Abstract

An increasingly urgent imperative for teacher education and K-12 classrooms is the application of technology for teaching and learning purposes. The research literature is replete with rationale for both pre-service and practicing teachers to develop information communication technology (ICT) skills. Developing sound technical skills can be challenging for educators who face a rapidly changing landscape of technology tools. Research also points to a lack of self-efficacy and utilization of technology among pre-service teachers that links back to teacher education programs. The author discusses prospects for improving technological acquisition among pre-service and practicing teachers.

Keywords: ICT, technology, pre-service teacher, preservice teacher, teacher education
Introduction

Education is a field with high expectations for outcomes and faces pressures to adapt and evolve quickly. Today, there is further pressure on education to respond to a technically driven society and the broad use of information communication technology (ICT). The Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), the performance measurement and reporting task force for the International Society for Technology in Education (ISTE), has defined ICT as “technologies used for accessing, gathering, manipulation and presentation or communication of information” while ICT literacy is defined as “the ability of individuals to use ICT appropriately to access, manage and evaluate information, develop new understandings, and communicate with others in order to participate effectively in society” (MCEETYA, 2005, p. 2). Teachers today can make use of new modalities including, most notably, smart phones and computer applications (Partnership for 21st Century Skills, 2011) to engage students in inquiry, collaboration and dissemination of new information (Larson, Miller and Ribble, 2010).

The ISTE has developed the major standards for ICT in teacher education in the United States. Applying a holistic view, the standards encompass students, teachers, administrators, coaches and computer science educators in the K-12 learning environment. ISTE standards for students propose that students should be able to communicate and collaborate within digital media environments, understand the legal and ethical considerations around using technology, have knowledge of technology systems and concepts, demonstrate creative and innovative thinking utilizing technology, and use digital tools for the gathering, evaluation, and use of information (ISTE, 2012a). The standards for teachers ask that they facilitate such learning events, design and develop digital age learning experiences and assessments, model digital age work and learning, promote digital citizenship, and engage in ongoing professional development and leadership of technology use (ISTE, 2012b). Yet, realities of funding, time, and resource allocation constrain the development of teacher leadership in this domain. For teachers to meet standards, let alone showcase technology with their students, an argument can be made that teacher preparation first must consider learning environments with ICT in mind, offering teachers opportunities to create a culture of learning that embraces technical acumen. While vital to today’s learning environments in the U.S. and worldwide, research indicates that teacher training environments do not adequately prepare educators to integrate a variety of technologies into their practice (Chien, Chang, Yeh & Chang, 2012; Enochsson & Rizza, 2009; Stobaugh & Tassel, 2011). Moreover, the literature on teacher training and ICT indicates a lack of teacher confidence with ICT tools and that there may be ways to nurture that confidence through improved teacher preparation experiences. In summary, “Technology is not at the forefront of teacher education program thinking and planning. Yet, it is the tool dramatically changing education” (Stobaugh & Tassel, 2011, p. 147).

Even as many teacher education programs provide some foundation of proficiency with technology (Gronseth, Brush, Ottenbreit-Leftwich, Strycker, Abaci, Easterling, Roman, Shin & Leusen, 2010; Vannatta & Beyerbach, 2000), teachers' ability to demonstrate technology to their students appears to be limited (Abbitt, 2011; Chien et
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et al., 2012; Kumar & Vigil, 2011; Stobaugh & Tassell, 2011) and teachers often employ only the tools used by those who have taught before them (Cuban, 2001). The question then becomes how teacher educators can best incorporate technological tools into the curriculum (Hernández-Ramos & Giancarlo, 2004). Institutions that prepare teachers must foster development of their technological competence.

This article explores literature that describes challenges to the development of pre-service teachers’ technological competence, and prospects for solutions. The following sections discuss the gap in purposeful ICT curriculum and teachers' perceived value and self-efficacy; and approaches to providing increased opportunities for direct experiences with ICT in teacher preparation programs.

The Need (and Challenge) of a Purposeful Curriculum

While teacher education programs provide some instruction on technology preparation, there appears to be variation in approaches and program models across institutions (Davis, 2010; Gronseth et al., 2010; Hernández-Ramos & Giancarlo, 2004; Kay, 2006). These variations are important, as institutions contribute to pre-service teachers' perceptions of the value of technology.

