

Professional Development for Technology Integration

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In the following report, Hanover Research considers the best practices for professional development in technology integration. The report also examines effective approaches for utilizing technology in classroom instruction.

TABLE OF CONTENTS

Executive Summary and Key Findings	3
INTRODUCTION	3
KEY FINDINGS.....	4
Section I: Professional Development.....	5
THE NEED FOR PROFESSIONAL DEVELOPMENT.....	5
BEST PRACTICES.....	6
Teacher Coaching.....	7
Professional Learning Communities	9
Technology-Rich Professional Development	11
Low Cost, High Customization	12
Section II: Changing Pedagogy	13
TECHNOLOGY-RICH EDUCATION	13
TECHNOLOGY AND THE STUDENT-CENTERED PEDAGOGY	14
Traditional Classrooms	14
Alternative Course Formats	16
EMERGING TECHNOLOGY AND CLASSROOM TOOLS.....	16
Challenges to Integrating New Technology in the Classroom.....	18

EXECUTIVE SUMMARY AND KEY FINDINGS

INTRODUCTION

The role of technology in the classroom has steadily increased over the past decade. In 2009, 97 percent of teachers had at least one computer in their classrooms. By 2013, more than 300,000 K-12 students were enrolled in fully online programs.¹ New technological tools – including interactive whiteboards, digital light processing projectors, and digital cameras – have also become more prevalent in K-12 classrooms.² As such, teachers must learn how to effectively integrate technology in the classroom and adapt their teaching methods to incorporate new devices.

The proven benefits of instructional technology highlight the need for its widespread adoption;³ however, professional development opportunities are essential to better train educators in the effective use of technology as an instructional tool. One major challenge for districts is preparing teachers who are well practiced in “traditional” classroom delivery methods to integrate educational technology into curricula.⁴ Moreover, some teachers and schools may lack the infrastructure or knowledge base to effectively integrate technology into instruction.⁵ Professional development provides educators the opportunity to understand new advancements and adapt their teaching styles and pedagogy to make effective use of available educational enhancements.

The following report is divided into two sections:

- **Section I** addresses the importance of professional development (PD) for teachers as they learn how to effectively integrate educational technology for positive student outcomes. It also examines best practices for PD programs integrating new technologies and related pedagogies.
- **Section II** examines considerations for integrating technology into K-12 classrooms, and how teachers can effectively alter their pedagogies to more seamlessly incorporate technology into classroom instruction.

¹ “Data & Information.” Keeping Pace with K-12 Online & Blended Learning, 2014. <http://kpk12.com/states/>

² “Teachers’ Use of Education Technology in U.S. Public Schools: 2009.” United States Department of Education – National Center for Education Statistics. <http://nces.ed.gov/pubs2010/2010040.pdf>

³ “National Educational Technology Trends: 2012.” State Educational Technology Directors Association. p. 31. http://www.setda.org/c/document_library/get_file?folderId=6&name=DLFE-1552.pdf

⁴ McNulty, R. “Student Expectations Unmet: Where are the Electronics?” *The School Administrator*. 1:76. 2010. <http://www.aasa.org/SchoolAdministratorArticle.aspx?id=11040&terms=Technology>

⁵ “Transforming American Education: Learning Powered by Technology, National Education Technology Plan 2010.” U.S. Department of Education – Office of Educational Technology. p. 48. <http://www.ed.gov/sites/default/files/netp2010.pdf>

KEY FINDINGS

- **Successful professional development programs provide ongoing support through coaching, professional learning communities, and information repositories.** Teacher PD should be highly customized, delivering immediately usable solutions to the daily challenges that teachers will face when making major curricular changes in their subject areas.
- **Understanding appropriate pedagogical practices for using technology can be more important to effective instruction than technical mastery of technology, although both elements are essential.** Extensive training in both pedagogy and technology are needed through ongoing professional development opportunities.
- **Research suggests that teachers participating in a PD program that includes coaching or mentoring are more likely to implement new instructional methods.** A 2011 study conducted by the International Society for Technology in Education (ISTE) demonstrated that teachers who received coaching implemented new instructional methods at a rate of 85 percent, while only 15 percent of teachers without coaching support implemented new methods.
- **Schools that adopt a learner-centered pedagogy tend to experience greater integration and more effective use of technology in the classroom.** Technology is less effective when used to support traditional “teacher-centered” pedagogies, which tend to use technology as a supplement rather than as a core element of instruction.
- **Online information repositories provide teachers continuous and convenient access to relevant teaching resources.** Many teachers report success conducting research at their own pace. The characteristics of an instructor’s particular subject area may also demand specialized investigations and considerations. For these reasons, successful professional development programs offer extensive online resources that teachers can access and search as needed.
- **Significant and long-lasting changes occur when a school’s “policies, practices, culture, and funding” are structured to facilitate the integration of educational technology.** Successful change in the classroom must be supported at the building and district levels. If access to and use of technology are not continuous from year-to-year, it is difficult to effect meaningful change in pedagogy.
- **Successful PD programs make use of the technologies that teachers will be using.** The ISTE notes that “learning *with* technology is more important than learning *about* technology.”⁶ Teachers benefit by seeing what and how they can learn through available technological tools.

