Preparing preservice teachers for integrating technology into the classroom: role of teacher preparation program

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Preparando os professores em formação para a integração da tecnologia nas salas de aula: o papel dos cursos de formação de professores

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ABSTRACT: Classroom technology integration for all levels of school-age students has become the expected norm. This places greater demands on teacher preparation programs to graduate preservice teachers who have proficient technology attitudes and skills, but more importantly the ability to create classrooms in which technology provides new and better ways of teaching and learning. In addition to identifying models for technology education, this study found that *digital natives* do not necessarily bring advanced technology skills with them and that new teachers are less likely to integrate technology into the classroom than experienced teachers.

KEY WORDS: Teachers Preparation, Technology, Pedagogy.

RESUMO: A integração da tecnologia em sala de aula para alunos em todos os níveis já é uma norma. Isso aumenta as exigências para com os programas de formação de professores, que devem produzir futuros professores que dominem as novas tecnologias e, mais importante ainda, que sejam capazes de criar salas de aula em que a tecnologia proporciona novas e melhores formas de ensinar e aprender. Além de identificar os modelos de educação tecnológica, este estudo descobriu que os *nativos digitais* não têm necessariamente domínio das tecnologias avançadas e que os novos professores são menos propensos a integrar a tecnologia em sala de aula do que os professores mais experientes.

PALAVRAS-CHAVE: Formação de Professores, Tecnologia, Pedagogia.

Undergraduate preservice teachers have long been required to learn the latest technologies as part of their teacher preparation programs. For instance, one might have been introduced to the DuKane Filmstrip Projector in required courses forty years ago (FIEHN, 2010). This "latest" innovation at that time was designed to feed the filmstrip through automatically, a definite improvement over winding it forward by hand – a job sometimes delegated to the well-behaved student – while teachers read the script aloud. Eventually, it could be linked to an audio device, so reading aloud was no longer required. Another "new" technology was the overhead projector. Within a few years of its release, it was considered a basic need for every classroom just like chalkboards and chalk and only within the last ten years has it been relegated to the dusty storage cabinet or chucked into the trash.

Fast forward to the ever-changing technologies available for use in today's schools and consider what curriculum is being taught to today's undergraduate preservice teachers. In a recent study, Betrus (2012) reports on a 2010 study which replicated a study ten years earlier in which the most senior faculty member teaching the introductory technology course for undergraduates in teacher education was asked what content was included. While Betrus found that "15 of the 31 topics taught in 2010 were not on the list in 2000" (p. 43), it should be noted that overhead projectors held the same ranking as mobile devices and document cameras, albeit ranked number 26 of 31. Of the institutions contacted in Betrus's study, only 64% reported having an introductory technology course for preservice teachers compared to 80% in 2000, and there was a shift from professors of "education" teaching the courses to professors of "instruction/educational technology".

Most teacher education programs started by teaching technology integration as a single course (HSU; HARGRAVE, 2000; HONAWAR, 2008) and continue to do so, as recorded in the study by Betrus (2012). It could be assumed that the reasoning behind this model is that if teacher education students can use the technologies, they will in turn use them in their classrooms and teach their students how to use them. This would mean that only the technologies on the course syllabi have changed, not the outcomes, so that today's topics may include Web 2.0 technologies, interactive whiteboards, and virtual tools (BLUE; TIROTTA, 2011). However, this model has been in place for a number of years, and yet many inservice teachers do not use much technology in their instruction. "Preparing preservice teachers to be proficient in technology is a key issue for the field of education… the public expects teachers to be able to integrate technology into their curriculum" (BOLICK et al., 2003, p. 300). Because the public is not seeing technology use in K-12 classrooms, there is increased pressure on teacher preparation institutions to integrate technology in preservice teacher education (BROWN; WARSCHAUER, 2006).