Teacher preparation institutions have been identified as a place of influence in a teacher's decision to use technology (Becker, 1994; Chen, 2010; Chien et al., 2012; Ertmer, Ottenbreit-Leftwich, & York, 2006). Specifically, Chen (2010) indicates that pre-service teachers' use of technology is influenced by their consideration of the technology’s value and their self-efficacy in using it. Research has shown that, by and large, pre-service teachers feel unprepared to effectively use technology in their practice (Baslanti, 2006; Chen, 2010; Chien et al., 2012; Enochsson & Rizza, 2009; Kumar & Vigil, 2011; Stobaugh, & Tassel, 2011). Several studies have indicated that pre-service teachers’ (and even practicing teachers’) use of technology in the classroom is strongly connected to their confidence in their ability to use it; the knowledge of the technology itself is not enough to transfer to their teaching (Abbitt, 2011; Chen, 2010; Ertmer & Ottenbreit-Leftwich, 2010). Therefore, it seems as though pre-service teachers are not confident enough to use technology for teaching and learning purposes and may not realize the value that various technologies bring – issues that should be addressed in teacher preparation programs. Moreover, pre-service teachers’ self-efficacy is even lower when utilizing assistive technologies for students with special needs (Ertmer & Ottenbreit-Leftwich, 2010; Safhi, Zhou, Smith & Kelley, 2009). One explanation offered for teachers' low self-efficacy is insufficient exposure to ICT in their teacher training programs (Kumar & Vigil, 2011; Lee, Hsieh, & Hsu, 2011). A contributor to this limited exposure is the impact of rapid changes in technology itself.

Technology is constantly evolving and the tools from which one can learn are numerous and growing (Abbitt, 2011). Russell (2010) finds that pre-service teachers need repeated exposure to working with technology in order to make connections to teaching. The presence of technology and the acquisition of isolated skills do not appear to be enough to transfer to purposeful teaching (Chen, 2010; Gronseth et al., 2010). In addition, methods faculty may not provide appropriate modeling “as they themselves struggle in keeping up with best practices in current technologies” (Gronseth et al., 2010, p. 30). This lack of exposure arguably leads to an apathetic adoption of technology by future
educators and may ultimately impede educators' ability to build ICT skills (Vesisenaho, Valtonen, Kukkonen, Havu-Nuutinen, Hartikainen, & Karkkainen, 2010). The reinforcement of learning about a technology and using it for teaching and learning purposes in K-12 settings could occur first in the teacher education classroom, then through field-based modeling and professional development. An obstacle to a more systematic approach to ICT is, despite national standards for teacher preparation, teacher education programs across the country vary greatly.

In her broad review of fifty states' policies and investment in teacher preparation, Darling-Hammond (2000) finds that teacher education programs vary in program hours, standards, and license requirements. Within this context, technology can be viewed alternatively as a content area, a theme across curriculum, or as a specific tool from which to learn (Davis, 2010). Thus it can be challenging for teacher training institutions to create a clear approach to teaching with technology. Adding courses such as a stand-alone ICT training course can be challenging as schools face decisions on which courses to keep, alter, or remove. For example, in the state of Illinois, the Board of Higher Education “approves all new units of instruction” in teacher education programs (Illinois Board of Higher Education, 2014, para. 9). Adding or revamping courses can be difficult to implement due to varying institutional goals, state requirements, and needed approvals by various college curriculum committees (Yontz, 2012). “Not only is it often difficult to add to or change teacher education curricula, but the sequence and duration of teacher preparation programming is a sensitive subject” (Yontz, 2012, p. 66) especially when considering ongoing tuition costs for students, the number of years it takes to graduate, and faculty interests, expertise, and availability to teach a variety of courses. Moreover, in 2015, the U.S. Department of Education plans to introduce a new rating system for higher education that measures graduation rates, tuition costs, and students receiving Pell grants, among other performance indicators (U.S. Department of Education, 2014). Institutional ratings may have a significant impact on enrollment in teacher education programs as prospective students make comparisons across competing programs on tuition, graduation rates, and available financial aid. These factors all have implications for structuring teacher preparation programs and the courses they offer. Teacher education programs must then ask: Where does ICT fall in our priorities and in our curriculum?

One solution is offering technology training as a component of other courses. For example, at Illinois State University, “the largest baccalaureate producer of teachers in the nation,” (Illinois State University, 2014a, para. 3) technology skills are “embedded directly into methods courses” (Illinois State University, 2014b, para. 2) for early childhood, elementary, and middle level major programs, as opposed to stand-alone technology-specific offerings. This solution would also lead to authentic opportunities to use ICT, a solution that has produced innovative ways to fill the curriculum gap.

