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ENHANCING EDUCATIONAL TECHNOLOGY CONFIDENCE AMONG TEACHER CANDIDATES: BENEFITS OF AND LESSONS LEARNED FROM A 1:1 DEVICE UNIVERSITY-ELEMENTARY SCHOOL PARTNERSHIP

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ABSTRACT

Aim/Purpose	This study describes and evaluates a teacher preparation program that combines a school-university partnership and a 1:1 device initiative.
Background	This educational design research report combines a 1:1 technology device experience with a school-university partnership to enhance teacher preparation for educational technology use.
Methodology	This is a mixed-methods educational design research study. Interview responses share benefits and lessons learned from the program experience. Survey responses give information about educational technology confidence among teacher candidates who took part in this program.
Contribution	This study provides a description of a unique teacher preparation program designed to enhance educational technology confidence among teacher candidates and shares lessons learned from this experience in light of collected data.
Findings	Teacher candidates' social outcome expectations for using technology were increased. Qualitative data indicate that the program also benefitted elementary school teachers by enhancing educational technology confidence and providing extra help.
Recommendations for Practitioners	University teacher candidates should be given more embedded technology-focused classroom experiences. Smaller university class sizes are necessary to support these types of experiences.

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Recommendations for Researchers	Future studies could more deeply investigate how school-university partnership programs with technology affect teacher candidates' social outcome expectations and educational technology confidence.
Impact on Society	Approaches to teacher preparation similar to the one presented in this study can enhance students' social outcome expectations for using technology.
Future Research	Future studies could investigate various educational technology initiatives' effects on teacher candidates' educational technology confidence and share teacher preparation program designs aimed at enhancing educational technology use.

Keywords teacher preparation, teacher candidate, educational technology, educational technology confidence, 1:1, school-university partnership

INTRODUCTION

To prepare K-12 students for our fast-paced technological world, schools and teachers are doing more and more to integrate educational technology in the classrooms. University teacher preparation programs also seek to prepare teacher candidates (TCs) with the necessary skills to integrate technology into teaching and learning experiences. However, not all TCs are confident and comfortable implementing educational technology to support teaching and learning after their university preparation is over (Sutton, 2011; Tondeur et al., 2012). The common model for teacher preparation programs – the stand-alone educational technology class – has drawbacks, which include a lack of pedagogical method development, lack of time, failure to adapt to current research, and failure to address extraneous real-world issues that affect technology integration (Hartshorne, Ferdig, & Dawson, 2005). To overcome some of these issues, teacher preparation programs have developed initiatives to increase preparation, confidence, and experience for educational technology use among TCs. Two types of initiatives designed to increase this type of preparation, which are relevant to the current study, are school-university partnerships and 1:1 device programs (Donovan & Green, 2010; El-Amin et al., 2002; Nguyen et al., 2016; Polly, Heafner, Chapman, & Spooner, 2015).

This educational design research study describes and evaluates a program that combines a school-university partnership and a 1:1 device initiative. The program design includes university elementary education language arts methods and educational technology classes integrated into a local elementary school. University TCs, university faculty members, elementary school teachers, and elementary students all have 1:1 iPads for teaching and learning activities. A variety of activities in the program involved TCs working directly with elementary students on learning activities including classroom observations, 1:1 learning projects, educational makerspaces, and whole-class teaching.

SCHOOL-UNIVERSITY PARTNERSHIPS AND 1:1 DEVICE PROGRAMS

Innovative teacher preparation programs in the United States have focused on better connecting university and K-12 schools to provide TCs with more real-world practice integrating technology (Benedict, Holdheide, Brownell & Foley, 2016; El-Amin et al., 2002; Johnson-Gentile, Lonberger, Parana, & West, 2000; Polly et al., 2015). These innovative programs can range from university-connected K-12 lab schools hosted on university campuses, to K-12 school-university partnerships featuring university classes in local K-12 schools (Polly et al., 2015). Holding university teacher preparation classes in a K-12 school can greatly increase the use of technology for K-12 learning and also improve the educational technology training of TCs (Hartshorne et al., 2005; Polly et al., 2015). Such experiences can help TCs gain knowledge and experience in dealing with real-world extraneous issues that can serve as barriers to technology integration in ways that traditional stand-alone educational technology classes cannot (Hartshorne et al., 2005; Lees & Kennedy, 2017).

Teacher preparation programs can also suffer from a lack of adequate access to technology tools and resources for TCs, leading to a lack of time for developing teaching methods and working with the technology tools (Hartshorne et al., 2005). To overcome these issues, some teacher preparation programs have adopted 1:1 device technology programs in an effort to support better technology expertise and use among TCs (Donovan & Green, 2010; Nguyen et al., 2016; Vasinda, Ryter, Hathcock, & Wang, 2017). A 1:1 device technology program means that each student within a class or a school has a personal device, such as an iPad or laptop, that he or she uses throughout the day (Bebell & Pedulla, 2015). A teacher preparation program that features 1:1 devices for TCs can better support beliefs consistent with high technology use and higher technology expertise among TCs than programs without 1:1 devices (Donovan, Green & Hansen, 2012; Hughes, 2013). In such programs, TCs have high access to technological devices and more opportunities to develop teaching methods using these devices (Nguyen et al., 2016).

Initiatives featuring 1:1 devices in K-12 schools also have great potential for enhancing student achievement and supporting positive changes in teaching methods (Bebell & Pedulla, 2015; Cavanaugh, Dawson, & Ritzhaupt, 2011). In one study, the implementation of laptop computing along with professional development within several schools yielded an increase in student-centered learning, project-based learning and time focused on academic tasks (Cavanaugh et al., 2011). Professional development and training that is situated within actual K-12 classrooms may be the best way to help teachers and TCs to teach effectively in a 1:1 device learning environment (see Kopcha, 2012).

