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One-to-One Laptop Teacher Education: Does Involvement Affect Candidate Technology Skills and Dispositions?

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Abstract

This study compares teacher candidates' initial and changed beliefs, dispositions, and uses of technology in two credential program models: a one-to-one laptop program with ubiquitous technology use and a traditional credential program in which students are expected to have specific technology experiences and requirements in each course (a model most frequently used in teacher education). Survey analysis found that pretest candidates who self-selected to be involved in the laptop program had lower ratings on beliefs about technology use than candidates who did not, and there was no difference in expertise or use. At posttest, laptop candidates showed development in all three areas, whereas nonlaptop candidates showed no change over time. Findings of this study point to the fact that programs in which technology use is ubiquitous better prepare candidates for technology-rich classrooms than do programs that take a more traditional approach to meeting credentialing requirements for technology use. (Keywords: 1:1 teacher education, one-to-one, models of technology integration, technology skills and dispositions)

There is no denying that our college campuses are filled with students who have grown up with technology and, as a result, have integrated technology into almost every aspect of their lives. These students—the Net Generation, Generation Y, millennials, or digital natives, as they are often called—report having high levels of ownership and use of various technologies. According to a Pew Research Study (2010), millennials are those born after 1980 and are, therefore, the first generation to come of age in the new millennium. The study reports that, in comparison to other generations, this group feels that their unique identity is due to their affiliation with technology, such as social networking sites, wireless technology, video games, and self-created videos. This technology-rich identity is paralleled in the educational environment. Smith, Salaway, and Borreson Caruso (2009) reported that 98% of 30,616 undergraduate students owned a computer. Further, the students reported using technology to access the campus library (73.1%), the learning management system (70%), presentation software (66.5%), and spreadsheet software (46.3%) (p. 65). Despite the increasing number of undergraduate students who report owning and using technology, little research highlights whether these digital-native students have the knowledge, skills, and dispositions needed to transfer their technology use into teaching careers (Lei, 2009). Lei found that, although digital-native teacher candidates were proficient at technology for personal use (e.g., social networking), they were sadly lacking in knowledge and proficiency in using classroom technologies, such as interactive whiteboards, or content-specific software and websites, for educational purposes. Ertmer and Ottenbreit-Leftwich (2010) would add that it is time for teachers, just like other professionals (e.g., law enforcement, medical), to be effective users of technology to meet performance outcomes (student learning) (p. 256).

Unfortunately, our experience as teacher educators does little to dispute the claims about teacher candidates' use of technology for professional goals. Although they are surrounded by technology in their personal lives and are able to use it in a variety of ways, our teacher candidates lack the instinctive ability to effectively integrate technology into their teaching practices. Although they are proficient at teacher-centered uses of technology (e.g., using a PowerPoint presentation to support a lecture), few are able to promote student-centered uses of technology (e.g., allowing students to create a piece of media to demonstrate understanding of a science concept). Our department decided to pilot a 1:1 program as a means to address this disconnect we saw in our students. The purpose of this study is to examine differences in student technology outcomes between a pilot 1:1 program with ubiquitous technology use and a more traditional program in which our candidates are expected to complete specific technology requirements in each course.

Cuban (2001) made similar assertions about technology use more than 10 years ago: We invest in technology for education, yet it is not being put to use in a way that promotes effective learning. This, of course, brings us to the question: Now that our teacher candidates are predominantly part of the digital native generation, why is technology integration into teaching and learning not something that comes naturally for them? All teacher education programs require coursework and classroom experiences, including observations and student teaching. We acknowledge that during the field experiences, and particularly during student teaching, teacher candidates are naturally held accountable to the same expectations to which we hold in-service teachers. In the current educational climate, this is often teaching a standards-driven curriculum. However, even within this back-to-basics and standards-driven curriculum, there is an increasing emphasis on integrating technology into K–8 teaching and learning. In 2006, Penuel suggested that, in addition to the large-scale 1:1 initiatives in school districts in such places as Maine, Henrico County, and Cobb County, there are hundreds of smaller-scale 1:1 laptop programs around the United States. This highlights the notion that the emphasis on a standards-driven curriculum does not lead to exclusion of educational technology in schools. It is clear that, as teacher educators, we need to prepare our teacher candidates for employment in technology-rich schools to the best of our ability. This invites us to investigate approaches for technology integration during the teacher credentialing process and leads to the purpose of this study.