**Authentic Opportunities**

The research literature has provided insights from teachers' successful experiences applying ICT in K-12 settings. Many of the recommendations for improvement begin at the university teacher preparation level that extend into real K-12 environments. An important way in which pre-service teachers can be trained with technology is in an authentic context (Chien et al., 2012; Kay, 2006).
It is in real classrooms with K-12 students that pre-service teachers can experience and examine effective technology use. A framework that is available to teacher preparation institutions – Modeled Analysis, Guided Development, Articulated Implementation, and Reflected Evaluation (MAGDAIRE) – driven by the use of authentic contexts, trains pre-service teachers in phases by showing them how technology can be infused from lesson development to delivery while other pre-service teachers offer feedback (Chien et al., 2012). With this framework, the modeling of teaching practices is done at the onset by a professor. Pre-service teachers then embed technology in their K-12 field-experience. Pre-service teachers further benefit by observing peers in a field-based teaching experience, extending their understanding about how a technology can be used in the classroom. In this way, authentic learning experiences with technology for teaching (to assist instruction) and for student learning (where K-12 students utilize technology for learning purposes) are put into practice. To create a learning sequence that encompasses these opportunities, program planning and curricular considerations must first acknowledge the value of learning in this way and design experiences that provide this type of integrated and applied approach.

Embedding authentic contexts in pre-service education can be a very powerful learning experience. A co-teaching method between university faculty and local school personnel can also be leveraged. For example, Hernández-Ramos and Giancarlo (2004) describe a model where pre-service teachers engage in discussions about technology, application-focused exercises with software like Inspiration and HyperStudio, and classroom visits to observe practicing K-12 teachers utilize ICT in their lessons. Pre-service teachers are thereby placed in a real-world teaching situation in which they can be engaged with technology (Herrington & Herrington, 2006) so that replicating that experience is much more likely in a future K-12 environment.

Resources In and Beyond K-12 Schools

In K-12 settings, principals play an important role in the use of technology. Principals can be viewed as “the main actors in the institutional promotion of innovative use of ICT in their school and should encourage teachers to use ICT in their instructional practices” (Blignaut et al., 2010, p. 1560). These leaders can help set the tone for how technology is embraced throughout the school. This can be accomplished through the encouragement of attending and offering workshops for teachers' professional development, making purchasing decisions about new technological tools, spearheading school-wide initiatives around ICT use, and establishing partnerships with universities and businesses. If the field of education vibrantly reflects a principal-driven ICT initiatives in schools, this would inform teacher preparation institutions that they need to prepare candidates to enter an environment with the expectation that technology will be used in dynamic and evolving ways.

Searching within and outside one’s school network may help to provide new perspectives on teaching with technology. There are benefits to exploring what educators outside the U.S. are doing (Futrell, 2010). Teacher education programs can consider innovative ICT practices across the globe in order to refine their training programs. MAGDAIRE, mentioned above, has been implemented in Taiwan schools to reinforce ICT's connection to pedagogical and content knowledge (Chien et al., 2012).
Technology, innovation, and educational change: A global perspective, Kozma (2003) arguably presents one of the most comprehensive analyses of innovative pedagogical practices utilizing ICT in K-12 settings worldwide. The findings provide clear examples for teacher education to consider when training teachers for what they should be able to know and do in the classroom. The examples highlighted by Kozma reflect good practices showcasing an interdisciplinary structure and integration of ICT to complement learning activities. Even as technology changes over time, the pedagogical examples showcased remain relevant. In one such example, schools in Portugal worked with ten-year-olds in small groups on a cinema project. Students worked two hours a week on the project, which was guided by a three-teacher team consisting of the main classroom teacher and two others who provided ICT and project support throughout the school year. Students wrote scripts, edited them, and then animated them. Five subjects of the curriculum were embedded within the project (Kozma, 2003). Projects such as this embrace a realistic approach to learning through the interdisciplinary nature of many life and work tasks and also provide support from more than one educator in a time frame that may help to reinforce and embed concepts learned. Another interesting approach developed by teachers in Hong Kong is known as lesson study: “As a group, teachers establish one goal for their classrooms and investigate the different methods that may help them reach that goal” (Ertmer & Ottenbreit-Leftwich, 2010, p. 274). The teachers consider various methods to meet their classroom goal and eventually develop an individual example to be modeled and observed by other teachers in a classroom. Subsequently, the teachers reconvene to debrief the lesson observations and begin to target a new lesson, goal, or strategy based on what they see (Ertmer & Ottenbreit-Leftwich, 2010). The purpose of this professional development process is three-fold: teachers work collaboratively to improve classroom practice, learn new strategies, and form a cohesive unit with common goals.