Though there are many potential benefits of school-university partnerships and 1:1 device initiatives, as yet there are not many reports of teacher preparation programs that combine these approaches together (see Ally, Grimus, & Ebner, 2014; Benedict et al., 2016; Nguyen, 2016). Some possible reasons for this might include the high costs of 1:1 devices that match those used at the elementary school, difficulty coordinating the purchase and distribution of these devices, and difficulty in setting up partnerships with local schools and making arrangements for university TCs to attend classes away from campus (Baran, 2014; Benedict et al., 2016). The approach reported here is unique because it features university teacher preparation classes held within a working public elementary school and Apple iPads as the 1:1 devices for all university and elementary students.

Technology Self-Efficacy and Outcome Expectations

One way to measure positive changes that may occur from innovative teacher preparation programs is to determine TCs' confidence with using educational technologies for teaching and learning. Researchers have studied teachers' and TCs' preparation and confidence to integrate technology using terms such as technology self-efficacy (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Wang, Ertmer, & Newby, 2004) and outcome expectations (Niederhauser & Perkmen, 2010). Positive computer self-efficacy beliefs have a positive influence on computer use (Igbaria & Iivari, 1995; Thompson, Compeau, Higgins, & Lupton, 2008), and evidence suggests that teachers' and TCs' self-efficacy for technology integration is a factor in determining whether technology will be used in the classroom (Abbitt & Klett, 2007; Albion, 2001).

In addition to self-efficacy, outcome expectations among TCs has been shown to relate to their motivation to use instructional technologies (Niederhauser & Perkmen, 2010). Outcome expectations – beliefs that a behavior will lead to a valued outcome – consist of three components, which include (a) performance outcome expectations, (b) self-evaluative outcome expectations, and (c) social outcome expectations (Bandura, 1986; Niederhauser & Perkmen, 2010). Teachers' intrapersonal beliefs, including their expectations of how others will view them (social outcome expectations) can affect their use of technology in the classroom (Niederhauser & Perkmen, 2008, 2010). The above-mentioned studies suggest that TCs with a high self-efficacy for technology use and high outcome expectations are more likely to use educational technologies in their classrooms.

Design and Purpose

Despite advances in teacher preparation programs, there are still difficulties with aligning educational technology theory and practice to support TCs' confidence to use and teach with educational technologies (Sutton, 2011; Tondeur et al., 2012). Few research reports of teacher preparation programs combine both 1:1 device initiatives and classes within a working school, with all of the possibilities for interaction with K-12 students that these provide (see Ally et al., 2014; Benedict et al., 2016; Nguyen et al., 2016).

This report is an evaluation of the first year of a teacher preparation program that included elementary education classes within an elementary school and 1:1 devices. Data collected include quantitative survey data on educational technology outcome expectations and self-efficacy, and qualitative interview data from elementary school faculty and administration on the benefits and lessons learned from the experience. The study follows tenets of educational design research, which includes real-world interventions, an iterative design process, and a focus on real-world utility (Van Den Akker, Gravemeijer, McKenney, & Nieveen, 2006). The questions for this educational design research study are:

1. What program benefits have been realized and lessons have been learned from the perspective of current elementary teachers?
2. How has the program affected elementary teachers' and teacher candidates' educational technology confidence?

Method

Program Design

The teacher preparation program described in this study combined university classes held at an elementary school with 1:1 devices for all elementary school and university students. The combination of proximity to elementary students and availability of technology devices provided for authentic experiences in which TCs interacted with and taught elementary students using technology. In the program, fifth semester elementary education TCs attended their language arts methods and educational technology classes in a room at the elementary school. During the first year of the program, there were 38 TCs (29 TCs in the first or fall semester and 9 TCs in the second or spring semester) enrolled in the classes, which were held on Monday, Wednesday, and Friday mornings. Traditionally this teacher preparation program enrolls a higher number of TCs in the fall than in the spring semester due to the sequence of courses. As part of the classes, the university faculty members worked closely with the teachers and principal at the elementary school to provide experiences for TCs to apply their course content learning by teaching and working with elementary school students.

During the first semester of the program, there were planned experiences for TCs, which included classroom observations, 1:1 learning projects, facilitating an educational makerspace, and whole-class teaching. TCs completed these additional experiences before accomplishing other clinical activities that are typically a part of university teacher preparation programs, such as pre-student teaching and student teaching experiences. The low pressure, simple activities during the first part of the program were designed to help TCs ease into the higher-pressure experiences of teaching in small groups and in front of a whole class.

Classroom observations

At the beginning of each semester, TCs observed teaching practices in the various elementary classrooms. The TCs were asked to note the instructional strategies, 1:1 device learning experiences, and classroom management techniques they observed. After the observation, the TCs were engaged in a reflective one-hour discussion in the university classroom. The total time that each TC was engaged in this classroom observation was also one hour, however TCs also had many other unplanned opportunities to observe teaching practices during the first and second semester.

1:1 learning projects

TCs assisted third graders with an animal research project in the first semester. The third grade students used their own school-issued iPad during the project. During the animal research projects, the TCs helped either an individual student or a small group to find information on the Internet about their animal, record their facts, and eventually create a slideshow presentation using the *Educreations* app on individual iPads. TCs were involved in this 1:1 learning project for approximately three hours during the first semester.

