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Technology Implementation in Schools: Key Factors to Consider New technologies have changed teaching and learning in a number of ways—from graphing calculators to online lesson plans to virtual field trips and simulated dissections, educational technologies can help students access content in new and often exciting ways. In fact, one would be hard pressed to find a single school that doesn't have access to some kind of educational technology. According to surveys, as many as 95% of schools are connected to the Internet; even at the level of the individual classroom, connection is nearly as universal—close to 75% of classrooms in the United States have Internet access (CEO Forum, 2000). Despite this nearly ubiquitous access to computer technology, however, there is a significant gap between the presence of technology and its usage in the classroom. While some type of technology is present in nearly every classroom in the country, it is rarely used to its fullest potential (Royer, 2002). Some of this discrepancy is due to a lack of comfort with using technology for teaching and learning. Even teachers who are using technology and report a high degree of comfort with technology tend to use it in fairly rigid ways, such as searching for activities to use with students, communicating with other teachers, and word processing (Price, Cates, & Bodzin, 2002). And while students frequently do use computers in the classroom, use is often limited to information gathering and word processing rather than using multimedia tools or digital content to design and create products (Price et al., 2002). Often, learning with technology is teacher-centered rather than student-centered. While many teachers still feel uncomfortable using technology in their teaching practice, it is also likely that teachers feel new technologies are unproven in the

classroom (Royer, 2002). Though there has been a great deal of research on the efficacy of technology tools for teaching and learning, many of these studies may not translate well to the reality of the classroom (Wallace, Blase, Fixsen, & Naoom, 2007). According to the stages of implementation discussed in the companion Research in Brief article, Understanding the Design, schools may find themselves stuck in a series of initial implementation efforts, trying one thing after another, and not achieving full implementation of a program. Even high-quality training, if used in isolation, is not sufficient to lead to full-scale implementation of technology; for true technology integration, teachers need to do more than simply learn about a new technology tool (Wallace et al., 2007). If schools want teachers to use technology to enhance student learning, then it is important to address these issues. Teachers are inundated with new initiatives every year; new ideas come and go and are rarely sustainable (Zorfass, 2001). To avoid "initiative fatigue," schools must focus not only on introducing new technology, but also on implementing and scaling up new technologies. While every school is different, with different needs and resources, there are several factors that facilitate technology implementation and can help address the challenges mentioned above, making your school's change efforts more successful. Research on educational interventions (Abbot, Greenwood, Buzhardt, & Tapia, 2006; Billig, Sherry, & Havelock, 2005; Blumenfeld, 2000; Ely, 1990; Elmore, 1996; Ertmer, 2005; Glazer, Hannafin, & Song, 2005; Price et al., 2002; Royer, 2002; Staples, Pugach, & Himes, 2005; Zorfass, 2001) has shown the following factors to be instrumental in implementing school-wide change: * Professional development * Leadership

* Organization and school structure * Resources and support Factors that facilitate implementation will play a role in every stage of the intervention, from the initial planning and exploration phases to helping to sustain the intervention once fully implemented. While certain factors may be more important during certain stages, each factor is a necessary component of an effective intervention. CITED's EdTech Locator is a tool that can help school-based teams have a conversation about the alignment of uses of technology with goals for teaching and learning. Consult the Locator and the accompanying self-assessments with a team of colleagues to identify paths toward deeper integration of technology in service of fuller inclusion and achievement of all students. Professional Development Every educator has professional development needs. From refresher courses on content areas to intensive training in new technology tools, professional development is a critical component of teaching and learning. It is also an essential component of any school change effort, but it is particularly useful in the implementation of educational technology and the creation of digital learning environments (CEO Forum, 2000). Many teachers—particularly those who did their teacher preparation years ago—did not receive instruction on teaching with technology tools (Staples et al., 2005). While this is becoming less of an issue now that more teachers have begun to learn about technology tools in pre-service training, it is still an area where considerable professional development is needed, as demonstrated by the shallow ways teachers report using technology (described above). When designing professional development activities for technology implementation, it is critical that efforts be twofold: teachers need basic technical knowledge about how to

use a tool, as well as knowledge about how to integrate the tool into their existing curriculum (CEO Forum, 2000). In order to achieve full-scale change, schools need to ensure that strong professional development programs are in place and that teachers have a variety of opportunities for learning and growth (CEO Forum, 2000; Price et al., 2002; Royer, 2002; Staples et al., 2005). Professional development choices are best made according to the individual needs of schools and educators. Some schools may find that small study groups meeting during the school day work for them, while other schools may orchestrate release time through the use of teaching interns or building substitutes. Regardless of format, there are several characteristics that effective professional development activities tend to have in common. Effective professional development is planned and intentional. Successful professional development does not just happen; it requires careful planning and goal setting. Schools should begin by determining the needs of their students and staff, gathering this information through planning meetings, teacher surveys, and collection of student data. Using this data, schools need to set clear goals and purposes for their professional development program. Professional development should focus on content and strategies that help students learn best. Schools should continue to collect data through all phases of professional development activities to ensure that the activities are linked to high standards and current curriculum, and are meeting desired goals. Effective professional development is ongoing. The teaching profession is constantly changing, so it is important for teachers to be continuous learners. Effective professional development should occur throughout the school year, not just during one-shot workshops or summer

sessions. Teachers must have frequent opportunities for in-depth and active learning that is authentic and useful in their daily practice. In order to ensure implementation of new strategies, teachers need to have ample time to practice in their own classrooms. For this reason, interventions learned during the summer without time for practice are often abandoned during the school year. Effective professional development is a systemic process.

