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Effective Teaching in
Today's Classroom



Integrating Technology into the Curriculum

2nd edition



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Chapter 1

Today's Technology for Tomorrow's Classrooms



“Technology has forever changed not only what we need to learn, but the way we learn.” —International Society for Technology in Education 2012, Standards

What is the go-to source for educators looking to maximize their technology instruction and use in the classroom? The answer is simple: ISTE. The International Society for Technology in Education (ISTE) is a membership association for educators who want to advance excellence in teaching and learning through the effective use of technology. This association provides resources for teachers, administrators, and all stakeholders in education, similar to how the International Reading Association (IRA), the National Council of Teachers of Mathematics (NCTM), and the National Science Teachers Association (NSTA) advance teaching practices with the goal of improving reading, math, and science achievement, respectively. ISTE houses information related to technology standards, offers professional development through conferences and publications, and connects educators from around the globe. However, its main focus is not the technology itself, but its resources to examine how teachers can use technology effectively to support instruction and learning.

ISTE specializes in taking technology that has arrived in classrooms and showing educators how to implement it so students' critical thinking and analysis skills are utilized. An example of this is the availability and use of a set of graphing calculators. These variable tools go beyond their obvious use: calculating complex (or even simple) algorithms and graphing the results. Although students may use this type of technology for its obvious intended purpose, these resources can go underutilized if teachers are unaware of all of their functions. Teachers can encourage students to collaborate to match a distance-time graph using a CBR (motion detector) attachment or compare the effects of chemicals in liquids using a thermometer attachment. Students can also use this technology to help them gather scientific data, organize it, and display it as part of a scientific exploration.

These advanced technology tools go beyond the mathematics classroom and can open a world of discovery and application in the science classroom as well. Yes, students need to learn how to solve and graph advanced algorithms. However, they also need to learn how to use technology as a tool to discover the relationships between events, think critically and analytically, solve real-world problems, and complete original projects. These are the skills 21st century students need to be successful in today's technologically advanced society. These are the skills and applied practices teachers must provide students so that they can successfully compete in a technologically advanced global society.

Looking Back on Technology

Imagine how excited people were to be able to dial a few numbers and talk with

others—family, friends, co-workers—across great distances. The telephone allowed this to happen. Before the introduction of the telephone, imagine how grateful people were to be able to quickly send messages, transmitted as signals, over land and sea. The telegraph enabled this to happen. But before that, people could share the written word with greater ease thanks to the printing press, which reduced the need for handwritten communications. Now, imagine walking into an abandoned cave and “reading” the messages left behind by the previous occupants. Prehistoric tools created the etchings archaeologists and anthropologists still study today, gaining insight into our ancestors’ earliest attempts at communication. If schools existed back then, we imagine students bringing stone tablets, rocks, and picks to class with which to record their thoughts and demonstrate their understanding.

Schools have come a long way since the Stone Age. Even schools which by today’s standards might seem to have “limited technology” have experienced some of its benefits throughout the years.

The overhead projector made its debut in the 1930s, having been initially used by the military for training purposes (<http://www.edudemic.com/classroom-technology/>). It eventually morphed into a useful instructional tool by teachers in schools. It allowed educators to face and engage in conversations with students directly, rather than turning their backs to record thoughts, ideas, or assignments on the board.

In a blog posted by Larry Cuban, he reminisces over what was available to 1950s teachers. He specifically mentions the use of the ditto machine, “Ah, just typing in the phrase brings back memories of smelling alcohol and purple stained fingers from handling those ‘spirit masters’”(2013); along with film strip and 16mm film projectors. These technologies saw many decades of hard use, bringing unlimited handouts to students and providing teachers with just enough leverage to keep students engaged; after all, only one lucky classmate would be chosen to turn the film from slide to slide.

Common recent practice had students engaged exclusively in paper-pencil tasks, such as accessing literature and information through textbooks, writing summaries on notebook paper, and completing math exercises on activity pages. However, our digital world is quickly overtaking our traditional paper-pencil world. All of the tools just discussed are being replaced by modern-day technological advancements. These tools, such as electronic documents and direct audio-video access, allow teachers to expand learning beyond the four classroom walls and engage students in creative communications, all with the touch of just a few buttons.