During the second semester, the TCs spent time in a fourth-grade classroom assisting the teacher and her students with two 1:1 learning projects. The first project was a picture collage that explained various types of sentences such as interrogative, imperative, exclamatory, and declarative. For the second project, TCs helped the fourth graders acquire and record information for a report on a chosen U.S. president's life using the *Epic!* app. Also in the second semester, the TCs assisted a second grade class with research and development of another presidential report created with the *Story Jumper* app. TCs were involved in these 1:1 learning projects for approximately six hours during this second semester.

Educational makerspace

TCs facilitated educational makerspace experiences for students in the shared elementary school (see Figure 1). The Makerspace Centers included technology toys such as Little Bits, Snap Circuits, Dash, Sphero Robot, Hummingbird Robotics Kits, Makey-Makey, and more. TCs were able to host a total of three makerspace experiences for elementary students comprising about an hour and 50 minutes during the first semester.

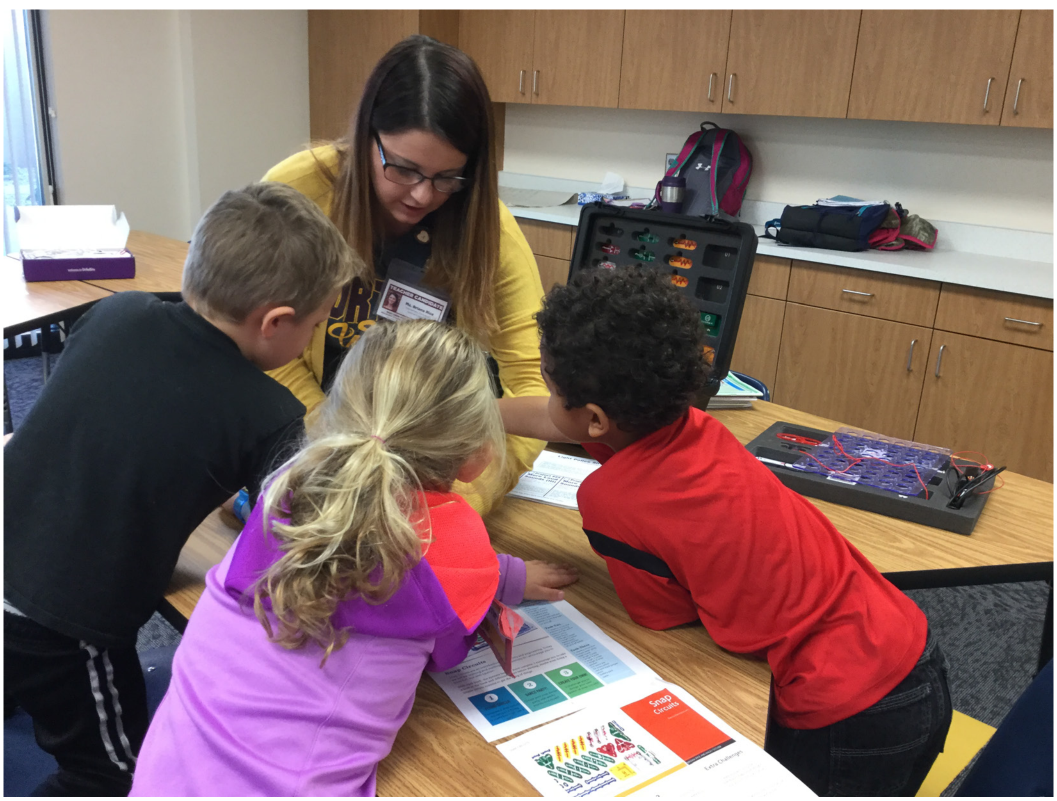

Figure 1. A university teacher candidate works with a small group of elementary students as part of a Makerspace experience.

In the second semester, an additional educational Makerspace experience for elementary students was facilitated by TCs, featuring many of the same educational tools and applications that were used in the first semester. As in the past semester, TCs were able to host a total of three makerspace experiences for elementary students comprising about an hour and 50 minutes during this semester.

Whole-class teaching

At the end of the first and second semester, each TC was assigned to a 1:1 device classroom and charged with teaching that week's vocabulary words using an interactive whiteboard and total participation techniques. The lesson was designed to take about 30 minutes. Later in the semester as part of an embedded clinical experience working with an elementary classroom teacher, TCs designed and implemented another longer interactive whiteboard lesson plan. The teaching time frame for this last whole group lesson was approximately 45 minutes.

Unplanned activities

In addition to planned activities that came as part of this experience, other unplanned activities that resulted from the program occurred during the first semester. For example, one day during their university class, TCs were unexpectedly asked by the elementary school principal to assist first graders with writing Friday messages. Friday messages are written notes from the elementary student to his or her family about the week's events and learning experiences. TCs assisted the first graders with proper sentence structure, spelling, and grammar.

Unplanned activities also resulted from the synergy of the program during the second semester. For example, TCs listened to a small group of elementary students read aloud in a guided reading session and were asked to help conduct literacy assessments in a classroom. Overall, each group of TCs had multiple opportunities to assist and teach elementary age children using a variety of techniques and technology tools that were above and beyond normal university clinical experiences and coursework. The TCs also had multiple opportunities to experience and observe 1:1 device classrooms.

Participants

Participants for this study include current elementary school teachers from the entire school district in which the program took place and TCs from the university (see Table 1). Within the entire school district there are a total of 98 elementary school teachers and 58 of these teachers chose to participate in this study.