The purpose of this study was two-fold: First, we sought to examine the technological skills and dispositions of teacher candidates prior to beginning a multiple-subject (K–8) teacher education program, and second, we wanted to explore whether involvement in a technology-rich (1:1 candidate-to-laptop ratio) program affected the skills and dispositions of the teacher candidates.

Teacher Candidates and Technology Experiences

We know from the literature that teacher candidates need multiple opportunities to experience technology, but more important, consistent exposure to technology allows for more natural transfer from what they learn in the teacher education program to the elementary classroom (Friedman & Kajder, 2006; Resta & LeBoeuf Tothero, 2002). Duran, Fossum, and Leura (2006) suggest alignment of technology use with coursework and faculty modeling as crucial elements of an effective teacher preparation program. Further, teacher educators play a key role by setting up environments within a teacher education program where teacher candidates receive vicarious (observation of technology integration) and personal (practice using technology to facilitate learning) technology experiences (Ertmer, 2005).

More recently, there has been added emphasis on the importance of technological, pedagogical, and content knowledge (TPACK), all of which are necessary for truly effective technology integration (Koehler & Mishra, 2009; Mishra & Koehler, 2006). This holds true for K–12 integration as well as teacher education. Koehler and Mishra suggest that technology integration into teaching and learning is not a one-size-fits-all phenomenon and in fact should be unique to the specific context of learning and intended learning outcomes. Although they were discussing inservice teachers, Ertmer and Ottenbreit-Leftwich (2010) have argued that teachers need knowledge of technology, expanded pedagogical knowledge (including planning, understanding how students learn, and classroom management), and an ability to make decisions about the appropriate technology to support student learning. Additionally, they suggest that technology-based learning experiences must have specific connections to academic content. Given this understanding, we can see the importance of preparing teachers to be proficient with technology, pedagogy, and content knowledge as a "unit" of knowledge rather than individual areas of expertise. Using Knezek's (2000) Stages of Technology Adoption framework, Strudler, Archambault, Bendixen, Anderson, and Weiss (2003) reported that when a school of education adopted a systematic approach to technology integration including faculty modeling (in prerequisite and core education courses), 64% of students self-reported their level of technology adoption to be at the stage at which they used technology as an instructional aide. It is clear that teacher educators explicating clearly defined goals for technology use in our courses is beneficial to teacher candidates and to their technology skills and dispositions.

Educational Technology Models for Teacher Education Programs

Teacher education programs have adopted several models to introduce teacher candidates to educational technology content, tools, and pedagogy. The first is a standalone technology course that is most often taught by educational technology faculty. The course addresses using technology as a teacher tool and as a tool to use in teaching. An advantage of this model is that we can draw on the expertise of the instructor, who can seamlessly demonstrate effective technology use. However, Mishra and Koehler (2006) posit that introducing teachers and teacher candidates to technology exclusive of a specific teaching and learning context will result in overemphasis on tools and underemphasis on using technology to support pedagogy.

A second model focuses on integrating technology into courses throughout the duration of the teacher preparation program by requiring specific technology assignments in specific courses. For example, our program following this model requires teacher candidates to evaluate educational software in their mathematics methods course. Another example is a diversity course that requires students to create a list of online resources for second-language learners. The major advantage of using this model is the potentially natural integration of technology into specific content areas, as connections between content, pedagogy, and technology can be made explicit. The disadvantage, however, is that we often rely on content-area experts to have expertise in technology use and pedagogy. This can be problematic, particularly considering the rate at which technology is advancing. Content-area experts are not often educational technology experts as well.

Recently, a third model has gained some traction in teacher education. This model is based on the 1:1 computing K–12 school environments that have been established and well researched for more than two decades. This model provides teacher candidates with laptops or requires them to bring their own to classes. What distinguishes this model from the second model is that the laptops become a tool that the teacher candidates have access to within and outside of their courses, and that they use for all activities and assignments rather than a specific course assignment. For example, teacher candidates in our laptop program were shown the benefits of social bookmarking, and many of them chose to create a grade-level-specific list of teacher resources for various content areas (which they shared with their peers and master teachers).

