to the chemistry museum.*

1. **Does the technology tool aid students in developing a more sophisticated understanding of the content?**

   No. The teacher is doing all the work with the technology.

2. **Does the technology create scaffolds to make it easier to understand concepts, gather information, or generate ideas**

   No. The teacher is using the technology to document the learning.

3. **Does the technology create paths for students to comprehend or demonstrate their understanding of the learning goals in a way that they could not do with traditional ideas?**

   No. The students are not engaged with the technology in a way that they are directly learning through it.

Enhancement Overview

Most of these scenarios had some level of engagement (as described in Chapter 4). Yet notice how some of the teaching scenarios that had engagement did not necessarily have the characteristics of enhancement. At the enhancement target, we are looking for "value added" to the learning goals. Thus, students could be engaged in time-on-task using an app, but not learning more than if they were

using a traditional workbook. For example, the kindergarten teacher's lesson using the interactive whiteboard for literacy learning can be fun and perhaps engaging to students, but the interactive whiteboard is not doing anything to enhance a student's understanding of the learning goals that traditional tools could not do. A teacher could easily use a whiteboard and post outlines of letters for students to trace, or use paper and pencil and have the same desired results. Other scenarios are enhancing the learning goals by adding opportunities for students to engage in higher-order thinking skills, differentiating learning, or providing learning opportunities that traditional tools could not easily offer.

The next chapter will explore the final component of the framework: extension. Once again, these same scenarios will be presented through the lens of how well the learning goals are extended to everyday life through the technology tools.

Chapter Take-Aways

This chapter provided an overview of enhancement, one of the components of the Triple E Framework, offering practical ways to enable students to engage in higher-order thinking skills and access deeper learning opportunities than traditional tools typically can.

- Authentic enhancement is a value added to learning experiences.
- Authentic enhancement should help to elicit higher-order thinking skills.
- Authentic enhancement should help to differentiate learning.
- Authentic enhancement should help to personalize learning.
- Authentic enhancement should provide supports that traditional tools cannot easily provide.