If technology is to fulfill its prophecy of being able to profoundly impact public education in the twenty-first century, it will require much more from teachers than learning how to use the latest gadgets and electronic products. Teachers in public education have done that for years. When the world of video games and handheld computers arrived in the early 1970s, creators soon realized there was a market in the field of education in which teachers who were frustrated with children who had trouble learning their number facts and vowel sounds could let the motivating world of technology take over. Forty-five years later, computer programs are still looked to as the solution for school-age children's learning problems. This superficial use of a myriad of electronic devices has not and will not solve the challenges of developing a literate, problem-solving, decision-making student body prepared for college and career.

Michael Fullan, one of the three to four most influential education writers of the last four decades, published *Stratosphere: Integrating Technology, Pedagogy, and Change Knowledge* in 2012, in which he espouses his conviction "[…] that we can and must build 'irresistibly engaging' learning experiences for both students and teachers" (VANDER ARK, 2012, p. 1). According to the *Integrating Technology with Student-Centered Learning Report* (MOELLER; REITZES, 2011), "[…] not surprising, 43 percent of students feel unprepared to use technology as they look ahead to higher education or their work life" (p. 4); "[…] only 23 percent of teachers surveyed feel prepared to integrate technology into their instruction" (p. 7); "[…] the most prevalent barriers to successful integration include organizational support, teacher attitudes and expectations, and the technology itself" (p. 7); and "[…] only eight percent of teachers self-reported that they fully integrate technology into their classrooms" (p. 13).

Fullan states that "[…] the integration of technology and pedagogy to maximize learning must meet four criteria. It must be irresistibly engaging; elegantly efficient (challenging but easy to use); technologically ubiquitous; and steeped in real-life problem solving" (FULLAN, 2012, p. 33). Fullan does stress his belief that "[…] it is teachers *with* technology who will make the difference" (p. 39).

PRESERVICE TEACHERS: DIGITAL NATIVES

Today's college freshmen are no doubt *digital natives,* those who were born into a technology-rich world and consequently accept technology as part of their daily lives (PRENSKY, 2000). This generation of technology users has also been referred to as the "Net Generation" (OBLINGER; OBLINGER, 2005) or "Generation M", the "M" standing for "media" and "multi-tasker" (RIDEOUT et al., 2005). Similarly, most of today's teacher education undergraduates are *digital natives*. These students have grown up surrounded by, entertained with, and proficient at using various technologies (PRENSKY, 2001; RUSSELL et al., 2003). Most of these students, but not all, had access to computers throughout their PreK-12 school years as well as personal or family access to digital cameras, personal phones, and social networking sites, so it might naturally be assumed that these *digital natives* would be well-prepared to use multiple technologies throughout their post-secondary education and careers. It has been rather widely accepted that these *digital natives, Generation M,* or the *Net Generation* enter the university level with high levels of technology proficiency.

However, several research studies do not affirm that assumption. For example, a study of 2007 intake teacher education freshmen by Jing Lei (2009), found that the majority of these freshmen spent most of their time using technology for social networking. They self-reported themselves as being strong in simple technologies (word processing, email, surfing the internet) and weak in using advanced technologies (Web 2.0 technologies, publishing audio or video files, developing web pages). According to Lei, "Results suggest that, growing up with technology, digital natives as preservice teachers are savvy with basic technologies and social-communication technologies. However, their technology proficiency is limited by both the narrow scope and the lack of depth of their technology activities" (Abstract, p. 87). Banister and Vannatta (2006) found in a pilot study of 125 students who were given a performance assessment requiring them to produce four documents using word processing, spreadsheet, drawing or painting tools, and presentation software, only 21% passed all four sections and only 36% passed three sections.