Allowing teachers to take active roles in their own learning is another way to ensure a successful professional development program. Encouraging teachers to take leadership roles and make decisions about interventions means that professional development is more likely to reflect the needs of teachers and students. Teacher-leaders also help to create a professional development model that is school-wide and long-lasting rather than the more typical one-shot workshops and piecemeal approaches. In this type of professional development program, teachers have the opportunity to work together through study groups or common planning time, sharing knowledge across grade level and subject. This collaboration and sharing of knowledge helps to ensure that professional development activities are system-wide, part of the daily practice of teachers and the overall school culture (CEO Forum, 2000; Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet, Porter, Desimone, Birman, & Yoon, 2001; Guskey, 2000). Further information about professional development and advancing professional knowledge can be found in CITED's Learn Center for PD Coordinators and Administrators .

Leadership In any school change effort, the role of the school administrator through every stage of implementation is critical. The attitudes and actions of school leaders surrounding new technologies will encourage and support

teachers as they engage in learning opportunities and explore new tools. Through their role as school leaders, school administrators can help ensure that the use of technology is prioritized, and that teachers feel comfortable trying new things (Billig et al., 2005; Staples et al., 2005; Zorfass, 2001). At one school, this was achieved by requiring that all school staff, from the school secretary to the principal, develop personal professional development goals (Hassel, 1999). Strong leadership in an educational setting means that school principals and other school leaders must play multiple roles in the change process, including role model, leader, motivator, resource provider, and facilitator (Payne, 2000; Wallace et al., 2007). The table below is compiled from the literature on the roles and responsibilities of leaders of technology initiatives.

Administrator Role	Responsibilities	Role Model
Engages in learning and change alongside teachers (e. g., using new technologies, attending conferences and workshops, and keeping up with current research)	Leads by example	Encourages teachers to try new things
Leader of a Learning Organization	Sets the tone for change by setting high standards for cooperation, learning, and collaboration	Motivator and Cheerleader
Makes change a high priority	Encourages and supports teacher efforts	Resource Provider
Helps to ensure that teachers have the resources they need to achieve change goals	Facilitator	Provides teachers with learning opportunities
Spearheads change efforts	Ensures that the project moves through each stage of technology implementation	Identifies barriers and facilitators to technology integration
Resolves problems	As part of CITED's Technology Implementation Partnership, administrators assume each of these roles as they work together to integrate technology. At	

one school, the building principal has attended every training meeting and workshop with her classroom teachers, orchestrated release time so teachers can plan together, and helped to coordinate efforts with other relevant staff (i. e., the school technology coordinator and other classroom teachers with interest in the intervention). This involvement on the part of the school principal has ensured that teachers feel they have the time to make necessary changes in their teaching in order to use technology to differentiate instruction. Her willingness to create and protect time also communicates to teachers that technology integration is a priority. As the school hopes to expand the use of the intervention software to other grades in the next school year, this initial investment by the school principal creates a strong foundation for further change. It is also important that school administrators have close working relationships with district-level administrators and technology coordinators. Working together as part of a team of change leaders, these individuals help ensure that technology implementation is carried out in a thoughtful manner that meshes with district visions for technology (Dede, Honan, & Peters, 2005). This team-based approach can also help ensure consistency and fidelity to reforms in cases of administrator turnover (Dede et al., 2005).

Organization and School Structure A necessary complement to strong school leadership is a school culture that supports and encourages change. Schools with successful educational interventions have organizational structures that encourage teacher autonomy as well as frequent collaboration among staff (Billig et al., 2005). These structures allow teachers to become responsible for their own learning and also create opportunities for teachers to learn about topics that

are valuable to their teaching practice. In addition, the organizational culture of these schools provides significant room and time for collaborative work (Billig et al., 2005; Elmore, 1996). Again, the school leader plays a valuable role in this process. As motivator and role model, the school administrator can help build a school culture where teachers work together towards a shared vision for change (Billig et al., 2005; Glazer et al., 2005). The school leader ensures that teachers have the resources and support they need for technology initiatives, and that selected technology tools are connected to teaching practice and curriculum (Staples et al., 2005). Another way that the administrator can influence school culture to encourage the scaling up of technology is to draw attention to teacher successes through the use of bulletin boards, newsletters, or showcase conferences (see the companion Research in Brief article, Sustaining Technology Implementation. When technology implementation projects are highly visible and valued by the school community, teachers will be more likely to attempt implementation in their classrooms, persisting through the difficult early stages to gain confidence and see results (Billig et al., 2005). Resources and Support Ultimately, successful school-wide change will not occur without strong resources and support from a variety of sources. While few technology innovations could be implemented without considerable financial resources; money alone will not ensure successful implementation. Changing an entire school requires hard work by all involved (see the companion Research in Brief article, Understanding the Design). This includes human resources in the form of time for planning, professional development, collaborative work, and trying new things (Abbott et al., 2006). Changing a school also requires