⁶ Beglau, Monica, et al. “Technology, Coaching, and Community: Power Partners for Improved Professional Development in Primary and Secondary Education.” International Society for Technology in Education. 2011. p. 16. http://instructionalcoach.org/images/downloads/ISTE_Whitepaper_June_Final_Edits.pdf

SECTION I: PROFESSIONAL DEVELOPMENT

In this section, Hanover addresses the need for professional development in educational technology integration and analyzes associated best practices.

THE NEED FOR PROFESSIONAL DEVELOPMENT

Available research suggests that the use of educational technology can improve student outcomes. A 2009 report by the State Educational Technology Directors Association (SETDA), which summarizes trends from a six-year study of educational technology integration initiatives funded by the federal government, found that incorporating technological tools in the classroom led to “positive academic results” and increased technological literacy for students.⁷

The study notes that student performance improved across a number of academic content areas, including mathematics, science, reading, and writing. For example, Paris Elementary School, in Paris, Arkansas, allocated available grant funds to purchase equipment (interactive whiteboards, LCD projectors, desktop and notebook computers, and document cameras), which was integrated into the curricula for K-4 students with the goal of increasing student engagement.⁸ The integration of educational technology was “certainly a contributing factor” in the subsequently improved reading and math proficiency scores of third and fourth grade students. Figure 1.1 compares student success rates in mathematics and reading from before and after the incorporation of educational technology.⁹

Figure 1.1: Student Success Rates, Paris Elementary School

GRADE LEVEL	BEFORE TECHNOLOGY INTEGRATION	AFTER TECHNOLOGY INTEGRATION
<i>Literacy</i>		
Grade 3	67%	83%
Grade 4	47%	69%
<i>Math Proficiency</i>		
Grade 3	76%	89%
Grade 4	64%	81%

Source: State Educational Technology Directors Association

State and federal government bodies have shown support for professional development programs aimed at familiarizing teachers with new technology and how to use it effectively in the classroom. PD was the most commonly listed project priority among successful proposals for federal grants offered by the U.S. Department of Education, authorized by No Child Left Behind legislation; it was listed as a priority in all winning grant proposals.¹⁰

⁷ “National Trends Report: Enhancing Education through Technology.” State Educational Technology Directors Association. p. 2. http://www.setda.org/c/document_library/get_file?folderId=6&name=DLFE-329.pdf

⁸ *Ibid.*, p. 8.

⁹ *Ibid.*

¹⁰ *Ibid.*, p. 20.

Teacher development programs are only one of multiple complementary initiatives that districts and schools should undertake to augment their abilities to provide instructional technology in the classroom. A school's "policies, practices, culture, and funding" must be structured to facilitate long-term success with technology integration.¹¹ The SETDA report notes that changes in just one area (e.g., a teacher training initiative alone) may bring a temporary or minor change, whereas congruent changes in all of these areas are likely to build capacity for lasting improvements.

A more recent SETDA report, "National Educational Technology Trends: 2012," identifies four "critical" areas that need to be addressed in order to successfully transform teaching and maximize benefits:¹²

- **Infrastructure** – A school must be able to provide the resources students and instructors need, when and where they need them. This includes "adequate broadband connectivity."
- **Educator Effectiveness** – Professional development resources like collaborative learning environments, education repositories, and teacher coaching must be available to instructors.
- **Innovative Learning Models** – Schools must make use of online and digital content to "create meaningful learning experiences."
- **College and Career Preparation** – Students should have opportunities to develop competency using technology that may be required in college or a career.

Teacher effectiveness, augmented by PD, is vital component for the overall success of a school's program of technology integration. However, PD should not stand alone as the only measure for improving the integration of technology in the classroom.

BEST PRACTICES

The U.S. Department of Education's (U.S. DOE) 2010 National Education Technology Plan not only highlights the importance of properly preparing teachers to effectively use technology in the classroom, but also recommends a "continuing" and "connected" approach to professional development.¹³ Technology training should be 'continuing' insofar as it does not consist solely of "short, fragmented, and episodic workshops that offer little opportunity to integrate learning into practice."¹⁴ The DOE instead calls for a culture shift away from traditional education practices.

For instance, while many teachers have adapted to preparing and teaching independently, a "connected teaching" model calls for teaching as a "team activity."¹⁵ To successfully

¹¹ *Ibid.*, p. 11.

¹² Bullet points adapted from "National Educational Technology Trends: 2012," *Op. cit.*, p. 1.

¹³ "Transforming American Education: Learning Powered by Technology, National Education Technology Plan 2010," *Op. cit.*

¹⁴ *Ibid.*, p. 39.

