Preservice Teachers' Technology Self-Efficacy

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Since efficacy of experienced teachers is difficult to change (Hoy, 2000), preservice teachers' technology self-efficacy is a creditable indicator of graduates' likelihood to use instructional technology throughout their careers. A study was conducted with elementary preservice teachers (n=62) who completed a 5-item, Likert-type survey measuring self-efficacy for teaching with technology. Responses revealed that 91% of participants incorporated technology into lessons with 95% of participants reporting some confidence in their ability to select and utilize technology in teaching. Additionally, 90% of participants felt they could integrate technology across the curriculum. Positive teacher-efficacy is essential for effective instructional technology integration (Moore-Hayes, 2011).

Integrating technology into teaching is among the greatest challenges facing today's teachers (Cennamo, Ross, & Ertmer, 2010; Clausen, 2007; Wang, Ertmer, & Newby, 2004). School districts across the nation are making a substantial investment in technology as well as professional development for technology integration (Lever-Duffy & McDonald, 2011). Successful use of technology in the classroom has the potential to engage students, promote conceptual comprehension, and develop spatial intelligence (Hennessy, Deaney, & Ruthven, 2006, Way et al., 2009, Wu & Huang, 2007 as cited in Bell, Maeng, & Binns, 2013; Swarat, Ortony, & Revelle 2012 as cited in Martin, Shaw, & Daughenbaugh, 2014). Technology use is critical to engaging in the global society; thus, using technology for learning is essential for the population of students found in schools today (U.S. Department of Education, 2010). As the National Council of Teachers of English (2013) state, active successful participants in this modern, global community must be proficient with technological tools, use multiple streams of simultaneous information, and think critically about multi-media text while maintaining required ethical standards. Despite greater access to technology in classrooms and training opportunities for students and teachers, technology remains underutilized in many classrooms (Roblyer & Doering, 2010; U.S. Department of Education, 2010). To teach meaningfully via technological aids requires educators to have tech-inclusive pedagogies and activity approaches (Bull et al., 2005, Brzycki & Dudt, 2005, Hew & Brush, 2007 as cited in Pamuk, 2012). Factors found to influence teachers' use of technology range from the school's physical facilities (Ertmer, 2005) to teachers' attitudes towards computer use (Teo, 2009/2010). Self-efficacy has repeatedly been reported as a major component in understanding the frequency and success with which individuals use technology (Sure, 2009). It can be postulated that teachers' beliefs regarding their capacity to work effectively with technology in general are directly related to their integration of technology in teaching. Consequently, the measurement of technology self-efficacy is a useful indicator of teacher education programs' effectiveness

in preparing graduates to use instructional technology (Moore-Hayes, 2011).

Teacher Efficacy

Research studies have established the importance of a positive sense of efficacy on teacher effectiveness (Knoblauch & Hoy, 2008; Putman, 2012). Self-efficacy is rooted in Alberta Bandura's social cognitive theory (1977). This theory highlights the perspective that people are their own change agents. Bandura (1977) defined efficacy as intellectual activity by which one develops one's beliefs about his ability to achieve a certain level of accomplishment. Research supports the theory that teachers with a high sense of self-efficacy and belief in their ability to positively impact student learning are more likely to participate in professional development (Gersten, Chard, & Baker, 2000) that often leads to implementation of innovative teaching strategies (Sparks, 1988), and ultimately have a stronger academic focus in their teaching (Dembo & Gibson, 1985). A strong sense of teaching efficacy also often results in higher motivation, more effort, determination, and resilience (Tschannen-Moran, Hoy, & Hoy, 1998).

Conversely, low levels of efficacy in teachers resulted in negative behaviors such as responding with criticism and giving up on academically struggling students (Tschannen-Moran, Hoy, & Hoy, 1998 as cited in Palmer, 2011). Research (Pendergast, Garvis, & Keogh, 2011) has shown that a teacher's self-efficacy has a strong connection to their overall impact and level of effectiveness. Their belief in themselves directly links to how well a student performs on academic tasks (Dembo & Gibson, 1985). Self-efficacy regarding computer use and technology integration has been of particular interest recently (Curts, Tanguma, & Peña, 2008; Gökçek, Güneş, & Gençtürk, 2013; Jimoyiannis, & Komis, 2006; Kramarski, & Tova, 2015; Miles, 2013; Moore-Hayes, 2011; Nadelson et al., 2013; Wang et al., 2004).