The second finding from Lei's (2009) study was that most of freshmen said they believed in technology, but they also expressed reservations about using it, especially in the student-age classroom. According to Lei, many expressed a reluctance to use technology, especially with elementary age children, or they suggested that it should be limited, justifying their feelings by indicating that there were other more basic things for these children to be learning. In conjunction with their reluctance, most admitted they felt that using classroom technologies would be challenging. Russell et al. (2003) found little difference between the beliefs or new teachers and teachers who had been in the field for six or more years when asked about the positive impacts of technology on students' learning. However, new teachers "[…] have significantly stronger beliefs about the negative impacts of technology on student learning [...] These negative impacts include making students more lazy, decreasing research skills, and decreasing the quality of student writing" (RUSSELL et al., 2003, p. 305). This finding is puzzling in that these new teachers would have had access to computers as students and would likely have used technology throughout their school-age career. Russell et al. (2003) did find that these new teachers were more likely to use technology for their own personal and professional use, but did not require their students to use it. This discrepancy between competency and beliefs, then, doubles the work for teacher preparation technology education professors who must not only make certain that preservice teachers are proficient in multiple technologies, but must also develop positive attitudes for technology use by school-age students. Ertmer (2005) concluded from her research that even if technology skills are increased for inservice teachers through professional development, they may not be implemented in classroom instruction if they are not aligned to teachers' pedagogical beliefs.

PRESERVICE TEACHERS' TECHNOLOGY COMPETENCY

Assumptions of user immersion leading to competency in a wide variety of technologies for *digital natives*, then, are misleading. Professors of the "[…] introduction to technology" course can expect to find teacher education students with a wide range of skills and abilities (BANISTER; VANNATTA, 2006). Determining the competencies necessary for preservice teachers, then, must include not only how to use technology for personal and professional use, but also how to integrate technology into classroom instruction. Jones, Buntting, and de Vries (2013), in describing the developing philosophy of technology, cite Mitcham (1994) who identified four components of the philosophy of technology: "[…] technology as artefacts [sic], as knowledge, as activities, and as an aspect of humanity" (JONES et al., 2013, p. 192). Mitcham's philosophy of technology provides a foundation for the five standards for digital age teaching established by the International Society for Technology Education (ISTE) for Teachers: 1) facilitate and inspire student learning and creativity; 2) design and develop digital age learning experiences and assessments; 3) model digital age work and learning; 4) promote and model digital citizenship and responsibility; and 5) engage in professional growth and leadership (ISTE NETST, 2012). Parallel standards from ISTE for school-age students include: 1) creativity and innovation; 2) communication and collaboration; 3) research and information fluency; 4) critical thinking, problem solving, and decision making; 5) digital citizenship; and 6) technology operations and concepts.

While these standards were not in place forty years ago, the outcomes they suggest are far removed from just learning how to use the newest piece of equipment or software, although that is still necessary. Maddux and Johnson (2005) explain the differences as *Type I* and *Type II* applications. "*Type I* applications are those uses that simply make it faster, easier, or otherwise more convenient to continue teaching or learning in traditional ways, while *Type II* applications are those uses that make it possible to teach or learn in new and better ways" (MADDUX; JOHNSON, 2005, p. 3). *Type II* uses of technology to help school-age students learn in new or better ways requires "[…] intersections among knowledge of pedagogy, content, and technology as the types of knowledge required for teachers to integrate technology into teaching and learning in meaningful ways" (ABBITT, 2011).

In the Understanding by Design framework (WIGGINS; MCTIGHE, 1998), curriculum is developed with the end in mind. Outcomes specify what students need to know and be able to do, both knowledge and application. Regardless of the era in which new technologies are released, teacher education students need content knowledge – what software, hardware, internet, and web-based products and programs are available; what their purposes are; how to use them, and when to use them. In addition, teacher education students must be able to demonstrate their ability to use these technologies to meet national standards for technology use by teachers and students and to understand how to implement technology use within the classroom. It will take more than a single, introductory technology course to accomplish what is needed for teachers in the twenty-first century to unleash the potential for technology to improve learning for school-age students (KRUEGER et al., 2000). These three models of mapping technology education demonstrate the scope of technology as it must be considered in determining the desired outcomes and designing curriculum to that end.