The Digital Age in the Classroom

Today’s technologically advanced classrooms have a host of digital components that are now becoming commonplace in the education world. Computer stations, portable computer labs, electronic equipment (e.g., digital microscopes) and measurement devices (e.g., digital balance scales), mounted projectors, document cameras, interactive whiteboards, tablets, and eReaders are just some of the tools today’s students use in the

classroom. With all of this technology at the ready, how does a classroom in today's digital age look?

Reading: Podcasts Enhance Fluency

According to the Reading Rockets website, "Fluency is the ability to read a text accurately, quickly, and with expression. Fluency is important because it provides a bridge between word recognition and comprehension" (2014, "Reading 101 - Fluency"). When students read fluently, they read words automatically, which facilitates comprehension.

An effective means of helping students improve their reading fluency is to use reader's theater scripts. These are texts written in the format of a play, with each character having his or her part. There may or may not be a narrator, but scripts typically include stage directions. Research has shown that this method of rehearsed reading practice leads to improved reading fluency (sight word recognition, quick and accurate decoding, the application of appropriate phrasing, and the acknowledgment of punctuation), as well as an increased interest in reading (Griffith and Rasinski 2004; Young and Rasinski 2009). Consequently, as readers become more fluent, they are able to increase their comprehension, as they expend less energy in the actual decoding process and more energy in the comprehension process (Pikulski and Chard 2005).

In years past, teachers would print adequate copies of the reader's theater script for students using it in small groups. Students would read and reread the text, conveying meaning through verbal inflection, facial expressions, and actions. While there is a lot of value in this, today's digital-age students have the added benefits of technology. Digital tools cannot only promote motivation and engagement but also help educators differentiate instruction for their students by "scaffold[ing] learning environments where support can be adjusted in relation to students' needs and preferences" (Dalton 2008, 155). One such tool is a podcast.

In the context of reader's theater, they can be used as recitals where students record their rehearsed parts and post their work as a podcast online. In a ten-week reader's theater podcasting study that included repeated reading, recording, podcasting, and listening to the published audio, struggling second- and third-grade students averaged a gain of 1.3 years in reading comprehension (Vasinda and McLeod 2011). With the integration of podcasting to enhance an already research-based effective strategy for improving reading, "Both students and teachers noted the wider audience, the permanency, and also alluded to audio as a visualizing medium" (Vasinda and McLeod 2011, 489).

A *podcast* is a digital audio file that is first uploaded to and then can be downloaded from a website to a media player or computer. These types of recordings are generally used as tutorials or lectures.

Writing: Automated Essay-Scoring Programs Enhance the Writing Process

One of the challenges teachers face when assigning written work is grading all of it in a timely and personalized manner. Automated systems are growing in popularity because

they can produce scores more reliably, quickly, and at a lower cost than human scoring (Topol, Olson, and Roeber 2011). Providing essential and timely feedback to students is crucial in our quest to maximize student learning. One tool to employ is taking advantage of the digitally enhanced classroom. Students can type stories, essays, and reports into automated scoring programs and receive immediate feedback as they continue to craft their writing. These automated scoring systems are based in natural language processes. They apply the principles of linguistics to computer science, creating a system that interacts with human language, both spoken and written. This technology has been recently scrutinized due to advancements in computerized testing that include written (typed) responses. The Educational Testing Service (ETS) supports the use of automated scoring systems, citing five essential ideas when considering the use of such systems (2013).

ETS contends that automated scores

- are consistent with human scores;
- are understandable and meaningful;
- are fair;
- are valid; and
- can impact the reported scores of the overall test.

With the use of embedded spelling and grammar checking features in word-processing programs, students in today's classrooms have few excuses for submitting documents with misspelled words and incorrect grammar. This minor enhancement to the writing process can, at the very least, assist with students' writing fluency, so teachers can focus on grading content as opposed to conventions.

Math: Handheld Devices Help Students Learn to Tell Time

Do you remember manipulating or having your students manipulate a paper clock to learn how to tell time? Any time or elapsed time could be modeled and practiced (e.g., hour, half-hour, quarter-hour, five-minute intervals) using these clocks. Today, in the digital classroom, students who have the advantage of using smartphones, tablets, or individual computers can use apps, such as MiniSchool, Todo Telling Time, and Tic Toc Time, to learn to tell time and calculate elapsed time. With a touch of the screen, the minute and/or hour hand moves around the digital clock face. When students select a button, the device announces the time shown on the clock. Additionally, students can take quizzes, play games, and otherwise learn to tell time through interactive activities, thanks to today's technology.