¹⁵ *Ibid.*, p. xii.

integrate instructional technology, teachers need regular support from a community that can provide feedback and assistance – something that occasional workshops cannot provide. Teachers should have continuous access to resources that will support their teaching activities and professional formation, including:¹⁶

- Online courses;
- Online tutorials;
- Personal learning networks;
- Relevant content and data;
- Educational technology experts; and
- Technical assistance providers.

Professional development resources should be available online to facilitate a convenient and immediate learning experience for teachers. Teachers should have the opportunity to interact with fellow instructors and experts as members of online communities, so that they can share best practices and learn about effective technology integration.¹⁷

A 2011 whitepaper released by the International Society for Technology in Education (ISTE), “Technology, Coaching, And Community: Power Partners for Improved Professional Development in Primary and Secondary Education,” recognizes that successful professional development has online and social elements similar to those laid out in the U.S. DOE’s plan.¹⁸ The whitepaper highlights the importance not only of teacher membership in online communities, but also the importance of having a network of coaches available to provide professional-level direction. The paper notes that successful PD is:¹⁹

- Technology-rich,
- Delivered through a coaching model, and
- Enhanced by the power of community and social learning.

ISTE’s research is widely cited in recent literature; discussions of successful professional development programs consistently highlight the elements listed above as central to effective programming.

TEACHER COACHING

Educator coaching in instructional technology provides a number of benefits. Most importantly, teachers who have the support of a coach or mentor are more likely to make curricular changes and utilize technology in the classroom. The ISTE’s white paper highlights a seminal 2004 study conducted by the University of Kansas Center for Research on

¹⁶ Bulleted list adapted from: Ibid., p. 40.

¹⁷ Ibid.

¹⁸ Beglau, M., et. al., Op. cit.

¹⁹ Bulleted list quoted from: Ibid., p. 2.

Learning, which found that teachers who did not receive such support implemented new instructional methods at a rate of 15 percent, while teachers who received coaching implemented new instructional methods at a rate of 85 percent.²⁰

The ISTE notes that coaching provides “a scaffold for ongoing support and growth,” which in turn offers opportunities for “low-risk practice and lots of feedback.”²¹ Coaches create a learning environment for teachers that encourages integration practices and provides support when teachers encounter difficulties. Additionally, coaches help teachers see beyond traditional classroom pedagogy and quell concerns about using educational technology.²²

ISTE notes that there are three “essential” aspects to effective coaching:²³

- **Context:** Coaching practices must be in context with what can be used immediately.
- **Relevance:** Coached information must be highly relevant to the lessons currently being taught.
- **Ongoing:** Coaching support must be provided on a day-to-day basis where teachers can practice newly learned skills and ensure the highest potential for success.

While face-to-face teacher coaching can be established through professional learning communities (PLCs) within schools, Internet-based PLCs have the potential to connect teachers across multiple districts, offering “real-time support” and “serv[ing] as a catalyst for growth.”²⁴ ISTE highlights three coaching models that can be implemented by programs seeking to meet ISTE coaching standards.²⁵

- **Cognitive Coaching** – This type of coaching is focused on changing the way educators think and problem-solve.
- **Instructional Coaching** – This type of coaching is focused on practice-based development for teachers, targeting their ability to integrate technology as well as the areas of:²⁶
 - Classroom management,
 - Content planning,
 - Instruction, and
 - Assessment.
- **Peer Coaching** – This type of coaching focuses on training teachers to help their fellow instructors integrate technology into the classroom. The goal is to establish a

²⁰ Ibid., p. 6.

²¹ Ibid.

²² Ibid.

²³ Bullet points quoted from: Ibid., p. 7.

²⁴ Ibid.

²⁵ Ibid., p. 9.

²⁶ Ibid., p. 10.

collaborative environment in which coaches and teachers improve their classroom environments by addressing technology integration problems together.

An example of successful **cognitive coaching** can be seen in the work done at the Enhancing Missouri's Instructional Networked Teaching Strategies (eMINTS) National Center in Missouri. The eMINTS professional development program combines classwork (including online courses) with Internet-based community practice activities and coaching from trained staff. Coaches helped instructors develop specific classroom solutions, using tools such as:²⁷

- Modeling instruction;
- Lesson planning;
- Technology assistance;
- Reflective practice; and
- Problem solving around program implementation.

