IMPROVING PRE-SERVICE TEACHERS’ SELF-EFFICACY ON TECHNOLOGY INTEGRATION THROUGH SERVICE LEARNING

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ABSTRACT
The paper reports an action research study that investigated pre-service teachers’ beliefs about service-learning in a Makerspace lab at an elementary school. As part of the service-learning project requirement in an Educational Technology course, the pre-service teachers were asked to work in an elementary school to provide service to the technology teacher and the school students utilizing what they had learned in the university course. The findings of the research indicated that the service-learning experience at the elementary school’s Makerspace lab had positive impact on pre-service teachers’ self-efficacy on technology competency, their beliefs in technology integration in future classroom instructions, and their understanding of the role of technology in education.

KEYWORDS: Technology, pre-service teacher, self-efficacy, service learning, integration

INTRODUCTION
Technology adoption has seen its increase in school districts in the United States at an exponential rate in recent years. In an article published in Education Week, Herold (2016) reported that American public schools provided at least 1 computer for every 5 students, spent more than $3 billion per year on digital content, and there were more than 23 million devices purchased for classrooms in 2013 and 2014. In addition, the United States was working to make affordable and free teaching resources available online to the rural and remote schools, and more state standard tests were administrated via technology in 2015-2016. Recognizing the increasing adoption and access of technologies in schools and
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districts across the United States, the U.S. Department of Education placed great emphasis on students’ learning (Engaging and Empowering Learning through Technology in the 2017 National Educational Technology Plan (U.S. Department of Education, 2017). In fact, other countries (for example, Australia) have seen this compelling push for technology integration in classrooms as well (Lemon & Garvish, 2015). Clearly, schools are expecting teachers to be equipped with technology integration skills. The question remains: how do teacher education programs meet this reality? Though technology integration course is often required in teacher preparation programs, pre-service teachers still feel uncomfortable with technology integration (Johnson, 2012). Much of the current practice in educational technology courses in teacher preparation programs is still skills-based (Jimoyiannis, 2010), and is often not connected with the method courses (Mims, Polly, Shepherd & Inan, 2006).

The barriers that lie in the transition from pre-service educational technology coursework to inservice technology integration in classroom instruction are often what Ertmer (1999) classified as the second order barriers: beliefs about teaching, about technology, and unwillingness to change. Recent research (e.g., Ertmer & Ottenbreit-Leftwich, 2010; Kim, Kim, Lee, Spector, & DeMeester, 2013) has shed light on the significance of teacher’s beliefs in facilitating technology integration practices in the classrooms. In other words, successful technology integration practices in the classrooms depend on positive changes in teacher beliefs about technology. The purpose of this action research was to investigate the impact of service learning in authentic school environments on pre-service teachers’ beliefs about technology integration.

LITERATURE REVIEW

Teacher Education and Technology Integration

In response to the challenge of preparing teacher candidates (pre-service teachers) to effectively integrate technologies as they transition to become classroom teachers (inservice teachers), a variety of approaches to teaching technology integration in teacher education programs have been implemented including stand-alone technology integration courses and adoption of Mishra and Koehler’s (2006) TPACK framework (Wetzel, Foulger, & Williams, 2009). However, each of those approaches has its own strengths and weaknesses. The traditional skills-based stand-alone technology integration courses are helpful in improving pre-service teachers’ technological knowledge. However, research has indicated that a single technology course does not provide teacher candidates with necessary capacity to integrate technology in real classroom practices (e.g., Bakir 2015; Wachira & Keengwe, 2011). Integrating technology in all courses was helpful in improving pre-service teachers’ confidence in using technology, but the challenge was to develop faculty expertise and time for implementation (Kay, 2006). Although there is no consensus on the best approach to technology education courses, the value of practicing technology integration in the field is obvious (Ottenbreit-Leftwich, Glazewsky, Newby, & Ertmer, 2010). The three recommendations from Moursund and Bielefeldt (1999) are still perceived and proved to be valid today: 1) infusing technology education throughout the teacher education program; 2) teacher education faculty modeling technology integration
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practices in coursework; and 3) providing teacher candidates with opportunities to practice technology in the field with mentor teachers (Bakir, 2016).

Student teaching has become a required and an essential part of teacher preparation programs because of the importance of field experiences (Darling-Hammond, Holtzman, Gatlin & Heilig, 2005). Despite the innovative approaches to technology education, the challenge remains in understanding pre-service teachers’ knowledge, beliefs, and attitudes and how they impact classroom practices as the pre-service teachers transition to become inservice teachers (Abbitt, 2014). What is often lacking in educational technology courses is the opportunity for pre-service teachers to apply their technology skills in authentic classrooms at schools.