Online Essay Scoring Resources

Students who might take the Test of English as a Foreign Language (TOEFL) or the Scholastic Aptitude Test (SAT) are able to use online practice tests that include electronically scored written components that serve to improve their time management skills and to gain competency and confidence with the testing format (Encomium Online, www.encomiuminteractive.com/exams/products_details.asp?egid=3).

A Rationale for Technology Integration: Into the Future

What tomorrow's technology brings to teachers and students is limited only by our imaginations. What is clear is that today's students are part of the digital era. Teachers can assume that a majority (upward of three-fourths) of the children entering their classrooms have been exposed to computers and the Internet since they were infants. According to the United States Census Bureau (2013), the percentage of households with computers rose from just over half (56.3 percent) in 2001 to 75.6 percent in 2011; and the percentage of households that use the Internet rose from 50.4 percent to 71.7 percent. As more students become connected at home, they may come to expect to be connected at school.

Technology can effectively enhance any school subject, such as science, social studies, health, media, music, and art. [Chapters 3 and 4](#) provide specific and effective suggestions for technology integration in English language arts and the content areas.

Learning through digital media is a real and familiar delivery system for our students. While students use flat-screen computers, tablets, and smartphones today, they may use three-dimensional holographic images tomorrow. Even though teachers use copiers to print papers or documents today, they may use three-dimensional printers in the near future for a host of new purposes. Albeit robotics are a thing of the movies today, they may find their way into tomorrow's schools to benefit students, teachers, administrators, and support staff with instructional applications, learning opportunities, management systems, or quality care (i.e., automated lunchrooms, clinic assistance, or disciplinary actions). With advances in technology comes a requirement for people to continually revisit their moral and ethical positions regarding related controversial topics, such as genetic engineering. Will educational institutions and instructional leaders be ready?

The future of what technology might offer schools is exciting, but it could leave some educators feeling uneasy or skeptical. Unfortunately, for all of the technology available, schools tend to lag behind in shifting instruction to meet the demands of society. Teachers can no longer use computers for rote skill practice or for low-level instructional assignments and believe that they are effectively integrating technology into the curriculum. According to the Partnership for 21st Century Skills (2013), learners must be engaged in critical, analytical tasks. They must learn to solve problems and work collaboratively. The Partnership has organized a system of essential skills into what they refer to as the *Four Cs*: critical thinking, communication, collaboration, and creativity. The organization has proposed student outcomes related to core subjects, such as reading and math; learning and innovation; life and career; and information, media, and technology. The latter set of skills is closely linked, since much of the information students receive and the media they use is connected in some way to technology. Even so, they each hold their own set of skills necessary for success in school and in life. Information literacy refers to students' abilities to access and evaluate information. Media literacy refers to students' abilities to analyze media and technology skills (oftentimes referred to as ICT, information and communication technology). It also refers to students' abilities to use and apply technology effectively (for research, organization, and communication) and ethically.

People in the 21st century live in a technology- and media-suffused environment, marked by various characteristics, including 1) access to an abundance of information, 2) rapid changes in technology tools, and 3) the ability to collaborate and make individual contributions on an unprecedented scale. To be effective in the 21st century, citizens and workers must be able to exhibit a range of functional and critical thinking skills related to information, media, and technology. (Partnership for 21st Century Skills 2013, under “A Vision for 21st Century Citizenship”)

Technology and 21st-century skills are inextricably linked in today’s classrooms. However, educators may ask what this looks like. These ideas are explored closely through the following examples. Although these examples are structured uniquely for each criterion, readers should identify overlap among the Four Cs.

Technology for the Advancement of Critical Thinking

Critical thinking skills include being able to analyze, argue logically, justify, and evaluate. Students who exhibit critical thinking skills ask questions, seek answers, and strive to rationalize thoughts and ideas to help make sense of the world around them. Typically, the types of activities that require the use of critical-thinking skills are high on Bloom’s taxonomy (Vanderbilt University 2014). In order for students to think critically, they must participate in open-ended activities that challenge what they know and require them to apply problem-solving skills in unique and original contexts. Wendy Conklin (2012) reminds teachers that classrooms that encourage critical thinking emphasize learning as well as knowing. For example, a student who knows the equation to find the volume of a geometric solid but cannot use this information to determine the possible dimensions of a 24-cubic-foot refrigerator has not really *learned* this concept, even though he or she *knows* it. Critical thinking is not a new idea in education; however, the purposeful use of technology opens an entirely new world to teachers and students as they analyze, question, and construct learning. In this regard, technology is a tool for developing critical thinking skills.