Instructional coaching programs have also shown successful results. For example, Kansas and Pennsylvania both participated in statewide initiatives as part of the 21st Century Teaching and Learning/Classrooms for the Future (CFF) coaching program. The program included training and networking opportunities for coaches, online resources for professional development, and webinars.²⁸

The Northern Arizona Technology Integration Coaching Consortium (NATICC) in Flagstaff Unified School District uses a **peer coaching** model focused on providing both technical hardware and training for teachers who will be using technology-enhanced classrooms. Teachers are taught how to effectively integrate technology into curricula, as well as how to coach other teachers who will be doing the same. The program is set up to instruct teachers in how to educate their colleagues on the effective use of technology in the classroom. During the first year of the program, student achievement grew by 15 percent or more in reading, math, and technology literacy.²⁹

PROFESSIONAL LEARNING COMMUNITIES

PLCs unite their members through a shared vision for improving education through the integration of instructional technology. Members come together to share ideas, problems, and solutions. This helps to reduce teacher isolation and provide the intellectual support and confidence that many teachers need to make significant changes.³⁰

²⁷ Bullet points quoted from: Ibid., p. 9. eMINTS resources are available online at <http://www.edutopia.org/stw-tech-integration-professional-development-video>.

²⁸ Ibid.

²⁹ These improvements are based on benchmark assessment scores ("National Trends Report: Enhancing Education through Technology," Op. Cit., p. 12). The report does not provide data from more recent years.

³⁰ "National Educational Technology Trends: 2012," Op. cit., p. 13.

While PLCs can be established locally and involve face-to-face meetings, the U.S. DOE, in its 2011 report, notes the benefits of Internet-based “Communities of Practice” (COPs). For the purposes of this report, “COP” is interchangeable with “PLC.” The report states, “Online communities can support systematic, transformative change in teaching and learning.” These online communities empower educators to:³¹

- **Access knowledge** – Teachers can access relevant knowledge through the Internet.
- **Share knowledge** – Teachers can share knowledge with each other without being bound by the limits of face-to-face interaction. For example, message chains can be developed, saved, and referenced over an extended period of time and at the convenience of the parties involved.
- **Create knowledge** – Like-minded teachers can work together even though they are geographically distant.
- **Build professional identity, relationships, and collaboration** – Educators’ professional identities become stronger through participation in online communities. Communities provide a sense of place and camaraderie for teachers who may otherwise feel disconnected or alone in their profession.

For these benefits to accrue to members, the DOE highlights seven core components fundamental to the success of online communities (see Figure 1.2).

Figure 1.2: Fundamental Core Qualities of Successful Online Communities

CORE QUALITY	DESCRIPTION
A clear purpose and collective identity	Communities should have a clear purpose that suits the needs of a well-defined targeted audience. Short-, intermediate-, and long-term desired outcomes of the community should be directly tied to the purpose and be clearly positioned to participants in this way.
Effective leadership and moderation	Notable online communities have leaders who are well connected and attuned to the group. Community leaders have a strong passion for the community’s goals and some expertise in at least part of the domain. They have excellent communications skills, the capability to build alliances both within and outside the community, and often have prior experience at moderating groups.
Clear policies, practices, and other methods to instill trust	Notable online communities generate trust by implementing clear and effective guidelines for participation and other governance structures and policies. For example, using a screening and approval process can provide an important level of reassurance for many educators about the credibility of other members.

³¹ Bulleted list adapted from: “Connect and Inspire: Online Communities of Practice in Education.” United States Department of Education. 2011. http://connectededucators.org/report/files/2011/03/0143_OCOP-Main-report.pdf

CORE QUALITY	DESCRIPTION
Sociability and social presence	As an initial condition, sociability can be cultivated by starting a community with a known critical mass of active or core users that can sustain it until it grows. Once launched, community responsiveness—making sure that questions are answered and contributions elicit responses—is key to sociability and to building trust as well.
Organic growth, dynamism, and innovation	Online communities should reflect the natural growth of the group in terms of its critical mass and sophistication. At the same time, successful online communities refresh their sites with rapid turnover of featured content, including topics, events, promoted contributions, challenges or contests, on the home page and throughout the site. To retain those who are constantly looking for "what's new," successful communities often place a premium on innovation.
Communication and outreach	Nearly all notable communities, in education and in other industries, reach out to participants and potential participants with regular, targeted communications. They share accounts of activity with other online communities and organizations within the domain to look for opportunities for collaboration. They understand that site registration is only the first step in an ongoing process to securing and retaining the loyalties of their members.
Integration with a larger professional ecology	Notable online communities do not exist in a vacuum. Their activities and interactions are well integrated with the online content, services, and larger goals and activities of the sponsoring organization(s), such as key initiatives, partnerships, or events. Equally important, many online communities connect to face-to-face opportunities for networking, learning, and collaboration, such as meetings, workshops, or conferences.

Source: United States Department of Education³²

TECHNOLOGY-RICH PROFESSIONAL DEVELOPMENT

The ISTE notes that “Learning *with* technology is more important than learning *about* technology.” In other words, teachers should be taught with the technology they will be using. When teachers are trained this way, they will have experienced the effectiveness of technological tools and will be better positioned to believe that they can utilize them effectively. This is especially true for technology that is unique to the classroom setting.³³

Some states have found success with education resource repositories. These repositories “provide access to aggregate resources and online learning options for students, teachers, and administrators. They also provide access to current and relevant data and information about teaching and learning to parents, community members, and other stakeholders.” A centralized online repository may also be useful to those instructors who are most comfortable working with integration issues at their own pace.³⁴

³² Figure contents adapted from: Ibid., pp. 13-22.