Pre-service programs can also pull from information systems theory and cultural models of diffusion to help assess teacher candidate proficiency and program effectiveness. The Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, 1989) and Innovation Diffusion Theory (IDT) (Rogers, 1995) can been used to understand an individual’s predisposition toward using technology. The TAM suggests that when a user is presented with a new technology, the decision whether or not to use that technology is most notably influenced by its perceived usefulness and ease of use. IDT considers the penetration of a technology in a culture, the channels through which it is available, and how use can be driven by social influences. Chang and Tung (2008) and Lee et al. (2011) conducted studies that utilized TAM in conjunction with IDT and their findings complement previous research; a user’s compatibility with a technology along with the perceived usefulness, ease of use, system quality, and self-efficacy with regard to the use of that technology are factors that affect intentions for use. Harnessing these evaluation approaches and findings may be helpful to designing technology training in teacher preparation programs.

**Conclusion**

Teacher preparation programs across the globe are confronted with pressure to equip teacher candidates with technological knowledge they can leverage in the
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classroom. While the development of ICT skills is acknowledged as important amongst teacher preparation institutions, there seems to be a consensus that teacher education generally is not doing enough to adequately provide students with the confidence and skills to utilize ICT in K-12 settings. There is some question as to whether K-12 schools are able and willing to undertake the teacher training, expense, and commitment to education that embraces the use of technology to prepare students for an increasingly technically dependent society (Schrum & Levin, 2009). The implementation of technology in education has not kept up with the way it is used in people’s personal and professional lives (Chien et al., 2012). Stobaugh and Tassel (2011) and the U.S. Department of Education (2012) find that the goals of educational technology standards and visions for a 21st century education are not evident in classrooms: teachers and students need to be encouraged to use technology for critical thinking, collaboration, and dissemination of new knowledge.

As each teacher preparation program is different, so too are the variables that affect the quality of ICT training: location (on a college campus or K-12 environment), availability of technology for use, and time to use it (Chen, 2010; Ertmer, 2005; Hernández-Ramos & Giancarlo, 2004). A teacher training institution’s focus on technology through its courses, emphasis on its use in field-based experiences, and presence of faculty and staff who can provide technology assistance and training workshops are all variables that influence pre-service teachers’ ability to learn and eventually teach with technology.

The literature review presented here highlights the perceived usefulness of a technology, ease of use, and confidence in one’s ability to use a technology as considerable factors contributing to pre-service teachers’ dispositions to embrace and showcase technology in K-12 settings. Expectations of 21st century educators include sound technical skills that keep pace with real-world, everyday use of technology and that reinforce content knowledge. Pre-service teachers need ICT training that is specifically aimed, regular in nature, and provides both breadth and depth in the understanding of ICT tools. Teacher education programs must consider their constraints and find ways to make the teaching and learning of ICT skills a priority. Consequently, institutions that prepare teachers must work together with K-12 schools to support relevant professional development opportunities, provide authentic experiences with technology, and encourage the use and support of such tools. Finally, teacher training institutions and K-12 schools should consider looking within and beyond their district or community to international contexts to identify innovative ICT practices for teaching and learning.

References


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ICT: Challenges & Some Prospects from Pre-Service Education to the Classroom


Author

KRISTINA J. KAUFMAN, ED.D., graduated from the School of Teaching and Learning at Illinois State University in the fall of 2014. There, she taught an undergraduate literacy course for elementary and middle-level education majors. In 2013, Kristina received a Curriculum & Instruction Graduate and Research Development Scholarship in support of her dissertation research and in 2012, she received the Michael A. Lorber-Stella V. Henderson, Mu Chapter, Kappa Delta Pi Scholarship Award Endowment, an award that goes to educators who demonstrate commitment to humanity, science, service, and toil. Kristina is certified to teach grades K through 9 in Illinois and has taught eighth grade language arts.

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