PRESERVICE TEACHER EDUCATION PROGRAMS

While the International Society for Technology in Education (ISTE) provided National Educational Technology Standards for Students in 1998 and revised them in 2007, some higher education institutions revised their teacher education technology education program based on their observations of students' skills or lack thereof. The University of Northern Iowa is one such institution and established three separate areas for focusing on technology proficiency development and transfer to PreK-12 classroom instruction in 2000: "1) Basic Technology Equipment Operations and Concepts, 2) Technology Resources and Tools for Information Literacy, and 3) Technology Resources and Tools for Content Areas" (KRUEGER et al., 2000, p. 48). These were used as the foundation for developing an online resource, InTime found at http://www.intime.uni.edu/, to support independent preservice teachers' learning of how technology can be used in school-age classrooms. The In-Time model espouses the learning process and the capacity technology offers in accessing information beyond the covers of books, for designing quality constructivist learning experiences, and for students to initiate and accept responsibility for their own learning (CALLAHAN; SWITZER, 1999).

Strudler and Wetzel (1999), in a study of four colleges viewed as having meritorious teacher preparation programs, found the following "enabling factors" (p. 66) that contributed to preparing graduates who were confident in their ability to teach with technology: 1) leadership with strong vision and goals; 2) access; 3) training and support; 4) pedagogical alignment; and 5) skill criteria for new hires. In addition to these elements within the colleges themselves, Strudler and Wetzel also found that students were supported with a variety of learning opportunities including "[…] educational technology courses, teacher-education courses, other courses, field experiences, and distance learning" (p. 74) that provided a comprehensive approach to technology immersion.

Lei (2009) concluded that teacher education programs must help *digital natives* transition from their role as students who use technology for personal reasons to teachers who can effectively manipulate various technologies in the classroom to improve teaching and learning. He proposes that technology preparation programs in teacher education commit to the following:

> Expose preservice teachers to a variety of technologies that can be used to support different teaching and learning activities…Emphasize subject-specific technology…Include assistive technology as an important component of teacher technology preparation programs…Help preservice teachers understand the enabling conditions for technology use… Help preservice teachers make meaningful connections between technology and teaching (p. 92).

Brown and Warschauer (2006) found in their case study of 110 teacher education students four elements that contributed to the development of preservice teachers' competencies which they described as "[…] peripheral role of technology in teacher preparation experience, insufficient exposure to technology integration, positive shift in student attitudes toward technology use, and pivotal role of field placements" (p. 603). Students in this study expressed being overwhelmed with the amount of work required in the teacher education methods classes, so being able to have time to complete assignments during class sessions helped to reduce their anxiety. This may have contributed to the shift to a more positive attitude as well as becoming more proficient with the software, hardware, and web applications. However, Brown and Warschauer (2006) noted that the course focused solely on software and hardware skill building as opposed to the more desired integration of technology to reach advanced levels of thinking and learning. This led to their identification of the importance of having a proficient field study mentor teacher who demonstrated how technology can improve instruction and learning.

Differentiation of instruction for this range of skills is no easier at the college level than at student-age levels. Add the requirement of accreditation accountability for student progress and growth and it becomes apparent that instructional delivery, course structure, or course requirements need to be modified. One suggestion from Banister and Vannatta is to establish a baseline by giving first year education students a performance assessment requiring them to produce four artifacts which demonstrate their ability to create a spreadsheet, construct a presentation, use drawing and painting tools to design a graphic illustration, and to use word processing tools. These become part of each student's e-portfolio. An offshoot of the development and subsequent scoring of the assessments was a heightened awareness of technology skill levels and student needs by the teacher education faculty (BANISTER; VANNATTA). This particular initiative most nearly measures the *Type I* uses of technology (MADDUX; JOHNSON, 2005).

Preparing undergraduate preservice teachers to use technology for instructional purposes is the charge to teacher preparation programs across the country. Several studies have been made to determine the impact from undergraduate teacher education programs to postgraduate classroom application. In a study of 2,894 teachers in Massachusetts et al. (2003), found that although new teachers reported being comfortable with technology, older teachers actually used more technology to enhance classroom instruction. At this point, it is important to review how various studies have collected information on teacher use and what criteria were used to determine teachers are technology-users. Using factor analysis of 44 specific types of technology listed in a teach survey, Russell et al. (2003) identified six categories of teacher technology use, four of which could be clustered as instructional – preparation, delivery, accommodation, and teacher-directed student use of technology – and two which could be clustered as management – email and grade recording. However, these six were found to vary in the amount of use with instructional uses being used much less than management uses. The findings of Russell et al. (2003) are mirrored in the research on technology applications in social studies methods classes by university faculty conducted by Bolick et al. (2003). Their study, too, found that digital communications (email, word processing, accessing web lesson plans, and communicating with newsgroups) were used much more in social studies methods classes than instructional technologies (creating web-pages or multi-media presentations, videoconferencing, using digital cameras, scanners, spreadsheets, or databases).