Technology Efficacy

The level of technology integration in any classroom is ultimately decided by the teacher (Jimoyiannis & Komis, 2006). Given the enormity of responsibility experienced by most new teachers, Clausen (2007) found that often times, new teachers have difficulty integrating technology into their teaching during their induction period (first years teaching). As leaders in education push using new technologies in the teaching process, teachers have reported feeling inadequacies in their abilities to teach via the emerging technologies (Martin, Shaw, & Daughenbaugh, 2014). Research supports that efficacy is situated within context, therefore, examining specific curriculum areas, such as technology, may help identify teachers that will be more likely to implement as higher levels of efficacy generally result in higher levels of implementation (Henson, 2002; Moersch, 1995). The importance of teacher self-efficacy as related to technology is demonstrated through the impact on teaching behaviors (Henson 2002), including instructional planning and preparation and the tools they select to use during instruction.

Many factors other than technical knowledge and skill contribute to teachers' success at technology integration in teaching (Miles, 2013). Factors include time to integrate curriculum, home access to Internet (Curts et al., 2008), training (Watson, 2006), vicarious experience (Wang et al., 2004), and positive attitude toward technology (Kumar, Rose, & D'Silva, 2008). Teachers' use of computers for teaching has been correlated with their belief in their ability to do so (Paraskeva, Bouta, & Papagianni, 2008). For teachers to integrate technology into teaching

practice, they must consider themselves to be self-efficacious at its use (Kumar et al., 2008) making a strong sense of computer self-efficacy among the basic preconditions for positive self-efficacy regarding the use of computers for instruction (Teo, 2010). Conversely, underutilization of technology in instruction has been linked to teachers' lack of self-efficacy (Kellenberger & Hendricks, 2003; Teo, 2009). "Though enhanced self-efficacy beliefs do not automatically translate into the actual use of technology among teachers, they are a necessary condition for technology integration" (Wang et al., 2004, p. 242).

There has been research that linked teacher self-efficacy to student self-efficacy (Henson, 2002). Therefore, it can be postulated that if a teacher has a high level of technology self-efficacy, students may also. Ultimately, if students feel confident in using technology for learning purposes, they are more likely to choose technology tools for learning.

Preparing Preservice Teachers to Integrate Technology

Technology as a tool for learning has been a recent focus of educational reform in the United States (U.S. Department of Education, 2010). In a technology rich society, there is a necessity for teachers to learn how to leverage what students already know about technology and connect that knowledge to how to use technology as a meaningful learning tool. Therefore, it is imperative that preservice teachers are taught how to effectively use technology as a teaching tool by infusing instructional technology throughout the teacher education curriculum (Groth, Dunlap, & Kidd, 2007). Requiring technology for coursework must be supplemented by university faculty and cooperating teachers who model effective use of instructional technology (Pope, Hare, & Howard, 2005). As Bell, Maeng, and Binns (2013) reported embedding technology instruction for preservice teachers in a variety of contexts can facilitate technology usage for science instruction during student teaching. Cognitive modeling is vital for preservice teachers to comprehend, not only how the technology functions, but also the instructors' decision-making processes to effectively maximize learning potential (Pamuk, 2012). In addition, Groth et al. (2007) emphasize the importance of preservice teachers integrating technology into internship experiences to foster the inclusion of technology in their future classrooms. To be successfully employed, preservice teachers will be required to use technology as they prepare students to compete in a global economy (Edutopia, 2008; Hamill, 2012, Cohn, 2005 as cited in Martin, Shaw, & Daughenbaugh, 2014). Teacher education programs must assess their effectiveness for transitioning candidates into technology savvy K-12 teachers. The preservice teachers' attitudes and cognition toward their own teaching with technology should be accessed for this integral assessment (Rohaan, Taconis, & Jochems, 2012). One established method is to obtain the preservice teachers' efficacy (Rethlefsen & Park, 2011).

As Holden and Rada (2011) found with inservice teachers, examining preservice teachers' efficacy for technology may allow for a specific focus on increasing the self-efficacy, thus, promoting the use of technology in instruction. The importance of the technology self-efficacy of preservice teachers may be summed up in this statement, "Technology self-efficacy has come to play a crucial role in the preparation and implementation of educators who can successfully use educational technology to enhance student learning" (Brown, Holcomb, & Lima, 2010, p.121).

Purpose and Significance of Study

This study investigated elementary preservice teachers' self-efficacy beliefs regarding instructional technology. Taking into consideration the immediate and long-term impact of positive teacher-efficacy related to technology integration, findings will be of interest to current educators and administrators, certification and licensing boards, and those responsible for training and mentoring new teachers. As the U.S. Department of Education National Technology Plan for 2010 states, "To achieve our goal of transforming American education, we must rethink basic assumptions and redesign our education system. We must apply technology to implement personalized learning and ensure that students are making appropriate progress…". Teacher education programs play an important role in the development of candidates' self-efficacy and identity (Pendergast et al., 2011). As a result, the role of teacher educators in developing preservice teachers' technology self-efficacy impacts the future of technology integration in America's classrooms.