To help students build this type of thinking, teachers can have students

- evaluate a website for its validity, reliability, and accuracy;
- compare two or more websites on one topic, and identify one site as more useful than the other(s), citing reasons;
- use an online simulation to reason abstractly; and
- use online research to find facts, information, and statistics about a controversial subject; align with one side; and use the information to support a position.

Technology for the Advancement of Communication

As detailed in the “Classroom Snapshot: Looking Back on Technology” section earlier

in this chapter, people have been inventing new and improved ways to communicate throughout time. Today's technology enables us to communicate with each other virtually through emailing, texting, chatting (typing in a chat room), blogging, posting (to a social network), and video chatting. Gamers, people who play video or computer games, can even talk to each other through their gaming systems when they are connected to the Internet. With a headset and a microphone, two or more gamers can spend the day together in virtual reality as if they were sitting side-by-side on the couch teaming up against zombies and warriors. Regardless of our preferred means of communication, technology is the means through which we communicate. It is the tool we use to share and exchange a thought or idea, information, or news.

Suggestions for teachers to offer effective integration of technology for the purpose of communication are as follows:

- Use a wiki or cloud-based storage option for students to collaborate on research projects.
- Have students post (tweet) summaries of assigned readings on Twitter.
- Set up a classroom webpage and have students author important information, such as vocabulary terms used in context, how-to summaries of math processes, and upcoming events.

Technology for the Advancement of Collaboration

People collaborate to accomplish all kinds of tasks. If we look closely, we will see evidence of collaboration in the grocery store, at the auto repair shop, at restaurants, with local emergency operations, such as police, fire, and paramedics, and pretty much in any career or summer job choice students might make.

Christopher Cattie and Kris van Riper (2012) summarized a Corporate Executive Board (CEB) survey of over 23,000 employees across industries and locations. They noted that the nature of collaboration has changed. More than two-thirds of employees reported that their jobs require more collaboration today than they did three years ago. Moreover, employee networks are expanding and becoming increasingly cross-functional. Sixty percent of respondents said their day-to-day work requires regular coordination with ten or more people, and two-thirds reported regular coordination with employees from different work units and supervisory levels (para. 2).

Collaboration is a skill that comes naturally and easily to some; for others, it must be taught. With technology being such an integral part of our everyday lives, teachers must attend to this critical *C* by employing strategies that integrate technology through a collaborative effort. The first suggestion under the previous *C*, communication, offered one way students may collaborate to accomplish a common goal. The following are a few other suggestions:

- Join a collaborative online project with other classrooms from around the world (e.g., Global SchoolNet or Cyberbee).
- Work as a small group to collect scientific data, and then organize it into a spreadsheet or graphing program to share with the class.
- Work with a partner to identify key words and ideas from a selected narrative or informative text, enter them into the Wordle website, and share the resulting organizer with the class to help identify themes or main ideas.

A *Wordle* is a creative writing tool used to “show” prominent words in a text, discussion, or brainstorming session. Once typed or otherwise loaded in, it organizes the words into what is referred to as a “cloud of words,” enlarging some and minimizing others based on their frequency of use.

Technology for the Advancement of Creativity

Most students like to be creative. Students are productive when they are allowed to design and create an original project related to a topic. To illustrate this point, with just one of many examples, Gregory Childress (2014) reported on a creative teenager at The School for Creative Studies in Durham, NC. This 6-12 magnet school’s curriculum “focuses on digital media and creative design” (“Student of the Month”). One of their students, Mattiyah Jones, reflects on the positive feedback she receives from her creative talents. She says, “I came to this school because my mom knows I was creative. I like to make things, put things together and draw. [My mom] felt like it was a good fit for me and believed it’s a school I will excel in” (Childress 2014).