It is only since the early 2000s that 1:1 teacher education programs began to emerge in the literature, so, although we have personal opinions and awareness of the advantages and disadvantages, the research on this is limited. Available literature that focuses on teacher candidate opinions and uses (e.g., Kay, 2006; McKimmey & Leong, 2006) found that candidates appreciated having the laptops available for use; however, the candidates felt the laptops could have been used even more. The literature on faculty involvement indicates that, due to faculty self-perceptions of their technology proficiency as compared to teacher candidates' abilities (Monroe & Tolman, 2004), faculty need to be mentored through the process of being involved (Donovan & Green, 2010). Other literature focuses on implementation logistics (e.g., Donovan & Green, 2009; Resta & LeBeouf Tothero, 2002). What is missing from the literature is a systematic discussion of candidate technology outcomes in the different models.

It should be noted that the models discussed are about the coursework and not the fieldwork components of teacher education programs, which we know also come in a variety of combinations. We chose to focus on the university-based teacher education program rather than the impact of fieldwork on technology use and disposition, because this study is part of a broader examination of the potential of requiring laptops in our teacher credential programs within our college. Additionally, our approximately 300 (per year) teacher candidates are placed in more than 50 very different K–8 schools, which makes it extremely difficult to highlight the impact that field experiences have on our teacher candidates.

Ertmer and Ottenbreit-Leftwich (2010) suggest that "time and effort should be devoted to increase teachers' confidence for using technology, not just to accomplish administrative and communicative tasks, but to achieve student learning objectives" (p. 261). Together with the recent emphasis on TPACK that promotes a holistic approach to technology integration, this highlights the increasing importance of examining how different approaches to technology integration in teacher education affect the skills and dispositions of teacher candidates to use technology.

Theoretical Framework

If innovation adoption (such as greater technology integration) is to be successful, change in attitude must precede change in behavior (Fullan, 2007; Hall & Hord, 2006; Rogers, 2003). More specific, Fullan (2007) would suggest that for an innovation to become institutionalized—in this case, for the use of technology to be a ubiquitous part of the teacher education program—the innovation first must go through initiation and implementation stages. As part of this process, individuals ask themselves a series of questions about the innovation before they consider adopting it (Rogers, 2003). For example, individuals may ask themselves—either purposefully or not—questions about (a) whether the innovation is better than what is in existence; (b) if the innovation is consistent with one's values, experiences, and needs; (c) the ease of use of the innovation; (d) the degree to which one can try out the innovation before completely adopting it; and (e) whether a change in outcome will be identifiable and observable by others. In the case of technology use in teacher education, this would mean that faculty must see benefit for technology use before they consider adding it as a natural part of their courses.

We conducted this study with an assumption that teachers teach the way they were taught (Ma, Lai, Williams, Prejean, & Ford, 2008). With this understanding, we had concerns that our millennial teacher candidates, who, although surrounded by technology in their personal lives, would not instinctively integrate technology into their teaching practices. To alter the cycle of teaching the way one was taught, "teacher educators must model, use, and teach the use of technology in their classes" (Monroe & Tolman, 2004, p.75). This places added importance on the role of teacher educators to teach teacher candidates they way we want them to teach (and know to be best practice for technology integration).

Within our program, we implement two of the three educational technology models: We have a 1:1 program situated within a department program that integrates technology into all courses during the program. Thus, grounding our study in the assumption that teachers teach the way they were taught allowed us to critically examine the impact of the two technology models along with the role of the teacher educator on candidate technology skill and dispositions.

Methods

Participants and Design

One-hundred nine teacher candidates participated in this study. Twenty-eight were enrolled in the 1:1 laptop cohort, whereas 81 were enrolled in four regular (nonlaptop) cohorts. Teacher candidates completed a pretest ($n = 109$) and posttest ($n = 71$) technology survey online using Survey Monkey. Participants completed the pretest survey at the beginning of the teacher preparation program in the fall semester and completed the posttest survey at the end of the spring semester.

Instructional Context

We conducted this study at a suburban university in Southern California. Specifically, we conducted this study in an elementary education department that prepares approximately 300 teacher candidates per academic year. The program is a two-semester postbaccalaureate program in which teacher candidates take courses and complete field experiences for the first part of each semester. During the second half of the semester, teacher candidates complete student teaching in local elementary schools. The program operates in cohorts of approximately 30 students per cohort. On average, 10 cohorts are operating at a time.