A total of 67 TCs participated in this study. The researchers collected data from 33 of the 38 elementary TCs who took part in this program. The other 34 elementary TCs participating in this study were part of the same university and elementary education major, but they took the language arts methods and educational technology courses prior to the implementation of the program. There were a total of eight teachers employed at the elementary school in which this program took place, and all of these teachers and the principal were interviewed for this study.

Instruments

There were three instruments used in this study, an interview question protocol, a teaching with technology survey, and an educational technology confidence survey. The interview question protocol helped answer the first research question about program benefits and lessons learned, and part of the second research question about educational technology confidence among elementary teachers at the school in which the program took place. It was developed by the authors and included questions designed to evaluate the experience of having TCs in classes within the elementary school. Questions were informed by the literature on the possible benefits of 1:1 technologies (Bebell & Pedulla, 2015; Cavanaugh et al., 2011) and educational technology self-efficacy (Abbitt & Klett, 2007; Ertmer et al., 2012). Additional questions were also included to focus on and evaluate the program. These questions ranged from more general perceptions of the program such as, "How have your teaching practices been impacted by the presence of university classes at the elementary school?" and, "If you could change anything about the current relationship with university classes at the elementary school, what would you change?" More specific questions about the program's impact on technology self-efficacy were also included such as, "How has your technology use in the classroom been impacted by the presence of university classes at the elementary school?" and "Has the presence of university classes at the elementary school influenced your willingness to try new technologies?"

The educational technology confidence survey helped answer the second research question. This survey included three sections: (a) demographics, (b) the self-efficacy for technology integration scale (Wang et al., 2004), and (c) the instructional technology outcome expectation scale (Niederhauser & Perkmen, 2010). The self-efficacy for technology integration scale is a 16-item instrument developed and validated by Wang et al. (2004) to measure self-efficacy beliefs of participants with regard to technology integration. In a previous study, this instrument was tested for reliability and yielded Cronbach's Alpha coefficients of $\alpha = .94$ and $\alpha = .96$ on pre- and post-survey implementations (Wang et al., 2004). Before implementing the self-efficacy for technology integration scale, the authors updated some of the items to say "technology" instead of "computer" because current classroom technology items generally also include devices other than computers.

Niederhauser and Perkman (2010) designed the instructional technology outcome expectation scale to measure motivation among teachers to integrate technology into teaching and learning. This scale is comprised of three main sections that focus on technology use in the teaching and learning process, including performance outcome expectations, self-evaluative outcome expectations, and social outcome expectations (Niederhauser & Perkmen, 2010). A validation study of this instrument resulted in high validity and internal consistency as measured by various constructs (Niederhauser & Perkmen, 2010). Both the self-efficacy for technology integration scale and the instructional technology outcome expectation scale feature closed-ended Likert-scale items.

The teaching with technology survey is a self-report measure of student ability to integrate technology into the teaching and learning process. It consists of six items and was developed by assessment personnel at the university to be used as a self-assessment of one's own ability to use technology for teaching and learning. This survey helped answer part of the second research question about educational technology confidence among TCs.

Data Collection

All data were collected during the first year, second semester of the program's implementation. The survey and interviews were implemented at roughly the same time during this semester. Interviews were conducted with the principal and all of the eight teachers who teach at the elementary school in which the program took place. A link to the educational technology confidence survey was sent to current elementary school teachers within the school district, TCs who had classes within the program described in this study, and TCs who were enrolled in the same university classes prior to this program's implementation. Follow-up emails were also sent after a few days to encourage those who had not responded to do so. Response rates from each group are reported in Table 1. Of the 38 TCs who had classes within the program, 32 chose to fill out the educational technology confidence survey, along with 15 TCs who were enrolled in the same university classes prior to this program's implementation. Teaching with technology survey data were collected in class from TCs who had classes within the program (data were available for n=33 of the 38 TCs) and also TCs who were enrolled in the same university classes prior to this program's implementation (n=34; see Table 1).

Table 1. Participant groups and number of respondents for the quantitative instruments in this study.

	Educational Technology Confidence Survey	Teaching with Technology Survey
Elementary School Teachers in the Program School District	n = 57	N/A
University TCs in the program	n = 32	n = 33
University TCs not in the program	n = 15	n = 34

Data Analysis

Data from the interviews of eight current elementary teachers and one principal were analyzed using qualitative content analysis techniques (Ezzy, 2013). The interview question responses were transcribed and combined into a single document and arranged by interview question in a deductive analysis (Ezzy, 2013; Miles, Huberman, & Saldana, 2014). This analysis included a focus on comments that related to general benefits and lessons learned as well as educational technology self-efficacy elements such as confidence and willingness to try new technologies (Abbitt & Klett, 2007; Ertmer et al., 2012). The responses were read through several times as the main author selected and highlighted key phrases in which respondents discussed benefits and lessons learned as they related to the program. Phrases with similar meanings were grouped together and meanings were read again, compared and checked for consistency in meaning to develop themes. Each theme was then labeled with a descriptive title. These themes were read again and compared to one another in order to determine if there was overlap in content and meaning. A total of 15 separate themes emerged from this process, which are reported in the results section. In preparation for reporting the results of the interviews, transcribed quotes that strongly supported the themes were organized and counted in a separate document. This provided a way to determine if themes were deemed minor (4 or fewer supporting quotes) or major (5 or more supporting quotes). For reporting, the themes have been classified into three main topics that relate to the first research question on benefits and lessons learned, (a) lessons learned from the program, (b) general benefits of the program, and (c) technology-specific benefits of the program.