Teacher Beliefs and Technology Integration Practices
Teachers’ decision to integrate technology is partly dependent on their beliefs and attitudes about technology and learning (Kopcha, 2012; Scherer, Tondeur, Siddiq, & Baran, 2018). Teachers with positive beliefs about technology are often able to effectively integrate technology in their classroom instruction (e.g., Heath, 2017). Teacher education programs should address pre-service teacher beliefs in technology education courses in order for them to successfully implement technology in their future classroom instruction (Yang, Yang, Wu, & Liu, 2013).

One of the important beliefs is self-efficacy. Self-efficacy refers to one’s judgement of his/her ability to perform a task within a specific domain (Bandura, 1977). Self-efficacy is predictive of technology adoption intentions (Anderson, Groulx, & Maninger, 2011; Li, Li, & Franklin, 2016), and has been identified to influence teachers’ technology integration practices (Albion, 1996; Ertmer, 1999; Li, Worch, Zhou, & Aguition, 2015). Research has suggested that authentic learning experiences influence pre-service teachers’ technology integration self-efficacy (Banas & York, 2014). Observing cooperating teachers using technology was found to be one of three most important factors influencing feelings of preparedness for technology use (Ertmer, 2005). Supervisor’s use of technology influences pre-service teachers’ technology use in their own classrooms (Downes, 1993). In other words, vicarious learning has impact on the judgement of self-efficacy (Wang, Ertmer, & Newby, 2004).

In light of the research findings in the literature that call for authentic field experiences, the reported action research implemented a new instructional approach, the service learning project, in an undergraduate technology integration course for pre-service teachers. This project was intended to provide authentic learning experiences as well as vicarious learning opportunities for the pre-service teachers in order to increase their self-efficacy in regards to technology integration and improve their understanding of the role of technology in learning. The purpose of this action research was to examine the impact of service learning on pre-service teachers’ self-efficacy and beliefs about technology integration.
**ACTION RESEARCH METHODOLOGY**

**Context of the Study**

A service learning component was integrated in an undergraduate class for pre-service teachers titled “Integrating Instructional Technology” in spring 2016. Service learning is a community engagement pedagogy that connects learning goals with community service to promote both the student growth and the common good (Bandy, 2018). Service learning provides authentic opportunities for students to learn, apply, and reflect on course materials. The service learning activities took place in an elementary school's Makerspace lab. This elementary school was one of the pilot schools for the school district's 1:1 initiative in which every student was issued a laptop to use both at school and at home. With the technology available to all students, the school started the Makerspace lab to help students develop STEM capacity with Maker activities such as robot building and 3D printing. The university instructor of the technology integration course for pre-service teachers collaborated with the supervisor of the Makerspace lab at the elementary school to bring the pre-service teachers to help manage the Makerspace lab at the elementary school. Through the service learning project, pre-service teachers engaged in hands-on experience working with elementary school students utilizing maker technologies (e.g., Lego Mindstorm EV3, LittleBits). The pre-service teachers first learned about those Makerspace technologies and the TPACK technology integration framework in their technology integration course. After learning about those Maker technologies, the pre-service teachers went to visit the elementary school's Makerspace lab to assist the lab teacher with Makerspace activities for the school children. Upon each school visit, the pre-service teachers were asked to complete a reflection journal on their service learning experiences at the elementary school.

**Research Method**

The researcher implemented the service learning project with the intention to provide authentic opportunities for the students to practice what they had learned in a university class in a real world setting such as an elementary school classroom. The purpose of the research was to examine the impact of this new instructional approach on students' understanding of and attitudes towards the topic (technology integration). Action research involves practitioners and community members to improve the community and practice (Reason & Bradbury, 2008). Action research methodology, as a means for practitioners to "investigate and improve their own practices" (Hendricks, 2013, p.3), fits well with this purpose of this approach. In an action research, the practitioner may examine his or her own instructional practices (Hendricks, 2013). For this research, the instructor as the practitioner examined how the new instructional approach (i.e., the service-learning project) impacted the pre-service teacher candidates in the class in regards to their beliefs and confidence in the use of instructional technologies.

This study was designed to examine two aspects that are related to pre-service teachers' technology integration training: 1) learning technology integration through service learning, and 2) the development of pre-service teachers' understanding of technology integration through participation at a makerspace lab. The data sources for this study were the pre-service teachers’ (n=12) reflection journals. Specifically, the pre-service teachers in
this class were asked to reflect upon each of their service-learning visits to the elementary school. The participants in this study submitted a journal entry for each of their school visits. Depending on how many hours each student spent at the school each time, the number of their school visits ranged from two to four times. The reflection journal had three guiding questions: 1) what did you do at the school; 2) what were your observations regarding the student's use of technologies; and 3) how has your experience impacts your beliefs and confidence regarding the uses of technology in education? The students' journals were submitted as a Word document in the course Blackboard site. Their reflection journals served as the data sources for this study.