We assigned one of the 10 cohorts to be a 1:1 laptop cohort. The other nine cohorts approached technology integration in accordance with California SB 2042 teacher education policy, which states that technology integration is expected to occur in all courses and there is no standalone technology course. For example, as a department, we agreed that candidates would complete assignments that require them to identify appropriate software in the reading/language arts methods course, to demonstrate knowledge of basic hardware and software terminology and competence in the operation and care of computer-related hardware in the Foundations of Education course, and to collaborate using technology (e.g. wikis, blogs) in all courses. All nonlaptop cohorts in our program follow these same guidelines, regardless of student technology access. However, individual teacher candidate cohorts can, of course, use more technology than outlined in our teacher preparation (SB 2042) guidelines.

Faculty

The department chair selects the instructional and supervision faculty involved in all cohorts based on area of expertise and cohort need. All cohorts complete the same courses, and faculty use the same approved syllabus for each course. What is not mandated is how the content is delivered. However, course instructors take part in regular meetings where they share ideas and discuss course assignments. Further, each methods course has shared resources (e.g., a math cabinet with games, textbooks, and manipulatives). From informal discussions, we know that faculty in nonlaptop cohorts range in degree of comfort and proficiency in technology use from laggards to early majority adopters (Rogers, 2003).

1:1 Laptop Cohort

With support from the university's IT department, we began one cohort in which teacher candidates received a Macbook equipped with educational software, including Inspiration, Kidpix, and traditional programs such as Microsoft Office and iLife. We gave the teacher candidates the computers to allow for 24/7 access to technology for the duration of their credential program, and we encouraged them to use the Macbook as their primary computer. For many candidates in the laptop cohort, the Mac platform was not familiar; thus, we spent approximately two hours at the beginning of the semester giving them guided opportunity to explore basic functions, such as saving and shortcuts, and the available software. There was no specific agenda for the introduction; candidates primarily explored and personalized their laptops.

Faculty in the laptop cohort did not receive a student-imaged Macbook but did have use of a university-provided laptop in the platform of their choice. All classrooms on the campus have a desktop computer and a projection device. Six instructional classrooms also contain an interactive whiteboard. Within the department, faculty can check out additional technology, such as Flip cameras, document cameras, probeware, and student-response systems. An earlier study (Donovan & Green, 2010) determined that faculty within the laptop cohort range from late majority to innovators of technology (Rogers, 2003), with some faculty having concerns about their ability to teach with technology and others having concerns about managing the technology-rich classroom. The laptop cohort leaders (innovators) mentored "nontechnology" faculty by co-planning and teaching or provided as-needed training on technology tools. The cohort leaders did not teach in other cohorts and are the only educational technology faculty in the department.

Typically, the credential program accepts all students who apply and have met all program prerequisites (CSET scores, GPA, letters of recommendation, medical release) and send them an official letter of acceptance into the program. As part of the letter of acceptance, students receive an overview of the laptop cohort and are encouraged to apply. The overview described the logistics of the laptop cohort (e.g., provided with a Macbook laptop, faculty modeling of technology, opportunities for professional development from teachers in 1:1 K–8 classrooms), a description of who might be interested in the laptop cohort (e.g., students with an interest in working in technology-rich schools or classrooms or who feel strongly about the role of technology in teaching and learning), and a description of a student who would be suited to the cohort (e.g., students who have access to high-speed Internet, confidence to take risks, commitment to seeking out technology experiences for K–8 students). There were no skill requirements for candidates interested in the laptop cohort. Students were encouraged to apply by sending an e-mail to the cohort facilitator that addressed their view of technology in teaching and learning and why they wanted to be considered for the laptop cohort. We had a total of 30 laptops and initially set a quota at 28 students to allow for extras, in case there were technical issues. However, 30 students applied, and all were accepted.

Within the laptop cohort, as appropriate during courses, candidates received quick tutorials on using specific applications. For example, in the math methods course, the instructor (the first author) completed a brainstorm using Inspiration and, in the process, highlighted some of the features. Teacher candidates then had time to individually explore and create their own concept maps relevant to the math topic. To close, candidates created shared documents listing possible implementation ideas for the elementary classroom.