This method for analyzing the interview responses helped to increase the credibility of the results by triangulating, or comparing and contrasting interview data from participants in a systematic manner (Miles et al., 2014). Because only the main author completed the qualitative data analysis, it is possible that personal and professional biases could have played a part in this process. However, the transferability and dependability of the collection and analysis of qualitative data for this study is enhanced by the description of the setting and experience provided previously (Miles et al., 2014; Mills & Gay, 2015).

Data from the survey were analyzed with analysis of variance statistical techniques on individual Likert-scale items to compare educational technology self-efficacy between the various groups of participants in the study. A reliability analysis of the results in this study yielded a Cronbach's alpha of $\alpha = .948$ for the self-efficacy for technology integration scale. Reliability analysis for the three factors of the instructional technology outcome expectation scale – performance outcome expectations, self-evaluative outcome expectations and social outcome expectations – yielded Cronbach's alpha scores of $\alpha = .873$, $\alpha = .843$ and $\alpha = .861$ respectively.

RESULTS

The first research question in this study focused on the benefits and lessons learned from the program from a qualitative perspective. The themes that emerged from a content analysis of interviews from the eight current elementary school teachers and one principal were categorized in three main areas; general benefits, technology benefits and lessons learned.

GENERAL BENEFITS

Interview responses shared items that elementary teachers viewed as general benefits from the program. Major themes within general benefits include that extra help was available for elementary teachers (12 supporting quotes), that elementary students had opportunities to learn from other adults (6 supporting quotes), and that additional learning opportunities became available because of the program (6 supporting quotes).

In interviews, elementary teachers often discussed the benefits of having extra help available to them. This help occurred as part of planned experiences, such as the one-to-one tutoring described previously in which TCs assisted elementary students with research projects, and also as part of unplanned experiences. One teacher discussed an unplanned experience in which TCs were asked to help on a literacy assessment activity, "I teach kindergarten, and all the assessments we do with them have to be one-on-one, and that can be kind of tricky for just me to do with the whole class, so they graciously came in and helped out, and I just really appreciated it." Another teacher shared, "Anytime I am having a large project where I need more hands, it is nice to have the option to ask [the university TCs] if they want to come in and help."

Elementary teachers in the program also felt like having other adults participate in the teaching and learning was a benefit for their students. In this program, TCs were the additional adults who participated in the teaching and learning through the various experiences shared previously, including 1:1 learning projects, and educational makerspace experiences. "I love to have them see new people come into the room and see them learn respect for any adults in our school," shared one teacher. Another teacher discussed how these experiences are a benefit to students and TCs, "I think it is important for the future teachers from [the university] as well as my students to see and interact with other adults." During the program, TCs often commented about how they were learning from elementary teachers' teaching and classroom management techniques.

Additional learning opportunities became available because of the program, and elementary teachers mentioned these as a benefit, "We have done some interesting activities with [the university] class so the kids have thoroughly enjoyed that." Some examples of new learning opportunities that became available because of the program included the educational makerspaces and the opportunity for providing guidance to help elementary students to complete research projects using 1:1 technology devices. One teacher declared, "I don't think myself or my students would have had these opportunities if the [university] classroom was not at the school." The content of the language arts and educational technology classes introduced new ideas and practices to TCs as well as elementary teachers.

Minor themes from the general benefits category included the opportunity for elementary teachers to learn from university faculty members (2 supporting quotes), TCs bringing an excitement and energy to the school (2 supporting quotes), and TCs learning together with teachers (2 supporting quotes). "I think they bring an element of joy and energy and they are excited about the profession," shared one elementary teacher. Another discussed how she gets ideas from the TCs and other elementary teachers, she shared that "just bouncing ideas off all the other teachers and seeing how they use the iPads in the classroom and being able to hear how the [university] students use it..." was a benefit. During this program, many of the technology tools and apps that were chosen for elementary students to work with were influenced by the fact that these apps were taught and used in the university classes. Afterward, TCs might use these tools and apps in an elementary classroom, giving teachers new ideas and methods for teaching and learning in a 1:1 classroom.

Technology Benefits

Elementary teachers also shared the benefits of the program for enhancing their technology integration. Major themes from this third category include modeling technology use (12 supporting quotes), and enhanced confidence with technology (5 supporting quotes). Interview respondents discussed that seeing technology use modeled in their classroom had a positive impact on their own practice. Teachers saw technology use modeled by university TCs during the one-on-one tutoring, educational makerspace and whole-class teaching experiences described previously. The principal discussed this impact from an administrative standpoint, "I think there has been a huge impact on our technology use, [university] students have built makerspaces, have introduced our teachers to different ways that technology can be used, but then also helped our students integrate that into their own learning." An elementary teacher discussed learning technology integration ideas from TCs, "I love learning from them, they know a lot about technology more than I do, so the teacher candidates, when they come in, they come in with fresh new ideas." Another teacher shared about the impact of the program on her willingness to try new technologies for teaching and learning in her 1:1 classroom, "I want to challenge myself and my students to do new things with technology."

Many elementary teachers felt that the program enhanced their confidence to use technology in the classroom. "I've done a little research on my own, the [university] students have helped us with technology as well," shared one teacher. Because this program brought university classes to the elementary school, this made the university faculty members much more accessible to the elementary school teachers and the principal to discuss questions and ideas about educational technology before, during and after the university classes. An elementary teacher mentioned, "[the program] has been helpful, like I said there are certain things that [a university faculty member] has shown us how to use, I don't know if I would have taken the time to do that before." The principal in the study also felt that teachers' confidence with using technology has increased, "I can definitely say that we have some teachers that have more experience with technology than others, but I would say everyone's comfort level has increased with the presence of the [university] tech classes there."