TECHNOLOGY INTEGRATION

One well-defined framework of technology integration that encompasses the complexity of using technology in education was designed by Koehler and Mishra and builds on Lee Shulman's construct of pedagogical content knowledge (1987) to include technology knowledge (KOEHLER; MISHRA, 2009). Koehler and Mishra start with three bodies of teacher knowledge – *content, pedagogy*, and *technology*. Representing each with a circle in a Venn diagram, *technology* and *content* overlap to form *technological content knowledge*; *technology* and *pedagogy* overlap to form *technological pedagogical knowledge*, and *pedagogy* and *content* overlap to form *pedagogical content knowledge*. When all three overlap in the center of the Venn diagram, the framework for technology integration is created: *technological pedagogical content knowledge* (TPACK). TPACK represents the dynamic interplay among the various components required for higher levels of teaching and learning and validates the importance of teachers having a thorough understanding of the three bodies of knowledge and can be measured (ABBITT, 2011). Abbitt's study of "[…] measures of technological pedagogical content knowledge within the context of teacher preparation" (p. 285) describes both self-perception surveys and performance assessments. Two examples are the Survey of Preservice Teachers' Knowledge of Teaching and Technology (SCHMIDT et al., 2009a; 2009b), and the Technology Integration Assessment Rubric (HARRISET et al., 2010). TPACK is one model that guides institutions of teacher preparation to design a program that ensures preservice teachers have the competencies they need in order to successfully integrate technology into their student-age classrooms.

Niess (2005) describes one university's approach of the TPACK integrated teacher preparation. That program started with a three credit course (45 hours), *Teaching with Technology Foundations*, followed by a three credit course (45 hours) on *Microteaching* emphasizing planning, teaching, and reflecting while simultaneously participating in a three credit course (45 hours), school-based *Practicum I*. This was followed the next quarter by a one credit course (15 hours), *Technology & Pedagogy I*, focusing on planning for teaching with technology taken in conjunction with a two credit course (30 hours), *Practicum II*, and in preparation for eight credits (120 hours) of full time *Student Teaching*. The last course, *Technology & Pedagogy II*, was a one credit course (15 hours) on reflections on teaching with technology. A study was done with 22 math or science students who went through this model. "At the end of the program, all 22 student teachers were recommended for their respective teaching licenses, although they had made varying degrees of progress in the development of TPCK" (NEISS, 2005, p. 514). Five case studies highlighted the variables among the student teaching experiences of the students: student teacher beliefs and attitudes; how the student teachers had been taught the subject matter when they were school-age; the technology competency of the cooperating teacher; students teachers' personal comfort levels in using the technology; and cooperating teachers' expectations. Integrating technology posed challenges for each of the five student teachers despite the strong integration focus of the program including specific courses focusing on various aspects of using technology in the classroom.

While it would appear from the example above that teacher education programs are providing future teachers with technology education, studies are finding that the knowledge and skills these future teachers are receiving is not always being transferred into classroom use during field experiences or as new hires in schools (RUSSELL et al., 2003). One of the problems identified was the lack of communication between the university and the school in which the student teacher was placed about technology resources and expectations (STRUDLER; WETZEL, 1999). If the training received from the teacher education program is to be meaningful, the field experience needs to provide expectation and opportunity for students to use what they learn in the classrooms in which they are teaching. Dexter and Riedel (2003) found the highest levels of technology integration occurred when institutions of teacher preparation set high expectations for instructional technology use with the student teacher and the school cooperating teacher; when there was both access to technology and technology support at the school site; and strong instructional support from school site personnel. Pellegrino and Altman in their 1997 article, "Information Technology and Teacher Preparation: Some Critical Issues and Illustrative Solutions", discussed how Peabody College transformed courses diagonally across a matrix from technology as an adjunct to enhance instruction to technology use to central to the course content and from students as consumers of knowledge to students as producers of knowledge in Figure 1 below (PELLEGRINO; ALTMAN, 1997, p. 97):