³³ “Technology, Coaching, and Community: Power Partners for Improved Professional Development in Primary and Secondary Education,” Op. cit., p. 17.

³⁴ “National Educational Technology Trends: 2012,” Op. cit.

A 2009 teacher survey by the NCES found that many teachers felt that they could prepare themselves to integrate technology in classroom instruction through independent learning.³⁵ Online repositories can help make quality resources readily available to teachers interested in learning about educational technology at their own pace.³⁶

LOW COST, HIGH CUSTOMIZATION

Professional development literature emphasizes that there is no universal model applicable to all districts. This is particularly relevant to PD for instructional technology education, where program customization through the use of teacher coaching, PLCs, and other online resources is easily accomplished. PD programs can be tailored to meet district needs while utilizing the same technology that teachers will be integrating into their lesson plans.

Many professional development programs can be implemented at a limited cost. Online resources and the train-the-trainer model of professional development make good use of existing technological infrastructure.³⁷ Online communities are also potentially productive environments that can be established using affordable technology.³⁸ The 2011 SETDA report notes that the collaboration provided by online communities takes place in “a nonthreatening, virtual environment...[where] educators can share and learn without regard to geographic location, reducing the financial burden on already strained state and local education budgets.”³⁹

Districts may not need to devote resources to a multitude of customized development options for teachers, so long as the general resources themselves are designed to provide customized solutions. Teacher coaching allows for individualized instructor feedback and guidance, which is likely to motivate teachers and heighten their senses of responsibility.⁴⁰ PD customization can be further directed by the teacher through selected participation in PLC discussions or by asking the community specific questions.

³⁵ Ibid., p. 17, Table 9.

³⁶ “Teachers’ Use of Education Technology in U.S. Public Schools: 2009,” Op. cit.

³⁷ “National Educational Technology Trends: 2011,” State Educational Technology Directors Association, p. 11
http://www.setda.org/c/document_library/get_file?folderId=6&name=DLFE-1302.pdf

³⁸ “Connect and Inspire: Online Communities of Practice in Education,” Op. cit.

³⁹ “National Educational Technology Trends: 2011,” Op. cit., p. 10-11.

⁴⁰ Ibid., p. 103.

SECTION II: CHANGING PEDAGOGY

In this section, Hanover examines considerations for integrating technology into K-12 classrooms, and how teachers can effectively alter their pedagogies to more seamlessly incorporate technology into classroom instruction.

TECHNOLOGY-RICH EDUCATION

According to the Organisation for Economic Co-operation and Development (OECD), schools that make use of educational technology on a routine basis report the highest levels of students with technology-related skills.⁴¹ However, commonly used supplementary teaching technologies, such as LCD projectors, interactive whiteboards, or guided web-tours, generally reinforce traditional “teacher-centric, lecture-based” pedagogy. While these tools may be occasionally useful for specific lessons, students can sometimes become distracted by the tools rather than engaged in the content.⁴²

Elevating the use of technology in the classroom from an instructional supplement to a core teaching component requires teachers to shift their pedagogical practices. Such a transition requires teacher support from the district level to facilitate access to the technology and training necessary to engender large-scale changes.⁴³ If access and use of technology is not continuous from year-to-year, it is difficult to effect meaningful change in teaching pedagogies.

One approach to integrating technology into classes is to develop a “technology-rich” classroom. Staker and Horn define technology-rich instruction as “a structured education program that shares the features of traditional instruction, but also has digital enhancements.”⁴⁴ Such classroom environments, according to SETDA, provide regular access to computers with Internet access and educational software, as well as other devices (“technology tools”) that foster student use of digital and online resources.⁴⁵ Available devices and support may include:⁴⁶

- Laptops
- Interactive Response Systems
- Digital Content
- Collaborative Tools
- Tablets
- Projectors
- Video Cameras
- Interactive Whiteboards
- Education Portals
- Learning Management Systems
- Online Assessments

⁴¹ “Teachers, Teaching, and ICTs.” InfoDev Growing Innovation. <http://www.infodev.org/articles/teachers-teaching-and-icts>

⁴² Ibid.

⁴³ Moeller, B., T. Reitzes. “Integrating Technology with Student-Centered Learning.” Education Development Center, Inc. July 2011. <http://www.nmefoundation.org/getmedia/befa9751-d8ad-47e9-949d-bd649f7c0044/integrating>

⁴⁴ Staker, H. and M. Horn. “Classifying K-12 Blended Learning.” Innosight Institute, May 2012. p. 6. <http://www.christenseninstitute.org/wp-content/uploads/2013/04/Classifying-K-12-blended-learning.pdf>

⁴⁵ “National Educational Technology Trends: 2012,” Op. cit., p. 17.