The data for this study were qualitative in nature. Coding in qualitative data analysis is “a range of approaches that aid the organization, retrieval, and interpretation of data” (Coffey & Atkinson, 1996, p. 27). Open coding technique (Creswell, 2005) was used to analyze the data as the codes were not predefined but were derived directly from the collected data. The journal entries were coded as they became available. Line-by-line coding technique was employed to identify codes to represent the meanings reflected in the journals. After open coding, the codes were compared among different participants. As a result, the data were organized and categories of meaning were constructed (Merriam, 1998).

This action research has certain limitations. First, the research was conducted in one class that had a small number of students (n=13). Secondly, the data sources from the study were from the students' journals only. Although the journal provided prompts that were similar to questions that would be asked in an interview, it would be helpful to include other data sources such as one-on-one interviews and/or focus group interviews.

**Findings**

Several themes emerged from the qualitative analysis of the pre-service teachers' reflection journals on their service learning experiences: 1) pre-service teachers' exposure to a variety of technologies that are used in schools; 2) school students' excitement with using technologies in classroom activities; 3) pre-service teachers’ improved self-efficacy on technology competency; 4) pre-service teachers' strengthened beliefs in technology integration in future classroom instructions; 5) pre-service teachers' enhanced understanding of the role of technology in education; and, 6) pre-service teachers' increased awareness of technology issues in the classrooms.

The pre-service teachers from the university shared in their journals the various technologies that they had observed being used in the elementary school where they completed their service learning project. In a third grade class, the students were using Skype to have conversations with another third grade class from a different school. In a history class, the school students were researching on the web on the colonial times and then creating a movie with green screen to present their findings. Students were designing 3D objects using software on their devices. The university pre-service teachers also got to see the elementary school students playing with Maker technologies such as Lego Mindstorm EV3 robot, MakeyMakey, and LittleBits. Some pre-service teachers were surprised by some of those technologies used in the elementary school. Participant 2
reflected, “I have never heard of students creating a movie with the green screen, which is awesome.” “I was shocked that they were going to make a movie, but it interested me greatly.” “It amazes me how good young learners are with technology.”

During their service hours at the elementary school, the pre-service teachers got to see elementary school students’ excitement with using technologies. This excitement was observed on students from different grade levels. The following quotes help illustrate the elementary students’ excitement with technologies: “even the first graders enjoyed using these technologies (participant 10).” “The students seemed very enthusiastic about making the movie using pictures (participant 2).” “This group of students loves building and creating their own projects every week after school (participant 5).” “The students loved seeing robot move down the hallway, knowing that we had built the program (participant 8).”

The pre-service teachers, through their service learning at the elementary school, have improved their self-efficacy with using technologies. Participant 3 reflected after her service hours during a 3D printing session, “my visit allowed me to become more comfortable with the Tinkercad software.” Similarly, participant 4 wrote in her journal, “When I was put in the situation of teaching others how to use it, I felt more pressure to really understand how it worked and feel knowledgeable enough to teach it to someone else. I feel much more confident now with the technologies than I did before.” Participant 8 echoed similar reflection, “This was a great experience because I got to learn the technology better by showing it to the students and watching it work.” Part of the improved self-efficacy was due to the tips learned from the mentor teacher at the elementary school. As participant 5 wrote in the journal, “she gave me great pointers and ways I could implement technology in my future classroom without causing any distractions.” Participant 5 shared in his reflection journal, “this was a great experience because I got to learn the technology better by showing it to the students and watching it work. This definitely made me a lot more comfortable and ready for future times if I am doing it with students.”

The service learning project helped the pre-service teachers strengthen their beliefs in technology integration in their future classroom instruction. Participant 10 reflected, “This experience has changed my mind completely about technology in the classroom. In the beginning, I was hesitant … I thought that it might be a distraction to the students … After learning more about it and seeing all that is out there, I have completely changed my mind.” Participant 1 wrote, “In my future classroom, I plan to incorporate technology so students can experience 21st century learning and get to use different methods of learning during their education.” Participant 2 reflected, “you should expose students with these technologies to challenge their thinking and help their knowledge grow when they are hands-on working with these technologies. I now know what technologies I can use in my classroom.” “I want to use technology in my future classroom because the students were so engaged and enjoyed this assignment so much. I think when students think an activity is fun and engaging, they are able to explore and learn more.” After seeing how the
elementary school students enjoyed learning with technology, participant 8 wrote, “this is a technology that I would definitely consider using in my own future classroom.”