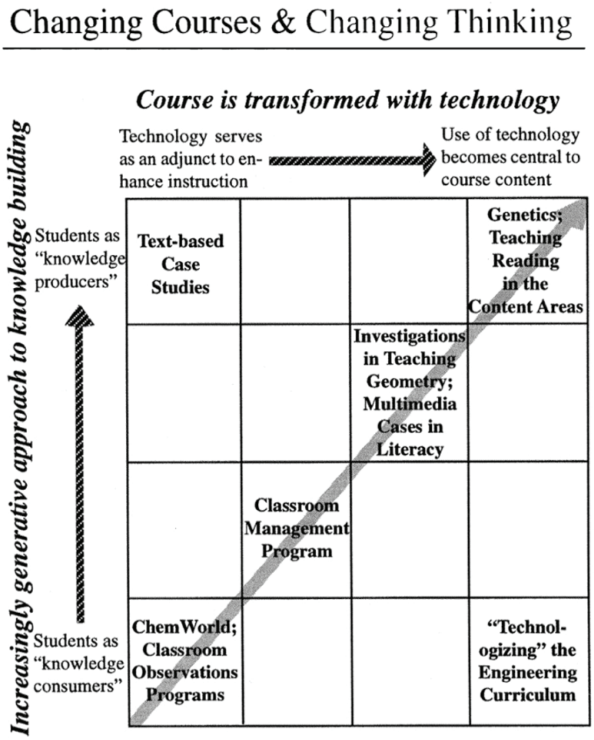

Figure 1. Transformation of course content and design as a result of technology.

Another study (ALBEE, 2003) found that by comparing elementary administrators' expectations and technology proficiencies of student teachers with an analysis of course technology requirements provided information for the preparatory institution on how to modify the teacher education curriculum to bridge the gap between expectancy and performance. Anderson and Maninger (2007) found that students' perceived abilities, beliefs, and intentions to integrate technology could be statistically improved through a stand-alone technology course when the curriculum design of the course was aligned with K-12 classroom technology uses and included observing and interviewing K-12 students. Anderson and Maninger concluded with: "Finally, though effective, a technology course alone is insufficient to fully prepare students to integrate technology. As the literature suggests, the integration of technology into methods courses is also an important component of such preparation" (p. 163).

PROMISING PRACTICES

Gomez et al. (2008) argue that the power of technology is in its capacity to connect and build relationships within the global community of learners. They suggest that there are three types of relationships that could be strengthened that would ultimately lead to improved teaching and learning: intrainstitutional, interinstitutional, and transinstitutional. Intrainstitutional would enhance the possibilities for interdisciplinary connections "in which the focus is a seamless integration of content from the disciplines and pedagogy from education" (GOMEZ et al., 2008, p. 120). The interinstitutional connection would bridge theory into practice by connecting the university to PreK-12 schools and districts via video conferencing, Web 2.0 technologies, and database management systems. The transinstitutional model encourages belonging to "broader professional communities beyond the local university and school" (GOMEZ et al., 2008, p. 120).

Another study highlights ways in which familiar technologies can be used to improve teacher education through case study examples (O'BRIEN et al., 2011) and provide protocols for using them effectively. The first web-based application they cite is synchronous chats in which professors and students engage in questioning and critical thinking, as well as opportunities for every student response to the professor's question. Others include interactive videos for professional development; podcasting for ongoing access to instruction, demonstration, or direction; collaborative websites to compile information, write, rewrite, and exchange ideas; and blogs for sharing perspectives or writing for an audience and getting feedback. According to O'Brien et al. (2011), these technologies offer positive ways in which to integrate technology without the burden of learning another new program.

Blue and Tirotta (2011) also advocate for cloud computing and interactive whiteboards as effective ways to improve teacher preparation courses while modeling technology integration for future teachers of school-age learners.