⁴⁶ Bulleted list quoted from: Ibid., p. 17.

This type of environment provides instructors with a wide variety of pedagogical opportunities. For example, instructors can also open their classrooms to a variety of educational sources that would be difficult or impossible to access otherwise, such as guest lecturers who interact with the class via Skype, virtual tours of museum exhibits, or interactive demonstrations of science experiments.⁴⁷

While it is vital for schools to have the proper technology infrastructure, including appropriate Internet bandwidth, in place when developing a technology-rich learning environment, schools must remember that the simple presence of technology in the classroom does not, of itself, ensure increased student engagement and improved student outcomes. Schools must maintain content and assessment quality standards.⁴⁸

TECHNOLOGY AND THE STUDENT-CENTERED PEDAGOGY

TRADITIONAL CLASSROOMS

A report prepared by the Information for Development Program (IDP) found that schools that maintain a teacher-centered instructional pedagogy (lecture-based, rote learning) in the classroom generally only use technology as a supplement to lessons – most often simply to display content.⁴⁹ On the other hand, schools that adopt a learner-centered “constructivist” model see greater integration of technology into the classroom and experience larger gains in student achievement.⁵⁰ The IDP has found that schools experience the most success in technology incorporation when there is complete buy-in from the administration and widespread pushes to incorporate these tools. Support from building and district administrators appears to be a key factor in motivating teachers to change their teaching styles and successfully incorporate instructional technology into their pedagogies.

Constructivist student-centered pedagogies involve using technology as a medium for experiential learning activities like writing, research, collaboration, and analysis.⁵¹ The use of technology in student-centered learning approaches requires a certain level of student responsibility and self-directed learning as both the teacher and students take on new roles.⁵² In this model, teachers act as coaches or advisors to students and guide them through the process of exploring their own distinctive career and academic interests.

In the student-centered model, teachers relinquish some control of topics covered and change their role in the classroom.⁵³ Students may pursue topics of personal interest; however, the teacher still sets specific goals for each student to meet that are content- or

⁴⁷ “Transforming American Education: Learning Powered by Technology, National education Technology Plan 2010,” Op. cit., p. 42.

⁴⁸ “National Educational Technology Trends: 2012,” Op. cit., pp. 5-6.

⁴⁹ “Teachers, Teaching, and ICTs,” Op. cit.

⁵⁰ Ibid.

⁵¹ Moeller, Op. cit., p. 10.

⁵² Ibid., p. 17.

⁵³ Ibid., p. 17.

skill-based. Students must be resourceful and self-directed, as they often move at their own pace and work independently, seeking help when necessary. Teachers make themselves available to provide support and necessary guidance throughout the student's learning.⁵⁴

The student-centered learning model generally requires that technology-based teaching be deeply integrated across the district. Teachers not only use technology to facilitate learning, but assignments should also expand technology literacy and skill-building in use (e.g., using multimedia software to create a video about evolution teaches the student about evolution and about the software being used).⁵⁵ It is important that students are not passive in this learning process and are not mere receivers of information via technology.⁵⁶ Additionally, teachers generally need to develop ongoing assessment tools to gauge students' progress toward their goals. Assessment technology can also be used by teachers identify strengths and weaknesses, thus further tailoring the support provided to each student.⁵⁷

The Education Development Center has identified eight common approaches employed by schools that focus on student-centered teaching pedagogies through the use of technology:⁵⁸

- *Technology is deeply integrated into the overall vision, mission, and curriculum of the schools.*
- *Technology is used flexibly across the curriculum as a tool for project-based learning and to support the pursuit of academic goals.*
- *Technology is also an object of study through courses such as video production, multimedia design or computer science.*
- *The curriculum is designed to foster the development of 21st century skills.*
- *There is an emphasis on using technology in authentic ways (e.g., using digital probes to collect scientific data, using computer assisted design tools for creating blueprints) that mirror how professionals in the workplace use digital tools.*
- *Students are active users and shapers of digital tools, rather than passive recipients of information delivered online.*
- *Schools utilize performance-based assessments that include technology as a tool and allow teachers to measure, among other things, students' competence with technology and 21st century skills.*
- *Teachers receive extensive professional development on using technology to support learning and have access to ongoing assistance during the school year.*

⁵⁴ Ibid., p. 17

⁵⁵ Ibid., p. 36.

⁵⁶ Ibid.

⁵⁷ Ibid., p. 18.