The pre-service teachers developed enhanced understanding of the role of technology in education through this service learning project. Participant 2 wrote in the journal, “As I observed and helped when needed, I realized that technology is more than these websites they work on. It is more than using a 3D printer or using objects to create sound. Technology is about gaining knowledge, learning, and applying your knowledge through the use of the technology.” Participant 2 reflected, “I originally thought technology just dealt with working on a computer. However, I have learned that technology is more than computers. Technology has to do with using things to come up with solutions. I saw this today, when observing students using MakeyMakey, that those students were able to use real objects, attach it to wires, and create sounds. It makes the students more engaged and gives them a chance to open up their eyes and get a sense of the world.” Participant 9 stated, “Through observing and helping out today, I can really see how advanced students’ knowledge truly is through working with different types of technologies.” After working in a fifth grade history class, participant 3 reflected, “I would not have thought about incorporating that amount of technology in a history lesson, but in the end, I found that this is a great way to teach history! The students were really engaged and excited to make videos portraying the information that they learned.”

Not all the experiences that the pre-service teachers had during their service hours at the elementary school were benefits; they had experienced and observed challenging issues in the elementary school in regards with the use of technology. For example, during one visit, participant 12 observed that the elementary students were having trouble navigating through the teacher assigned website because “the internet was acting weird and the volume was not working for all the devices.” This had caused the problem for the elementary school teacher as she had to take on the responsibility of trouble shooting technical problems for the students, which took time off her instruction. Participant 6 experienced printing problems during her service hours, “my job was to help students create the file for the printer. Unfortunately after we began to print the first file, the printer began having troubles. Eventually I found out that was because the file was too big.” Another technology issue participant 6 experienced was when she was trying to download a software to the school devices, “the computer wouldn’t allow me to get through the download process because the system was set up to not allow pop ups as well as the fact that the internet was in a type of safe mode.” “It is not uncommon issue with technology where there is a lot of downtime while everybody gets to the right place. This problem could be solved in the classroom by making sure there is something else that students know they can work on if there computer isn’t working or they are waiting for a teacher.”

**Discussions and Conclusions**

The service learning project provided the opportunity for the pre-service teachers to observe and help with technology infused students’ activities in an elementary school. The findings from this action research shed some light on ways to overcome what Ertmer
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(1999) classified as the second order barriers: beliefs about teaching, about technology, and unwillingness to change. In this study, the pre-service teachers not only have developed enhanced understanding of the role of technology in education, but they have also strengthened their beliefs and self-efficacy with using technologies in their future classroom instruction through the service learning experience.

The results from this action research echo some of the approaches that have been identified in the literature to be helpful to change teachers’ beliefs about technology integration. For example, Ertmer (2005) suggested that three elements were influencing teachers’ beliefs: personal experiences, vicarious experiences, and socio-cultural influences. Ottenbreit-Leftwich et al., (2010) suggested that field experiences were critical for improving teachers’ technology integration practices. In this action research, the pre-service teachers engaged in vicarious experiences by observing the school teacher’s technology integration practices during their service hours. For example, participant 5 said that her observation of the school teacher’s technology integration practices help her learn some tips on how to avoid distraction caused by technology in the classroom. Participant 10 stated that seeing how technology worked in a classroom changed her mind from a non-believer in technology integration to a strong advocate for technology use in education.

Self-efficacy has been identified as an influencing factor for teachers’ technology integration practices (Ertmer & Ottenbreit-Leftwich, 2010; Ottenbreit-Leftwich et al., 2010). The participants in this action research study reported increased self-efficacy in their reflection journals as a result of their service-learning experiences. Specifically, the participants found both the hands-on experience working with school children and the observation of school teacher’s technology integration practices in the real classroom to be helpful to enhance their self-efficacy in technology integration in the classroom.

Overall, the service-learning project was found to have positively influenced pre-service teachers’ beliefs about technology and improved their self-efficacy regarding the use of technology. Participants in this study reported that they had developed a stronger positive belief in the role of technology in education and believed more in their ability to integration technology in the classroom. Technology Education courses in teacher education programs may consider adopting similar project initiatives that provide pre-service teachers with adequate opportunities to practice their technology integration skills in schools and opportunities for them to observe inservice teachers’ technology integration practices in the classrooms. While this may or may not necessarily be in the form of service-learning, the idea of authentic experience for pre-service teachers is worth promoting since the authentic field experience plays a significant role in helping pre-service teachers develop stronger beliefs in the positive role of technology in education and enhance their self-efficacy on their technology integration practices.
REFERENCES


**Biographical note:**

**Dr. Liyan Song** is a Professor in the Department of Educational Technology & Literacy at Towson University. Dr. Liyan Song received her PhD in Instructional Technology from University of Georgia in 2005. She has worked at Towson University since then. Dr. Song teaches different levels of courses in the Instructional Technology program including undergraduate, master graduate, and doctoral level courses. She is the program director for the Instructional Technology Master’s program (EDTE and ISDV concentrations). In addition, she advises doctoral students on their dissertations as their dissertation advisor or dissertation committee member. Dr. Song’s research is centered in the areas of technology integration in schools, online learning and teaching, conceptual change, and epistemic beliefs.