Participants. In the first phase of the study, participants were 28 preservice teachers (27 females and 1 male) at a Doctoral/Research Intensive university. Ages ranged from 20 to over 49 with 86% between 20-29 years old. Most (89%) were European American. All (19 juniors and 9 seniors) were K-6 majors and had completed a course designed to teach how to integrate technology as a meaningful learning tool in school classrooms.

In the second phase of the study (one year later), participants were 35 preservice teachers (33 females and 2 males) at the same Doctoral/Research Intensive university. Ages ranged from 20 to over 50 with 89% between 20-29 years old. Most (74%) were European American. All (11 juniors and 24 seniors) were K-6 majors and had completed the same educational technology course as the first phase participants. In the teaching methods courses, participants experienced different levels of technology integration into the courses, and, to various degrees, were also expected to incorporate technology into their assignments. Participants were all placed in field experience classrooms with a moderate level of technology available, though the amount of use in the classroom varied. The technology included items such as SmartBoards, desktop and laptop computers, and other hand-held devices that would be used from enhancing instruction to extensive implementation for project-based learning.

Instrument. Moore-Hayes (2011) used questions and a rating scale adapted from Tschannen-Moran and Woolfolk-Hoy's (2001) research on teacher-efficacy to create a 5-item instrument for assessing teachers' perceived efficacy beliefs related to technology integration. The resulting survey was used to collect data in this study. The six-point, forced-choice response Likert-type scale ranged from "not at all" to "a great deal."

Data Collection and Analysis. Quantitative, descriptive statistics were used to determine participants' perceived self-efficacy on several specific aspects of technology integration. After obtaining permission for use, the survey was electronically disseminated to participants. Responses to the five survey items were converted to numerical data (one low efficacy and six high efficacies). Participation was voluntary, and there were no identified risks or benefits nor incentives provided.

Results

Participants (n=62) had a total score mean of 4.6 on a six-point scale indicating a moderately high level of technological

efficacy overall. Table 1 presents the means for each item. The highest item mean (4.9) was reported for extent to which preservice teachers felt that they could integrate technology across the curriculum. The lowest item mean (3.9) was reported for actual implementation of technology into lessons taught during field experiences.

Table 2 presents participant responses in percentages. Item specific data revealed that 66% of participants felt a high level of confidence in their ability to select and utilize technology in teaching and learning as indicated by their capability to determine why, when, and how to use technology. Overwhelmingly, 91% of participants indicated that they felt at least somewhat capable of incorporating technology into the lessons they taught. Similarly, 76 felt they could integrate technology across the curriculum.

Discussion

Educators at all levels must be aware of the impact of technology self-efficacy on student learning. Preparing educators to lead students in the use of technology so they are better able to navigate the global society in which we live is imperative (Johnson, 2009; U.S. Department of Education, 2010). Interestingly, participants in this study had a fairly high efficacy rate on their ability to use technology for instruction. These results are considered positive as research supports the impact of teachers' efficacy on teaching and learning (Pajares, Usher, & Johnson, 2007). These results are also supported by the research by Nadelson et al., (2013) that revealed many new teachers are digital natives and have grown up using technology and report high levels of confidence in using email, learning management systems, personal computers, television, smartphones, word processing, and social networking but only moderate levels of confidence using instructional technology such as podcasts, virtual simulations, and Web 2.0 applications.

The data in this study revealed that while the participants felt confident in their ability to implement technology as part of the teaching and learning process, 30% do not feel confident in their ability to select and evaluate the technology prior to implementation. This could be due to lack of knowledge of elements of effective technology, lack of experience with the process of evaluating technology, lack of teaching experience that would help provide the background knowledge to effectively evaluate the technology, time constraints, or various other factors. Considered in light of the multitude of available software, websites, and other technology-based resources that are available to classroom teachers today, these data indicate that there is more work to be done in the preparation of candidates for critically examining instructional software for meaningful technology integration. Linking efficacy for technology and use in classroom instruction should be further explored, specifically in relation to competency in selecting the appropriate technological tools used to enhance teaching and learning.

The data also indicates that preservice teachers need more preparation in selecting and utilizing assistive technologies with special education students. This is particularly important due to the increased number of inclusive classrooms found in most schools. Teachers must be adequately prepared to meet the need of all students, with a range of academic needs.

Technological tools are now considered a staple in most classrooms. As societal and educational expectations for integration of technology into daily classroom's practices continue to grow, it becomes increasingly important that all teachers are adequately prepared for this

dimension of their professional practice. Preservice teachers must be prepared by first being equipped with the knowledge, skills, and resources to effectively teach with technology in order to design innovative and meaningful learning experiences for their students.