Intentionally designed assignments have this advantage for students. Teachers can assess their students’ levels of learning from basic knowledge and comprehension levels to the highest evaluation and synthesis levels. In exchange, students get to share their learning through more authentic tasks rather than rote paper-and-pencil worksheets, assignments, and tests. The value of creativity in the classroom is evidenced in what future employers require of their employees. Creativity leads to innovation. Innovation leads to economic growth. Economic growth leads to increased employment, and so on. In fact, Singapore and Korea emphasize creativity in their curricula from elementary school through secondary school (Vincent-Lancrin 2013). Heidi Hayes Jacobs (2010) advocates for curricula that nurtures creativity in all learners. Students can demonstrate creativity by participating in innovative and original tasks or by completing assignments that place students in open-ended problem-solving situations. With regard to technology, these ideas allow students to be creative and innovative thinkers while staying true to the subject matter required by state and national curricula. Some examples are:

- Use building block sets with motorized parts to design and create a vehicle to perform a certain function or complete a certain task.
- Use digital or multimedia options to design and create a book review.
- Use multimedia software to create an original quiz game centered on a particular content-area topic.

More Benefits of Integrated Technology

Technology has many benefits for teachers and students as indicated, particularly as a means to learn and apply the essential 21st-century learning skills of critical thinking, communication, collaboration, and creativity. Additionally, integrating technology into the curriculum can shift the responsibility of learning from the teacher to his or her students. David Nagel (2014) defines these teachers as ones who “routinely use digital strategies in their work with students and act as guides and mentors” (“Near-Term Shifts: Teaching and Learning with Tech”). As students access information digitally and complete instructional activities through technology, they become active participants in the learning process. Students are no longer restricted to working independently, returning to school the next day to turn in an assignment, and then waiting at least another day to receive their grade or what their teacher thought of it. For example, instead of sitting in class listening to their teacher teach and then having to work, students in the digital age can read informational text online, add notes or ideas as they read, summarize information using a text-based software program, and submit and receive feedback from their teacher electronically. In this situation, the teacher provides a direction for students by selecting links to the assigned reading material. Students, using their computers, do the rest. Through interactive communication devices, students can ask their teacher questions and receive immediate responses. Students can post their work to an electronic storage system, which the teacher can access and give feedback through, making this information available for students at any time.

Benefits for Students

The effective integration of technology can build more cohesive teacher-student and teacher-parent relationships and improve the academic achievement of students. Consider a group of second-grade teachers at Middleton Elementary School in Woodbury, Minnesota. On their website, *Almost a Third Grader*, they created a series of online learning videos to help their second graders transition into third grade. The site was intended for summer viewing, and students who watched the creative skits and narrations (some starring Gunner the dog) could review what they learned the previous school year and gain insights into the challenges they would face as third graders. Through digital media, these teachers not only demonstrated their commitment to teaching and learning, but they also addressed their students’ concerns and/or apprehensions about the upcoming school year. Additionally, they strengthened teacher-parent connections. Parents could easily link to see what their children should know and get a glimpse of the adventurous learning to take place during the upcoming school year.

Benefits for Teachers

Teachers, too, benefit from the effective integration of technology into the curriculum. They improve their effectiveness in the classroom through informational sharing sites, such as Edmodo, Moodle, blogs, and wikis, which allow teachers to benefit from each other. For example, a teacher who is looking for a whiz-bang idea related to the skill of making inferences might find just what he or she seeks on an online educational forum. Additionally, teachers who frequent these sites improve their own information literacy

skills, which better enables them to instruct their students in technology use. Some of these sites are specific to education. Others, such as Pinterest, are open to miscellaneous areas of interest. Some require accounts with login credentials, and some “groups” within them require passwords.

Benefits for Student Achievement

Finally, but arguably most importantly, effective technology integration can lead to improved student success and overall achievement across subject areas. Because “technology” is such a broad topic, research regarding its effectiveness with student achievement has been targeted to specific technology in specific instructional areas. For example, researchers have studied the effects of the use of interactive whiteboards in reading (Digregorio and Sobel-Lojeski 2009, 2010) and math (Linder 2012); the effects of using blogs, wikis, and podcasts (Richardson 2010); and the effects of using games or gamelike programs (Tuzun et al. 2009). All the same, past research demonstrates the positive effects that the integration of technology can have on learning (Hawkins 1997; White, Ringstaff, and Kelley 2002). Current research accepts several known facts about the use of technology in learning. According to Namsoo Shin et al. (2012), educational technology researchers already know that “technology and games have yielded consistently positive results with regard to motivation, persistence, curiosity, attention, and attitude toward learning” (540).