A minor theme from the technology benefits category that elementary teachers discussed was that more technology tools and resources became available because of the program (2 supporting quotes). The experience of holding an educational makerspace was new to the teachers and principal in the elementary school, but the idea caught on. Technology devices available for each student helped support these makerspace experiences. During the first year of the program, the principal and some teachers applied for a grant funding opportunity to acquire their own educational makerspace equipment. The principal shared, "We actually applied for a 3M STEM grant and we were awarded that, [...] part of our desire to apply for that was [because a university faculty member] brought in some of the technologies that he was using in his class so we could actually see what those items were, and what we would be looking for to bring into our classrooms, and so we were able to test it out and check things out a little bit before applying for that grant."

Lessons Learned

Within the final category – lessons learned – some major themes included difficulty with coordinating schedules (12 supporting quotes) and variable impact on classrooms (6 supporting quotes). The university classes were held in the mornings on Mondays, Wednesdays, and Fridays, so this limited the time that TCs could be required to be present at the elementary school. Elementary school teachers often discussed the difficulty of coordinating schedules so that TCs could come to their class and teach or participate. One teacher shared, "I wish we had gotten more of an opportunity to be with them, but it just didn't fit with our schedule, they were there when we had reading and also when we were heading out to recess so it was kind of tricky to schedule that way." Several teachers mentioned a desire to have TCs available not just in the mornings when our classes were held, but also in the afternoon. Comments to this effect included, "I would love more afternoon time," and "it would really help to have [university] students more available in the afternoon."

Another major theme from the lessons learned category was variable impact on classrooms. Some elementary teachers were able to work often with TCs, but others were not and therefore experienced less of an impact from the program. Responses share some of the reasons why this was the case. "To be real honest, [my technology use] hasn't really [been impacted], like I said I did not take advantage of the makerspace program but I am going to next year," was the response from one teacher. In order for the educational makerspace experiences to work, teachers had to sign up for a time that would fit with their class schedule. Another teacher shared, "I don't think my teaching practices have been impacted very much, other than I know there are future teachers always watching and observing – even if it is just in the hallway." This type of program depends on scheduling meaningful activities for both TCs and elementary students. However, when scheduling fails to work out or when elementary teachers fail to make it a priority, some of the potential impact of the program can be diminished.

Minor themes from the lessons learned category included respondents mentioning other difficulties unrelated to the program for getting started in the new year (2 supporting quotes), the need to design and coordinate each activity with a clear purpose (1 supporting quote) and the need to cater university activities to elementary class requirements (2 supporting quotes). The university faculty members learned quickly through the experience that unless each 1:1 learning project and educational makerspace activity was designed with a clear purpose, there was a danger of TCs not becoming involved at all beyond observation. As a consequence, they worked with elementary school teachers to design experiences that would meet their needs but also get TCs actively involved in the teaching and learning process.

Educational Technology Confidence

The second research question for this study asks about how integrating the university elementary education classes into the elementary school has affected elementary education TCs' confidence with technology integration. Findings from the educational technology confidence survey compared responses from (a) TCs who took classes in the program, (b) TCs from the two previous semesters who did not take classes in the program, and (c) current elementary school teachers at the school district in which the program took place.

An analysis of survey responses from the self-efficacy for technology integration scale revealed that there were no significant differences between the groups for this section of the survey overall [$F(2, 102) = .228$, $p = .797$]. Separate analyses of each question in this scale revealed only one item in which the groups responded differently to a statistically significant degree. The item was, "I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices." TCs who had not experienced the program responded with higher agreement to this item ($M = 3.87$) than did current elementary school teachers ($M = 3.21$), [$F(2, 102) = 4.398$, $p = .015$]. There were no significant differences between TCs who took classes in the program and any of the other groups on this item.

Results from the part of the survey that includes the instructional technology outcome expectation scale revealed no statistically significant differences between the groups on the performance outcome expectations factor [$F(2, 101) = .761$, $p = .470$] or the self-evaluative outcome expectations factor [$F(2, 101) = .971$, $p = .382$]. However, statistically significant differences were found between the groups in the social outcome expectations factor of this survey [$F(2, 101) = 3.887$, $p = .024$] (see Figure 2). TCs who were a part of the program ($M = 3.83$) responded with statistically significantly higher scores than did current area elementary school teachers ($M = 3.40$). The particular questions within this category that showed statistical significance were, "Effectively using instructional technology in the classroom will increase my status among my colleagues" [F(2, 101) = 3.740, p = .027], and "Effectively using instructional technology in the classroom will increase my colleagues' respect of my teaching ability" [F(2, 101) = 3.375, p = .038]. For both of the above questions, TCs who were part of the program responded with higher agreement than did current elementary school teachers. No significant differences were found between TCs who had not experienced the program and any other groups on these or any other questions in this part of the survey.