Nonlaptop Cohorts

The experiences of nonlaptop cohorts were varied and not controlled. At the most, we can only speculate about the specific experiences of the nonlaptop candidates. However, we are reminded that, according to department guidelines, all credential students are to be exposed to a minimum range of technology tools, content, and pedagogy, per state teacher preparation standards. Anecdotally, we know that some of the cohort leaders for other cohorts were not technologically proficient and do not consider technology an important part of the teaching and learning process. For example, one colleague commented, "We don't need fancy whiteboards—students need experience writing on chalkboards and regular whiteboards."

The authors, who make up the department's educational technology faculty, did not formally collaborate with the nonlaptop cohort faculty; however, we were always available for questions. Anecdotally, as we had a sense of which cohort groups participated in our study, we know that the leaders of these cohorts were above-average users of technology in the classroom and would have met more than the minimum requirement for technology integration. For example, the cohort leader for one of the participating nonlaptop cohorts mentioned to us in passing that her students created a blog for sharing lesson ideas, whereas another cohort leader requested our help in planning a lesson using probeware in her science methods courses and used the same math and digital photography lesson with her students as shared by the first author. We also know that several other instructional faculty in the participating cohorts took advantage of the additional technology resources, such as the document cameras and Flip cameras.

Data Sources

We created the Technology Proficiency Survey (see Appendix, pp. 137–139) to estimate teacher candidate proficiency/expertise at using technology tools, their current use of technology programs and applications, and their beliefs about (a) integrating technology into teaching and learning, (b) using technology for assessment and evaluation, (c) using technology to support professional growth, and (d) understanding social and legal issues of technology in schools. Questions on the survey were based on an existing department survey and a survey designed by Hartley, Donovan, Strudler, and Klecka (2007) to examine candidate preparation to integrate technology. Participants completed the survey online at the beginning and end of their involvement in the program. The survey as a whole and the beliefs categories have internal consistency (Chronbach's alpha = .91 and .89, respectively).

We grouped survey questions into three categories: beliefs about ability to use technology and understand technology issues (beliefs), estimates of current use of a variety of technologies (use), and self-rated expertise/proficiency to use various technologies (expertise). There were 21 questions about beliefs, and candidates responded to these questions using a 7-point Likert scale (corresponding to strongly disagree, disagree, slightly disagree, neutral, slightly agree, agree, and strongly agree). There were 14 questions about technology use, and candidates responded to these questions on a 7-point scale (corresponding to: "I've never heard of this technology," "I've heard of this technology but have never used it," "I've used it a few times," "Once or twice a year," "A few times a month," "Weekly," and "I use it daily"). There were 12 questions about expertise, and candidates responded to these questions on a 7-point scale (corresponding to: "Total novice," "Just starting out, but I have used it," "Still learning but can do some things," "Average user," "Slightly better than average," "Proficient but not an expert," and "Expert user"). The alpha coefficient for the survey was .91.

We further divided the questions that captured participants' beliefs about their own ability to use technology and understand technology issues into four categories for analysis. There were five questions on technology integration, four questions on assessment, five questions on professional needs, and seven questions on understanding of legal and social issues around technology. It should be noted that this survey in no way determines teacher candidate readiness to integrate technology into teaching and learning.

Data Analysis and Results

We were first interested in differences in beliefs, use, and expertise between the laptop and nonlaptop groups at the beginning of the teacher preparation program. Table 1 presents means and standard deviations for the laptop and nonlaptop groups for each construct (beliefs, use, and expertise) and each of the four beliefs categories at the beginning and end of the credential program. This table shows that students in the nonlaptop group rated themselves higher on all categories of the survey than students in the laptop cohort.

A multivariate analysis of variance (MANOVA) suggested that candidates in the nonlaptop group had higher scores on the Technology Proficiency Survey than those in the laptop group, $F(3,107) = 3.61$, $p < .05$, $\eta^2 = .10$. The nonlaptop group reported significant higher pretest beliefs than the laptop group, $F(1,107) = 10.71$, $p < .001$, $\eta^2 = .09$, but there were no significant differences in use, $F(1,107) = 0.31$, ns. Expertise was marginally significant, with the nonlaptop group reporting higher expertise than the laptop group, $F(1,107) = 3.69$, $p = .057$, $\eta^2 = .03$.