As with any instructional tool, technology is only effective in improving the academic achievement of students when it is used with purpose, meaning, and relevance. For example, a teacher who has and uses an electronic reading program is not guaranteed higher student achievement just because the program is the main instructional tools used in the classroom. Along with the use of the technology, the teacher must set clear instructional outcomes, deliver outstanding lessons, use research-based instructional strategies, closely monitor student engagement, continuously monitor student progress, and adjust instruction accordingly to best match students to materials and tasks. According to a study by CompTIA, the IT Industry Association (2011), teachers and school leaders believe that “technology has positively impacted the classroom and the productivity of students” and that “roughly 65 percent of educators also believe that students are more productive today than they were three years ago, due to the increased reliance on technology in the classroom” (“Making the Grade”). As technology continues to make its way into America’s classrooms, teachers are learning how to use it with meaning, purpose, and as a supportive tool for overall effective instruction.

We recently studied eight secondary districts throughout the United States that exemplify the creative use of technology in K–12 schools, particularly what leaders in these schools did to make sure technology enhanced learning. For these districts, we found, using technology is not the goal. It never was. These schools achieved their results by focusing on learning-centered goals like making learning relevant, providing new opportunities to close achievement gaps, and improving graduation rates and college readiness. In other words, their goal was to educate students for work and life in the 21st century, not just to add technology. (Levin and

Challenges for Educators

An article published by Education Week (Editorial Projects in Education Research Center 2011), lists several challenges schools face with regard to technology. First of all, technology advances rapidly. Schools and school districts do what they can to keep their technology fresh and current. Teachers can use in class with students tomorrow only what they know exists today. When new technology comes tomorrow, teachers will devise a plan to use it the next day with their students; but by that time, tomorrow will be today, and something else new and exciting will have come along for teachers to use.

Secondly, this same article reports that with the rapid changes that occur with technology every day, teachers, administrators, students, and parents all face challenges with regard to its effective integration. “Longitudinal research that takes years to do risks being irrelevant by the time it is completed because of shifts in the technological landscape. The iPad, for instance, became popular in schools soon after it was released and well before any research could be conducted about its educational effectiveness” (2011, para. 4).

Just keeping up with what is fresh and current is a full-time job, and simply finding or finding out about technology is not enough. Teachers must effectively integrate technology to support, enhance, and extend learning and thinking. For example, teachers may have students use computers and presentation software to generate a report about a specific science or social studies topic. However, depending on the criteria the students must meet, this assignment can remain a very low-level comprehension task. In this instance, the computer and software just become digital paper and pencil. Although this type of assignment certainly has its place in today’s schools, teachers who use computers and software only to have students complete tasks at a low level (such as simple research projects or drill exercises) are missing the greater scope of what technology has to offer teachers and students in today’s classrooms.

With the wide range of options available, teachers might easily get wrapped up in technology for technology’s sake and lose sight of the overall goal: to improve student learning. The previous example illustrates this point. Teachers are busy people. They want to engage students in meaningful work. As valuable a skill as report writing is, it likely does not challenge students to think critically or analytically, a necessary and essential part of today’s learning environment. To effectively integrate technology for meaningful purposes, teachers can and should consider how the technology students use helps them develop any one or more of the 4 Cs of 21st-century skills discussed earlier in this chapter. For example, as eReaders become more popular and prevalent in today’s classrooms, teachers will want to devise a plan for students to use them not only to practice reading, but also to apply critical thinking and communication skills. Perhaps students post a book review on a classroom website or access two informational texts on the same topic, comparing how each author chose to deliver the information and explain which text they preferred and why.

All of this talk about technology’s impact on student learning is meaningless if schools

are not adequately equipped with the hardware (computers) they need to achieve the greatest impact. Schools with multiple computer labs, portable labs, or independent student stations in classrooms have obvious benefits over schools where the only lucky individual to have access to a computer is the teacher. Additionally, the availability of LCD projectors, interactive whiteboards, document cameras, and audio and video feeds can directly impact the overall effectiveness of a teacher's ability to integrate technology into the curriculum. Schools and school districts needing to add, update, and/or expand their hardware supplies can seek grant funding opportunities, investigate fundraising options, and consider entering contests with technology equipment awards. These ideas are explored in more depth in the next section.