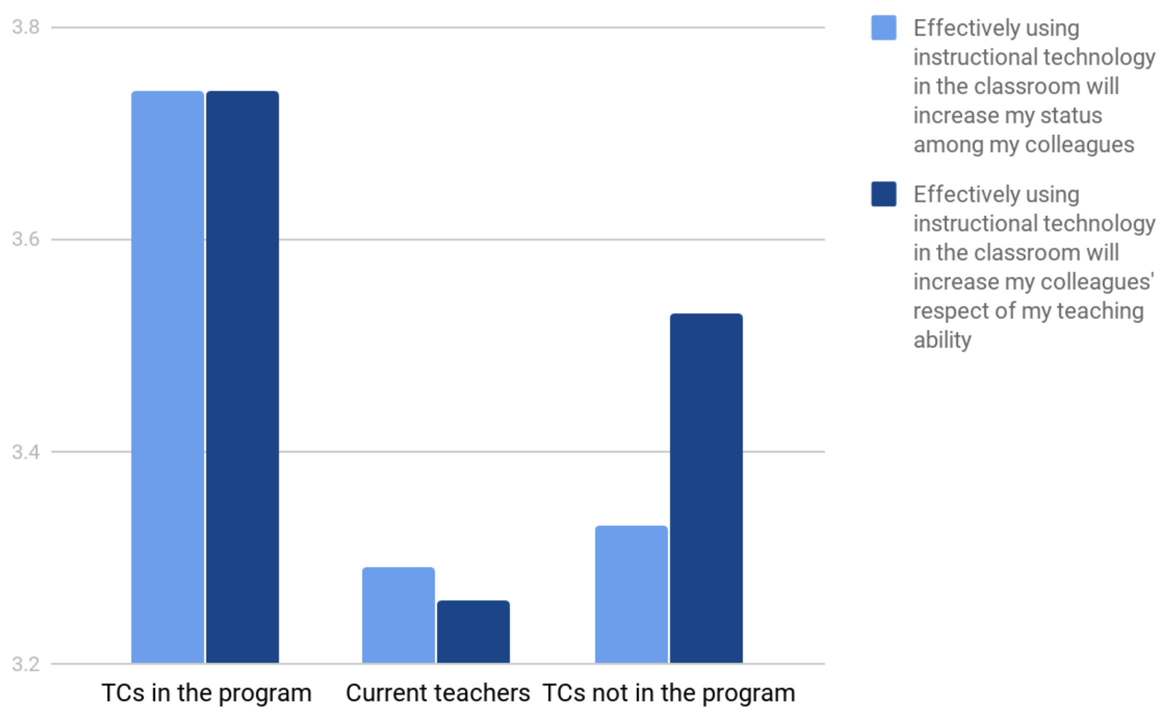

Figure 2. A graph of mean scores from questions for which statistically significant differences were found

Results from the teaching with technology survey compared TCs who took classes in the program to TCs who did not. Gain scores were calculated for each group and no statistically significant differences were found between these two groups on this instrument [F(1, 55) = .046, p = .831].

The second research question for this study also focused on elementary teachers' technology confidence. Responses from teachers at the program elementary school were separated and compared with responses from other elementary school teachers in the same school district. No significant differences between these groups were found on the self-efficacy for technology integration scale [F(1, 56) = .323, p = .572]. Nor were significant differences found on any of the three factors from the instructional technology outcome expectation scale. The three factors tested included performance outcome expectations [F(1, 56) = .137, p = .712], self-evaluative outcome expectations [F(1, 56) = .045, p = .833], and social outcome expectations [F(1, 56) = .083, p = .774].

Discussion

Findings from the self-efficacy for technology integration scale suggest that educational technology self-efficacy was not highly affected by the program. Elementary school teachers at the partner school did not respond differently on self-efficacy for technology integration than did other elementary teachers in the same school district. TCs in the program showed about the same level of self-efficacy for technology integration as did those who were not a part of the program. TCs within the program also reported about the same level of self-efficacy for technology integration as local school district elementary teachers.

In the literature, previous studies show an increase in TCs' technology self-efficacy after they experience authentic or embedded learning activities (Banas & York, 2014; Lee & Lee, 2014). TCs within the program did respond differently than current elementary teachers on the social outcome expectations factor of the outcome expectation scale. This finding suggests that the program could have increased TCs' expectation that others will view them as higher in status or with better teaching ability if they use technology in the classroom. This finding is in line with a previous study, in which TCs anticipated using technologies in their future classroom when they felt that others expected them to do so (Anderson & Groulx, 2015). Possible explanations for the differences between TCs and current teachers are that TCs in this program value technology more highly than current elementary school teachers, or that current elementary school teachers may not use technology as often. Current teachers are likely older than TCs, and previous studies have also discussed age as a factor in technology integration, with older teachers less likely to value or use technology in education (Francom, 2016; Inan & Lowther, 2010).

Qualitative findings show that some teachers in the elementary school felt that their educational technology confidence was affected positively as TCs and university faculty members modeled educational technology use in the 1:1 classroom. Perhaps the focus for current teachers is not on social outcomes that can occur as was measured in the survey. Instead, these current teachers may desire more to see performance or self-evaluative outcomes when educational technologies are used for teaching and learning. Performance outcome expectations relate to the usefulness of educational technologies, and previous studies have shown that perceived usefulness of technology tools is a strong factor for the actual use of these tools and resources in by teachers (Scherer, Siddiq, & Teo, 2015).

Qualitative findings from the study also share elementary teachers' perspectives on the program, including benefits and suggestions for improvement. Interview responses suggest that elementary school teachers benefited from the extra help offered through the program, whether it was having TCs to help students write a letter home, read a book, or create a presentation on the iPad. Quality classroom management is a prerequisite to successful technology integration practices, particularly in 1:1 classrooms (Dunleavy, Dexter, & Heinecke, 2007; Lim, Pek, & Chai, 2005), and having TCs available to work with elementary students on 1:1 device learning projects helped to improve classroom management in this program. This might have been particularly important in the unplanned events that happened in which elementary teachers asked for help from the TCs to do literacy assessment and Friday messages. The teachers saw a need to complete an activity which required a higher level of classroom management than they could accomplish alone and asked for the extra help.