The questions about beliefs assessed candidates' beliefs about their ability to use and understand classroom technology. A MANOVA on pretest beliefs categories suggested that nonlaptop candidates had higher pretest beliefs scores than laptop candidates, $F(4,107) = 2.98$, $p < .05$, $\eta^2 = .10$. Candidates in the nonlaptop group reported significantly higher beliefs about assessment, $F(1,107) = 9.60$, $p < .01$, $\eta^2 = .08$, professional needs $F(1,107) = 6.75$, $p < .01$, $\eta^2 = .06$, and legal issues, $F(1,107) = 3.94$, $p < .05$, $\eta^2 = .04$ than candidates in the laptop group. There were no significant differences between the two groups on beliefs about technology integration, $F(4,107) = 3.29$, ns.

Next, we were interested in candidates' beliefs, use, and expertise at the end of the teacher preparation program. A MANOVA on posttest Technology Proficiency Survey scores suggested that the pretest pattern had reversed, with laptop candidates showing higher scores than nonlaptop candidates,

Table 1. Means and Standard Deviations for the Laptop and Nonlaptop Groups

	Laptop		Nonlaptop	
	Pre	Post	Pre	Post
Beliefs	5.09 (.65)	6.10 (.57)	5.59 (.69)	5.72 (.52)
Beliefs: Tech Integration	5.69 (.81)	6.62 (.44)	6.02 (.83)	6.15 (.55)
Beliefs: Assessment	4.84 (1.26)	5.89 (.86)	5.67 (1.18)	5.89 (.93)
Beliefs: Professional Needs	5.50 (.61)	6.27 (.62)	5.93 (.77)	5.95 (.59)
Beliefs: Legal Issues	4.58 (.95)	5.75 (.89)	4.99 (.93)	5.20 (.86)
Use	3.88 (.62)	4.64 (.66)	3.97 (.77)	4.03 (.52)
Expertise	3.86 (.79)	4.73 (.86)	4.21 (.83)	4.27 (.70)

$F(3,70) = 8.03$, $p < .001$, $\eta^2 = .27$. Candidates in the laptop group reported significantly higher beliefs, $F(1,70) = 8.16$, $p < .01$, $\eta^2 = .11$, use, $F(1,70) = 18.54$, $p < .001$, $\eta^2 = .21$, and expertise, $F(1,70) = 5.90$, $p < .05$, $\eta^2 = .08$ at posttest than candidates in the nonlaptop group.

A MANOVA on posttest beliefs categories suggested that laptop candidates had higher scores than those in the nonlaptop group, $F(4,70) = 4.64$, $p < .01$, $\eta^2 = .22$. Candidates in the laptop group reported significantly higher posttest beliefs about technology integration, $F(1,70) = 14.14$, $p < .001$, $\eta^2 = .17$, professional needs $F(1,70) = 4.61$, $p < .05$, $\eta^2 = .06$, and legal issues, $F(1,70) = 6.44$, $p < .05$, $\eta^2 = .09$ than the nonlaptop group. There were no significant differences between the two groups on beliefs about assessment, $F(1,70) = 0$, ns.

We were also interested in pre–post changes between the three cohorts of teacher candidates who completed the survey in August and in May. Table 2 (p. 132) presents means and standard deviations for the cohorts for each construct (beliefs, use, and expertise) and each of the four beliefs categories.

A MANOVA suggested that there were pre–post differences in Technology Proficiency Survey scores, $F(15,362) = 4.93$, $p < .001$, $\eta^2 = .16$, and that differences occurred in beliefs, $F(5,139) = 8.04$, $p < .001$; use, $F(5,138) = 7.92$, $p > .001$; and expertise, $F(5,139) = 4.83$, $p < .001$. To account for differences in pretest scores, we calculated post-hoc Bonferroni adjusted analyses of variance to compare pre–post changes in beliefs, use, and expertise. These analyses suggested that the laptop cohort showed growth in all three categories of beliefs, use, and expertise, p < .05, but that neither of the nonlaptop cohorts showed growth in the three technology categories, ns. Thus, only the laptop cohort showed significant differences between pre- and posttest scores in beliefs, use, or expertise.