One of the barriers for educational institutions is the speed at which new technologies are developed and released. This makes being informed of latest trends essential. The New Media Consortium (NMC) is a group of experts in educational technology who publish an annual report predicting future technology trends for educational institutions at all levels, regionally, nationally, and globally. According to NMC webpage:

> The role of the NMC is to help our hundreds of member universities, colleges, museums, and organizations drive innovation across their campuses…by performing research that catalyzes discussion, by convening people around new ideas, and by building communities that encourage exploration and experimentation…NMC has a growing and influential role on the global stage, working with leading organizations around the world to move current education models to forms that are more engaging, effective, and inclusive (NMC HORIZON REPORT, 2013).

According to the NMC Horizon Report: 2013 K-12 Edition, *cloud computing* and *mobile learning* already allow "[…] students…to work, play, and learn via cloud-based services and apps across their mobile devices, whenever they want and wherever they may be" (JOHNSON et al., p. 3). In the not too distant future *learning analytics* – "[…] the study of big data…to gain insights about student behavior and learning" (p. 3) and *open content* – "[…] a growing range of open source textbooks and a wider recognition of the collaborative philosophy behind creating and sharing free content" (p. 3) will likely be adopted by K-12 education. The report further predicts that in four or five years *3D printing* and *virtual and remote laboratories* will be common practice. The 2011 Horizon Report included the following six technologies for mainstreaming within one to five years: *electronic books, mobiles, augmented reality, game-based learning, gesture-based computing,* and *learning analytics.* The wide-spread use of many of these innovations from the 2011 Report would appear to validate this group's ability to identify what is coming next.

These kinds of technologies looming just over the horizon will necessitate a very different technology curriculum than is currently being offered in most teacher education departments and a brain trust of teacher education professors exploring how to take advantage of these innovations to improve teacher training within college "classrooms" and within student teaching placements.

DISCUSSION

U.S. politicians, government officials, technology industries, media, and society in general exponentially increase the expectation that technology will be integrated into school-age educational institutions at the rate in which new technologies are being released. The recently adopted Common Core State Standards (CCSS) is one example in which multiple uses of technology are expected, particularly in the literacy standards and beginning at the kindergarten level. The new CCSSs are demanding a shift from teaching about technology to using technology for "[…] other purposes such as communication, collaboration, and location and synthesis of ideas" (ROBERTS et al., 2012, p. 57). The only way to achieve this transformation is to provide ongoing professional development for inservice teachers at all educational levels; provide quality technology education integrated throughout the teacher preparation program; and to require high levels of technology integration proficiency of all preservice teachers.

The literature includes the barriers to overcome in achieving these goals. These include individual teachers' beliefs about using technology; competency using technology itself; understanding how to connect pedagogy, technology, and content into meaningful learning experiences; and desire to embrace the opportunities technology offers to enhance and improve learning. Perhaps the biggest hurdle is tradition and the idea that "teachers teach as they were taught." If this idea has merit, then not only must teacher preparation programs insist on rigorous technology competencies for preservice teachers, it must also transform current professors' pedagogical preferences to include a strong, appropriate technology base from which to learn content. In addition, departments of curriculum and instruction must carefully screen student teaching placements and only place student teachers with cooperating teachers who are adept at integrating technology and who can mentor student teachers through the change process to a new teaching and learning model.

Teacher preparation programs must realize that a one-size-fits-all model will not be successful in bringing all preservice teachers to high levels of competency in using technology, but more importantly in understanding how technology transforms classrooms when it is combined with sound pedagogical practice and rich curriculum content. Recommendations for teacher preparation programs from the literature include pre-testing preservice teachers on basic technology skills; providing independent practice modules for various technologies for those who need them; developing or aligning course curriculum to robust standards; regularly evaluating the program's effectiveness by analyzing student teacher planning artifacts against outcome expectancies and analyzing teaching practices through student work samples; developing strong relationships with local school districts with strong technology integration models; creating a vision of digital classrooms; and seeking out technology trends and patterns to prepare for the future.

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