In interviews, elementary teachers also mentioned that seeing TCs and others use technology in their classroom enhanced their own educational technology practice. In order for teachers to integrate technology effectively into the teaching and learning process, they need various types of knowledge and skills, including technological, pedagogical and content knowledge (Joo, Park, & Lim, 2018; Koehler & Mishra, 2009). Having TCs and others at hand who give them a glimpse of how 1:1 technology could be used effectively in the classroom can provide them with a little more technological and pedagogical knowledge. In the interview responses, elementary teachers discussed how they learned and adopted educational technology ideas and skills from the TCs and university professors who played a part in the program.

Program Revisions

Educational design research includes an iterative design process and focuses on real-world utility (Van Den Akker et al., 2006). Both quantitative and qualitative data from this study suggest possible revisions to the program, some of which are already currently underway.

Responses from teachers suggested that the program had a positive impact on the elementary school generally, however the impact was mainly seen for those teachers and classrooms that got involved by taking advantage of the opportunities offered by partnering with the university. Some elementary school teachers even went so far as to propose various technology-enhanced learning experiences that the TCs could help out with, while other teachers simply became involved when they were invited to come to a makerspace experience or have a teacher candidate in their classroom to read to their students (see Figure 3). Still other teachers didn't become involved at all in the program. If a teacher did not get involved, whether it was because of scheduling issues, or just a lack of understanding of the program, then the impact of the program was negligible for that particular teacher or class.

Figure 3. A university teacher candidate works with a small group of elementary students on a 1:1 research project.

Program revisions are currently underway to help spread more learning opportunities to more classes. The increased technology tools available that resulted from the STEM grant award have allowed for more opportunities to reach more classrooms by holding educational makerspace sessions for more elementary classes. In the current program, TCs have also been invited to every class in the elementary school to do a read aloud event, and a few other 1:1 learning projects have been spread to additional classes, such as the presentation project on animals.

In the second year of the program, the elementary school expanded to include four additional classes and teachers. The university faculty members involved in the program plan to increase its impact by having a more open conversation with elementary school teachers about what can be done to improve teaching and learning in the classrooms, as long as it has something to do with educational technology or language arts methods. The hope is to learn about additional opportunities for learning experiences in which TCs are able to interact with and learn from elementary teachers and students.

The university faculty members involved in the program have also taken more care in adjusting the timing and goals of proposed activities to better meet the needs of the elementary school classes. One new activity idea that emerged from interview responses involves having TCs come to classes to help elementary students get started with their iPads at the beginning of the school year. The way that the district administers these iPads requires an initial setup where elementary students must login and enter a new password. Each iPad must also be checked to see if it is connected to the classroom with the *Apple Classroom* app, and for classrooms that use the *Seesaw* app, student accounts must be connected to their teacher's virtual class. Having TCs there during this process not only helps to greatly speed up this process to save elementary school class time, but it also trains TCs to do these tasks in their own future classroom.

One final revision already implemented in the second year of the program in an effort to support better educational technology confidence among TCs is a more deliberate progression of field experiences. In addition to the various opportunities for working with elementary teachers and students that come as part of university classes, the curriculum has been specifically redesigned to also provide TCs first with the opportunity to observe, then work one-on-one with an elementary student, then teach a small group lesson, and then progress to a whole class lesson. Because there are more TCs than there are classes at the elementary school, some of these clinical field experiences will occur at other local elementary schools, but all students in their first junior semester will experience all of these levels of progression within that semester.

Limitations

In addition to limitations to the qualitative data analysis process provided previously, limitations of this study include issues with self-reporting and timing. Survey instruments rely on participant self-reports, and some of the questions can be misunderstood or answers can be given inaccurately. Students from previous semesters may also report their technology self-confidence higher as a result of additional university courses and clinical field experiences that have occurred since their first junior semester. TCs' perceptions of their educational technology self-efficacy can be affected by outside factors unrelated to the program reported in this study. Current elementary school teachers' perceptions of educational technology self-efficacy can also be similarly affected.

Conclusion

Evaluation data from this study suggest that a program that includes a 1:1 technology initiative and school-university partnership could increase TCs' social outcome expectations. From a qualitative perspective, the program benefited the elementary school by providing extra help for elementary teachers and students and enhancing educational technology confidence among current teachers.

Based on this evaluation and first year of implementation experiences, the authors offer some suggestions for others who may be considering implementing a similar teacher preparation program. In this program, TCs learned much that cannot be replicated in a university course by experiencing authentic, embedded elementary classroom situations. Additionally, the embedded experiences this program provided an avenue for TCs, university faculty members, and current teachers to share and learn new ideas, strategies, and technologies from each other. An additional value of this experience was that TCs learned how to work with students in a 1:1 classroom and about possible 1:1 learning projects that could be used in their own future classrooms.

This program also found success due to a shared understanding from all the stakeholders that the coordination would be a "work in progress" and that everyone involved would need to remain flexible. Coordinating this type of program requires diligent work, patience, and understanding. It takes time and effort to coordinate the university class activities to match the needs of elementary classes, yet this time and effort is a necessary component of the experience. For those who may be considering implementing a similar program, smaller university class sizes (under 25 university TCs) will likely work best in order to allow coordination with elementary class activities.

An unanticipated benefit of this program was an elevated professionalism observed among new incoming TCs. In the second year of implementation, new TCs approached the program differently and were more prepared at the onset of the program and seemed to "rise to the challenge." In general, it is recommended that more teacher preparation programs consider designing a program that includes more embedded experiences within an actual K-12 classroom where 1:1 technology is a primary focus.

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