Technology must be foundational to the teaching and learning process in teacher education programs. By integrating technology in both coursework and field experiences, preservice teachers' can be scaffolded through the process of learning to effectively use instructional technology. Along with knowledge, positive teacher-efficacy is an essential prerequisite for effective technology integration for instruction (Moore-Hayes, 2011). According to Wang et al. (2004), the use of electronic vicarious learning experiences and the incorporation of specific goals may help preservice teachers develop the confidence they need to become effective technology users within their own classrooms. Shivelya and Yerrickb (2014) argue real classrooms experiences that enable preservice teachers to gain the confidence, experience, and competence required to integrate instructional technology in their teaching practices are essential. While extensive, intrusive training techniques had no significant effect on elementary teachers' attitude or self-efficacy toward technology (Miles, 2013), successful experiences with instructional technology as a preservice teacher leads to positive efficacy (Flores, 2015; Kramarski, & Tova, 2015; Shivelya & Yerrickb, 2014), thus, resulting in an increased probability that technology will be used as a teaching tool (Holden & Rada, 2011).

Limitations. As with all studies, consideration must be given to conditions that may limit the generalizability of the findings. The participants in the study were a convenience sample of preservice teachers located in a mid-sized university. In addition, the relatively small number of participants limits the generalizability to a larger audience. It must also be acknowledged that the data collection instrument was a survey, and though the participants remained anonymous, the self-reporting nature of survey research is a limitation in itself.

Future Research. Some research (Henson, 2002) has indicated that Likert-type questionnaires may not accurately measure a person's judgement; therefore, follow-up research using a qualitative approach may provide greater insight of the preservice teacher's self-efficacy. In addition, including qualitative data along with the quantitative data may provide insight to determine specific factors that may influence the technology efficacy. It would be interesting to explore specific factors that influence preservice teachers' technological self-efficacy in order to facilitate the implementation of these elements within a teacher education program. Knowledge of these factors may provide institutions of higher education and school districts with information that could have a positive impact on the technology self-efficacy and promote usage of in instruction.

Conclusion

There are simply unending opportunities to engage with technology to enhance innovative learning opportunities (Duncan, 2010). In order to make the use of technology for learning a reality in schools, teacher preparation programs must integrate technology in both coursework and field experiences to scaffold preservice teachers through the developmental process of learning to effectively use technological tools to expand students' probability for success. Preservice teachers must graduate prepared to evaluate, select, and integrate technology into their daily instruction. Institutions of

higher education must incorporate these opportunities into preparation programs in order to adequately equip new teachers to be able to do so.

Technology provides opportunities to be used in various ways including being part of the curriculum, as a tool to deliver instruction, and to enhance the learning process. Technology offers the capacity for the entire educational process to move from passive to interactive and engaging. As self-efficacy for technology usage increases for preservice teachers, using technology as a teaching tool will also likely increase. An obvious by-product of technology as a teaching tool is increased technological learning. The ultimate impact of increased self-efficacy of teachers, as related to technology, is that students graduate with the knowledge and skills to be successful in utilizing technology for life-long learning.

Table 1

Preservice Teachers' Mean Response

Question	Mean
How competent do you perceive yourself to select and use various media to support teaching and learning?	4.8
How well prepared are you to evaluate software to support teaching and learning?	4.0
To what extent can you integrate technology across the curriculum?	4.9
How capable are you of determining why, when, and how to use technology in education?	4.8
To what extent do you feel prepared to select and utilize assistive technologies?	4.2
To what extent did you incorporate technology to enhance teaching and learning in the lessons you taught in your field experience this semester?	3.9

Note: Based on a Scale from 1 (Not at All) to 6 (A Great Deal)

Table 2

Preservice Teachers' Response in Percentages

Question	Not at all	Very little	A little	Somewhat	Quite a bit	A great deal
How competent do you perceive yourself to select and use various media to support teaching and learning?	0%	3%	2%	38%	27%	30%
How well prepared are you to evaluate software to support teaching and learning?	1%	10%	19%	33%	19%	16%
To what extent can you integrate technology across the curriculum?	2%	2%	6%	16%	42%	34%
How capable are you of determining why, when, and how to use technology in education?	3%	1%	4%	25%	36%	30%
To what extent do you feel prepared to select and utilize assistive technologies?	1%	4%	17%	34%	28%	15%
To what extent did you incorporate technology to enhance teaching and learning in the lessons you taught in your field experience this semester?	2%	4%	4%	11%	44%	36%

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