⁵⁸ Bulleted points quoted, with minor adjustments, from: Ibid., p. 36

ALTERNATIVE COURSE FORMATS

Many virtual schools augment traditional brick-and-mortar schools by providing online instruction and content. Online courses allow students access to an increased variety of course content with flexible scheduling so that students can spend as much or as little time as they need moving through coursework.⁵⁹ Because the virtual class is done in conjunction with traditional schooling, there is still teacher interaction and opportunities for teachers to intervene and provide guidance when necessary. Furthermore, students can also actively engage in their online coursework both in and out of the classroom.⁶⁰

The “flipped classroom,” which employs instructional technology to move typical lectures to the online space, is another tech-based teaching method that has grown in popularity in recent years.⁶¹ Within the flipped classroom format, students watch recorded lectures and content online outside of the classroom as “homework.” During classroom time, the teacher can engage students in activities to reinforce the concepts they learned about online. Because the traditional “homework” (i.e. concept engagement) is done during class under the supervision of the teacher, students can receive individual help working through problems and successfully complete assignments.⁶²

In order to make this pedagogical shift, teachers must utilize technology to record content themselves, or employ prerecorded content, for students to watch outside the classroom. Pre-recorded or “asynchronous” lectures require their own set of unique considerations, such as additional time need to produce online modules, video quality, and the ability of the videos to keep students engaged.⁶³ Classroom activities do not necessarily need to employ additional technology; however, the additional time for in-class activities would allow teachers to incorporate other learning technologies to reinforce project-based learning.⁶⁴

EMERGING TECHNOLOGY AND CLASSROOM TOOLS

There are many technological tools at a teacher’s disposal to facilitate classroom instruction, assessment, and general administrative tasks. According to the IDP, teachers most often use educational technologies for routine administrative tasks such as record keeping, lesson planning, and basic Internet searching.⁶⁵ In terms of instructional applications, many teachers are still not familiar with the scope of technology available or are not confident in their abilities to use them effectively.⁶⁶ However, the IDP suggests that technical mastery of technology, while important, is not as central to effective instruction as understanding appropriate pedagogical practices for using technology.

⁵⁹ Ibid., p. 23.

⁶⁰ Ibid., p. 21.

⁶¹ “Flipped Classroom.” Knewton. <http://www.knewton.com/flipped-classroom/>

⁶² Ibid.

⁶³ “7 Things you Should Know About Flipped Classrooms.” Educause.
<http://net.educause.edu/ir/library/pdf/eli7081.pdf>

⁶⁴ Moeller, Op. cit., p. 29.

⁶⁵ “Teachers, Teaching and ICTs,” Op. cit.

⁶⁶ Ibid.

Digital media tools are readily available and highly customizable to classroom needs. For example, the State of Arizona, as part of its iAchieve Project, used federal and local funds to ensure that each student in 18 third grade classes and two Spanish immersion classes (700 students total) in the Creighton Elementary School District had access to a mobile device. These were used to practice and improve reading skills. Students had access to audio recordings, digital flash cards, digital stories, and Internet access to additional apps. Students in this program improved their reading assessment scores by 8 percent, while students not participating in the program improved by just 0.5 percent.⁶⁷

Digital textbooks and library books have become widely adopted on college campuses but have yet to gain popularity in K-12 settings.⁶⁸ New platforms like CAST's UDL book builder give teachers and students the capability to "build" digital books to meet a variety of academic needs. Furthermore, with some digital books, students have the capability to post their annotations and comments from reading directly to the online classroom. A range of options are available for online student collaboration, from simple tools like GoogleDocs to comprehensive learning systems like Blackboard.⁶⁹ "Social learning" harnesses social media platforms to foster student engagement and collaboration through virtual study sessions, educational content sharing, and classroom blogs.⁷⁰

Within the live classroom, mobile devices are increasingly useful as teaching and assessment tools.⁷¹ Teachers can use an Automated Response System (ARS) to poll or quiz students through students' mobile devices such as cell phones and iPods, with the results instantly displayed for the class. This can instantly provide accurate assessment of student understanding and facilitate an appropriate discussion or lesson. In elementary reading instruction, teachers have used handheld computers to "manage and organize the administration of assessments and as a data input device to keep records of students' errors as they read passages that are provided to them in print."⁷²

Online project submission platforms, such as SafeAssign and TurnItIn, help teachers keep assignments organized and track multiple drafts of a document; furthermore, teachers can also use this software to check projects for plagiarism.⁷³ These online submission tools can also facilitate student collaboration, peer review, or resource sharing among students.

⁶⁷ "National Educational Technology Trends: 2012," Op. cit.

⁶⁸ Moeller, Op. cit., p. 37.

⁶⁹ Ibid.

⁷⁰ Crockett, R. "50 Education Technology Tools Every Teacher Should Know About." 21st Center Fluency Project, March 26, 2013. <http://fluency21.com/blog/2013/03/26/50-education-technology-tools-every-teacher-should-know-about/>

⁷¹ Moeller, Op. cit., p. 38.