that teachers and administrators support each other and share a vision for the future of the school. In addition to resources such as time, money, and staff needed to carry out educational interventions, several types of support (Abbott et al., 2006; Billig et al., 2005; Glazer et al., 2005; Hawkes, 1995; Price et al., 2002; Staples et al., 2005; Wallace et al., 2007) are needed for all staff involved: * Technology support * Support for participation * Administrative support * Community support * External support Technology support. Before beginning any technology innovation, schools need to have strong technology supports in place. Teachers need to know that they have help when technology fails, that they have resources when they are unsure how to use a tool, and that they can get recommendations about technology usage in the classroom. Technology tools are often purchased and abandoned in classrooms, not because they aren't helpful for students, but because teachers do not have the time to troubleshoot software or set up peripherals. If a tool does not work the first time, teachers often become discouraged and decide that the new tool is not worth the trouble—particularly when their old way of doing things worked just fine! The CITED Learn Center for Administrators features a Technology Infrastructure resource list that assists administrators in creating a strong technology support system for teachers. Support for participation. If schools hope for teachers to be fully involved in the implementation of new technologies, they need to provide supports for teacher participation. Schools may use incentives (e. g., flex time, school supplies, graduate credit, or free babysitting for teachers who stay late) to encourage participation in learning opportunities. Incentives can also take the form of praise and recognition

from school administration. It is beneficial to offer support for participation even in instances where the school opts to make implementation mandatory (as when a school is switching over to a new online grading system). For some teachers, these changes may be overwhelming; a kind word or recognition of success from school leaders will go a long way in encouraging future participation (see the companion Research in Brief article, *Sustaining Technology Implementation*). Administrative support. Technology implementation brings anxiety to the change process; teachers need an environment where they feel comfortable taking risks and learning new things. Administrative support allows teachers the freedom (and the time) to explore new technologies. Administrators also must help ensure that technology projects are valued. Supporters may include members of the implementation team, such as teacher leaders, subject area coordinators, technology coordinators, and/or a special education director. These leaders are responsible for moving the project forward in ways that may include identifying potential barriers to change and finding solutions, or ensuring that facilitators to change are solidly in place. This allows teachers to move forward with technology changes knowing that they have the administrative backing to succeed. Community support As with any school change effort, support from the larger community can give technology implementation a boost. Community support can come from a variety of sources: community-wide support for funding increases so schools can purchase technology, for example, or community members who are willing to teach courses to students (and teachers) on Web design, computer-aided drafting, or programming. Community support can also refer to the overall school

community and stakeholders in the school change process. In order to bring about change, schools need the support of these key stakeholders (educators, administrators, school board members, parents, etc.) from the early exploration stages of implementation through to full implementation of a new technology. Their support is a key element in developing a sustainable change in your school. External support . Support from outside the community can also be beneficial. Schools may opt to partner with universities, educational researchers, software companies, or others as ways of gaining access to research, technology tools, and technical assistance. For example, a school in an urban area may have a number of colleges and universities nearby. Graduate students may be helpful in developing assessments and conducting evaluations of progress. Local businesses or corporations or their philanthropic efforts are potential partners in technology efforts given the connection to 21st century skills and workforce development issues. Further information about providing necessary resources and support for technology integration can be found in Administrator resources. Facilitators vs. Barriers to Technology Implementation Each of the factors mentioned in the previous section is an important piece of the puzzle when integrating technology into your school. Professional development, leadership, school structure, and available resources all work together to facilitate the process of technology implementation. However, any of these facilitators can easily become barriers without careful planning. The presence of professional development alone will not guarantee successful implementation. In fact, a weak or poorly planned professional development program may actually impede technology

integration. A lack of community or parental support for your school's technology initiative may also present a barrier to implementation. It is important to carefully evaluate the various factors present in your school, district, and community before beginning a technology implementation, and to identify potential barriers and facilitators. In this way you can try to address possible problems before they arise; consider the stages of implementation and importance of a team approach in the companion Research in Brief articles, *Understanding the Design and Implementation Teams Make it Happen*. Consider, too, the critical importance of alignment with other initiatives. For example, if a lack of community support or interest is likely to be a barrier, your school may opt to involve community members in planning efforts, keep parents and families regularly updated with a technology newsletter, or convene focus groups to determine the technology priorities of the community. In addition to addressing potential barriers before they arise, these actions may also lead to the development of facilitating factors—perhaps a member of the focus group will volunteer time to help show teachers how to create their own classroom websites! There are a number of factors involved in integrating technology into your school or district; if properly addressed, they can help facilitate the process and ensure that your efforts are more successful. Many resources on facilitators and barriers are available to assist you in this process; see the reference list below for suggestions.