Schools with an adequate supply of hardware may face challenges over time with regard to system management. Twenty-five computers with outdated operating systems will not benefit students. Whether there is one computer in the classroom or several, schools can also run into connectivity challenges. There are limitations to a school's wide area network (WAN) and local area network (LAN). Either or both of these can affect a school's bandwidth, which can limit the amount of online learning students can access at one time. One option for improving student access to the Internet is to provide additional wireless connectivity through the use of a mobile hotspot generator. These devices are small, portable boxes that use a cellular network. They allow several wireless devices to access the Internet using a wireless boost.

Some schools and school districts have strict policies regarding the use of external devices on school property. Teachers interested in using mobile hotspots to increase their students' access to the Internet should check with a school or district technology coordinator to learn of any limitations at their school.

Options for Financing Technology

Administrators and teachers interested in expanding their school's hardware, software, or connectivity have several options available to financially support this endeavor. First, grants provide opportunities for schools to develop a plan with regard to time, resources, materials, and people that best suit them, their student population, their teacher knowledge level with technology, and their community base. Knowing what a school wants and needs, and finding a grant to meet these needs, can take time and patience. Some grant applications are quite extensive and require quite a bit of preplanning and forethought to complete. Regardless, the benefits of receiving such grants can mean the world to students. Doing some background research on how to write and submit a good grant application is time well spent.

Grant-Writing Tips

School administrators and teachers interested in writing grants to fund technology should abide by the following simple tips:

- Read any and all information related to the grant. This includes who the money is intended for, what types of programs the grant supports, and guidelines and submission regulations. Do not skip anything. It helps, too, to read winning

submissions from previous grants. Mimic these proposals with regard to format and content.

- Devise an innovative, creative, and original idea that is based, above all, on student achievement. Infuse research to support this project.
- Identify SMART goals (Doran, Miller, and Cunningham): Goals that are Specific, Measurable, Attainable, Relevant, and Timely.
- Projects that can be replicated sometimes gain points by the grant evaluators.
- Synthesize a detailed, itemized budget.
- Review the evaluation criteria. The proposal should address all the criteria and be written in clear, understandable language.

In addition to applying for grants, administrators and teachers can enter contests to win technology products for a school. Typically, companies that represent a specific product offer sweepstakes or contests where those who enter can win free products and services from the company. Before spending lots of money on interactive whiteboards, such as Mimios or iPads, schools should access these companies' websites and check to see if they are offering any special promotions or contests.

Outside of grants and contests, schools can participate in school-wide fundraising events. Bake sales, carnivals, book fairs, and private sales companies (which sell cookie dough, candy bars, paper products, or other miscellaneous materials) are just a few fundraising options. Also, schools can elicit the assistance of larger retailers to boost fundraising support. For example, schools can schedule a day and time with retailers so that a certain percentage of the sales made within that time frame comes back to the school. Similarly, schools can post projects, supply needs, or special event funding needs online for anonymous donations through such sites as [DonorsChoose.org](https://www.donorschoose.org) or [GoFundMe.com](https://www.gofundme.com). When engaging in fundraising, schools should have a plan for the use of the funds raised and clearly communicate this plan to parents and community members. Family and friends might be more willing to support a child's school if they know what the money is for and how it will benefit the school and community.

Finally, schools can look into recycling old hardware to gain devices and money for upgrading and replacing outdated equipment. Some schools have drop-off locations where parents and community members may donate their gently used digital devices, particularly smartphones that no longer have service contracts but still work and mini-tablets that can connect with any wireless network. Students will not be privileged with the latest and greatest hardware, but this program will put much-needed technology in the hands of students. In addition, many local communities have computer-recycling centers where people trade in their old technology equipment for cash. Furthermore, some computer retailers allow people to trade in their old equipment for discounts on new equipment. This may or may not be an option for schools or school districts depending on finance laws and regulations, but they are something to consider.

Conclusion

This chapter provided a few insights into the world of technology as it relates to teaching and learning in order to lay a foundation for the idea that effective technology integration is essential for students in today's classrooms. Regardless of their familiarity and comfort level with technology, teachers in all settings and situations should do what they can to move into the world of digital teaching and learning. Our students will grow to become even more reliant on technology in the future. The time is now for schools to ensure success for all in this digital age.

Reflect and Respond

1. In what ways do you integrate technology into your classroom?
2. Who benefits more from integrating technology into the classroom, teachers or students? Why?
3. When you look for ways to use technology, which 21st century skills do students apply most often?
4. How do you believe your students will respond to the use of more technology integration in their day-to-day learning?

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