⁷² Ibid,

⁷³ "Technology for Education." for Teaching Excellence & Educational Innovation. <http://www.cmu.edu/teaching/technology/>

CHALLENGES TO INTEGRATING NEW TECHNOLOGY IN THE CLASSROOM

Information visualization is often a key component of effectively using technology in the classroom. Information can be presented as simply as on the traditional classroom blackboard or as complexly as an interactive 3-D visualization of a concept or data set.⁷⁴ Using technology to present information to students has the potential to be highly successful, but teachers should be aware of the potential obstacles that may arise, particularly when experimenting with a new method or technology platform.

The Eberly Center for Teaching Excellence and Educational Innovation (ECTEEI) is a division of Carnegie Mellon University that focuses on addressing the pedagogical and technological issues that instructors and students encounter in the classroom.⁷⁵ The ECTEEI has identified a number of common pitfalls teachers experience when introducing new pedagogies and classroom technology, as well as preemptive strategies to address them. Selected pitfalls and strategies most relevant to K-12 applications are presented in Figure 2.1.

Figure 2.1: Guidelines for Implementation of Technological Tools

PITFALL	STRATEGY
Instructor focuses on the technical capabilities of a tool and loses sight of the learning objectives.	Structure the assignment to reinforce the learning objectives. Think hard about goals for a course or assignment, and design the material so that students must demonstrate learning in these areas. Make sure performance criteria are consistent with these objectives as well. If teachers find they are having trouble reconciling the tool with learning objectives, they should consider dropping the tool or looking for a more appropriate one.
Instructor assumes that since students are familiar with the web, they will automatically know how to use digital tools.	Provide guidance on how to use tools. Do not assume that students who are savvy in some aspects of computer use can easily learn and use digital tools. Provide guidance on how to use a new tool, whether by demonstrating it in class, pointing students to an online tutorial, or providing instructions.
Instructor underestimates the time it will take students to develop fluency with the tool.	Give students practice with the tool before applying it to complex tasks. When students are trying to learn two things at once (e.g., how to use a new tool as well as how to analyze data), their learning and performance often suffer because their attention is divided. Thus, it is important when teaching a new tool—especially a complex one—to allow time for students to practice using it. Make sure they have enough time not only to learn the tool, but also to gain fluency with it before tackling complex problems.
Instructor doesn't anticipate potentially time-consuming problems.	Factor in time for unanticipated problems. When planning and scheduling assignments, think about logistical and technical problems students might encounter. Warn students about potential trouble spots (e.g., non-intuitive aspects of the interface, limited access to computer clusters) and hidden steps (e.g., configuring a personal computer, acquiring necessary software). Make sure students have access to the resources and technical support they need, as well as the time to address problems as they arise.

⁷⁴ "Information Visualization Tools." Eberly Center for Teaching Excellence & Educational Innovation. <http://www.cmu.edu/teaching/technology/informationvisualization/>

⁷⁵ "Home." Eberly Center for Teaching Excellence & Educational Innovation. <http://www.cmu.edu/teaching/index.html>

PITFALL	STRATEGY
<p>Instructor assumes students understand what they're seeing in visual displays.</p>	<p>Ask students questions to probe their understanding. Instead of assuming that students can “read” graphic representations of information, ask questions that require them to describe, explain, and reason about what they are seeing. For example, an instructor using the visually rich Gapminder.com website might ask students questions such as: What do these circles represent? Why are they different sizes? What do the colors indicate? Why are they moving up as we approach the 20th century? How would you describe the trend you're seeing?</p>
<p>Students focus on peripheral aspects of the assignment rather than the main tasks.</p>	<p>Focus students' attention on the learning objectives of assignments. Clearly articulate expectations and priorities for an assignment (e.g., “I am interested in your analysis of demographic patterns, not the number of photos you attach to your map”) so that students focus on the key intellectual tasks and are not distracted by the tool's other capabilities. Explicitly distinguish the key components of the task—for example, “create a map that clearly illustrates patterns of violent crime in the city, write a report in which you explain these patterns in terms of public policy, and provide three policy recommendations.” Clarify priorities via a breakdown of points for the assignment (e.g., 80 points for data analysis and explanation; 20 points for visuals).</p>
<p>Instructor assigns group projects, thinking it will be more efficient.</p>	<p>Recognize the added burdens of group work. Rather than reducing the amount of work students must do or enabling them to work faster, group work generally adds an additional and different set of complications, because it requires students to coordinate their schedules and integrate their work. It also requires a different set of skills than working individually, such as reconciling differences, synthesizing perspectives, communicating effectively, and delegating. Because students' success is tied to other students' efforts, it can be stressful. Group work is a complex pedagogical issue in its own right that requires careful thought and planning. When combining it with other complexities, such as new technologies, teachers should plan carefully.</p>

Source: Eberly Center, Carnegie Mellon University⁷⁶

⁷⁶ Figure contents quoted, with some modifications, from: “Information Visualization Tools,” Op. cit.

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1700 K Street, NW, 8th Floor
Washington, DC 20006

P 202.559.0500 F 866.808.6585
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