Table 2. Means and Standard Deviations by Cohort

	Cohort A		Cohort B (laptop)		Cohort C	
	Pre	Post	Pre	Post	Pre	Post
Beliefs	5.54 (.56)	5.56 (.43)	5.09 (.65)	6.10 (.57)	5.57 (.89)	5.86 (.71)
Beliefs: Tech Integration	5.97 (.65)	6.07 (.54)	4.69 (.81)	6.62 (.44)	5.97 (1.0)	6.32 (.57)
Beliefs: Assessment	5.70 (1.19)	5.70 (1.01)	4.84 (1.26)	5.89 (.86)	5.58 (1.29)	6.33 (.52)
Beliefs: Professional Needs	5.74 (.54)	5.89 (.44)	5.50 (.62)	6.27 (.62)	6.02 (1.13)	6.09 (.83)
Beliefs: Legal Issues	4.98 (1.0)	5.19 (.72)	4.58 (.95)	5.75 (.89)	4.96 (.95)	5.22 (1.16)
Use	3.77 (.57)	4.05 (.52)	3.88 (.62)	4.64 (.66)	3.75 (.71)	3.98 (.55)
Expertise	4.09 (.59)	4.13 (.56)	3.86 (.79)	4.73 (.86)	4.04 (.98)	4.62 (.91)

Discussion

We are not the first researchers to endorse the benefits of a 1:1 laptop teacher education program; however, this study is significant for teacher education because of the statistical evidence supporting our claims that providing teacher candidates 24/7 access to laptops is a better choice for promoting 21st century skills in our candidates than other methods. In this study, we found that, when given 24/7 access to laptops with the expectation of purposeful integration into all coursework and the encouragement for personal use, teacher candidates' beliefs about educational uses of technology and skill level with educational technology significantly increased. Our results also indicated that teacher candidates who were not given ubiquitous access did not improve in skill level, nor did their beliefs about educational technology change. Existing literature (e.g. Donovan & Green, 2009; Kay, 2006; MacKinnon, Aylward, & Bellefontaine, 2006; McKimmey & Leong, 2006; Ni & Branch, 2004) discusses laptop programs from a more anecdotal or qualitative perspective but does not definitively show more long-term benefits. To highlight the importance of our results, we will discuss them based on the ideas that emerged from the data analysis.

Purposeful Integration

It is natural to assume that being involved in a laptop program would result in increased use of technology. It is also natural to assume that the expertise with educational technology would also increase with increased use. Not surprisingly, the results of this study show that when an expectation for laptop use in coursework and field experiences is integral and consistently applied to the teacher education program, teacher candidates are positively affected. We attribute the increased expertise, use, and beliefs about educational technology recorded in this study to the purposeful integration of the laptops. What we can learn from this and apply in teacher education programs is the implementation logistics of facilitating a 1:1 laptop program. Donovan and Green (2009) discuss how aligning a 1:1 teacher education program with a K–8 1:1 program allowed for teacher candidates to see the technology they were learning about and using in coursework being applied in authentic learning situations in K–8 classrooms. We continue (and encourage others) to examine more specifically how the laptops were used in each course and whether there was transfer of use across courses independent of instructor.

There was no reported difference between laptop and nonlaptop cohorts on expertise and use at pretest. At posttest, the laptop group had a significant difference when compared to itself at pretest. Further, their posttest data also showed a significant difference when compared to the other cohorts at posttest. Based on these differences, we can convincingly say that the experiences provided to our nonlaptop candidates are not enough to prepare them for technology-rich K–8 teaching environments.

We feel the most important finding of this study is actually what happened (or did not) in the nonlaptop cohorts. Although there is an increase in the number of 1:1 teacher education programs, there are still many programs that either have a standalone technology course or are expecting nontechnology faculty to integrate technology into their courses. Findings of this study suggest that these programs need to closely examine their candidates' expertise and beliefs about educational technology. By using data on candidate expertise and beliefs about technology as a tool to evaluate the impact on student technology outcomes of their program's approach to meeting candidate educational technology requirements, credential programs can better make informed decisions about how to modify their programs for maximum effectiveness. The finding in this study—that candidates in the nonlaptop cohorts had no difference in their beliefs, use, and expertise from pre- to posttest, despite being required to complete technology course assignments (e.g., website evaluations, technology-based lesson plans), use Promethean boards (interactive whiteboards), had classes in computer labs, and were exposed to alleged instructor modeling of technology—could have a profound impact on how teacher educator programs plan candidate technology experiences. As a department, we are using this information to rethink how we "allocated" technology assignments to specific courses and are now moving to having a more holistic approach.

Hidden Benefits of a 1:1 Laptop Program

Although the goal of the study was to extend the literature examining the impact of 24/7 candidate access to laptops, by comparing the laptop and nonlaptop cohorts, we were able to not only provide data-driven support for highlighting the positive impact of 1:1 programs, but we were able to determine that our current method of "tech integration in all courses" is not effective in affecting teacher candidate use, beliefs, and expertise with technology. In our own department, we have begun a purposeful and focused revision of our technology plan (including equipment, faculty proficiency, and professional development) to address this issue. We continue to collect data and perhaps revisiting the study in the future will give us insights into the effects of our revised approach on technology integration. Other colleges of education or departments of teacher education could use this information to strategically examine their own program model's impact on candidate technology beliefs, use, and expertise.

Given that the laptop participants self-selected to be in the program, we were surprised that they ranked themselves lower than nonlaptop participants on areas of beliefs about technology in education (i.e., legal issues, assessment, integration, professional use). Even if we presume that the students who did not select the laptop cohort did so because they already felt they had enough proficiency, we are again reminded that they apparently did not grow in their technology use and beliefs over their one-year program. What this means for teacher educators, and especially those who feel "students know more than I do," is that we must not assume that there is no room for growth because candidates feel they are already proficient with technology. Additionally, we should make a concerted effort to promote authentic uses of educational technology.

In this study, we further categorized teacher candidate beliefs into beliefs about technology integration, assessment, professional needs, and understanding of legal and social issues around technology. What we find particularly noteworthy is that nowhere in our curriculum do we "teach" legal and social issues surrounding technology. There is only one small assignment that addresses technology for professional needs; yet the laptop cohort increased their belief and understanding of these elements of technology integration. We feel this is important for teacher educators, because we have limited time with candidates and unlimited material to cover, so having candidates gain awareness in important issues of educational technology without explicit instruction adds weight to support the use of laptops in teacher education.

Looking Ahead

Despite the positive findings about laptop access, our study does have limitations. The identification of individual changes in pre- and posttest data would allow us to identify specific needs as candidates and dispositions as future technology using teachers. Identifying this, we can work on building a culture in our department that embraces a TPACK approach rather than focusing solely on technological knowledge. Further, our study did not consider candidates' readiness to integrate technology. Examining readiness could have impacted the degree to which we are able to interpret the changes candidates did or did not make in the program.

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References

Cuban, L. (2001). *Oversold and underused: Computers in the classroom.* Cambridge, MA: Harvard University Press.

Donovan, L., & Green, T. (2009). Two-way mirror: Technology-rich K–8 and teacher education programs. *Action in Teacher Education, 30*(4), 45–55.

Donovan, L., & Green, T. (2010). One-to-one computing in teacher education: Faculty concerns and implications for teacher educators. *Journal of Digital Learning in Teacher Education, 26*(4), 101–109.

Duran, M., Fossum, P. R., & Luera, G. R. (2006). Technology and pedagogical renewal: Conceptualizing technology integration into teacher preparation. *Computers in the Schools, 23*(3), 31–54.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*(4), 25–39.

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255–284.

Friedman, A., & Kajder, S. (2006). Perceptions of beginning teacher education students regarding educational technology. *Journal of Computing in Teacher Education, 22*(4), 147–151.

Fullan, M. (2007). *The new meaning of educational change* (4th ed.). New York: Teachers College Press.

Hall, G. E., & Hord, S. M. (2006). *Implementing change: Patterns, principles, and potholes* (2nd ed.). Boston: Allyn and Bacon.

Hartley, K., Donovan, L., Strudler, N., & Klecka, C. (2007). *Assessing teachers' preparation to integrate technology in the classroom.* Paper presented at 2007 Annual Meeting of the Association of Teacher Educators, San Diego, CA. Retrieved July 13, 2011, from http://projects.web2teach.com/teacher_preparation_and_technology_integration_survey

Kay, R. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education, 38*(4), 383–408.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60–70.

Lei, J. (2009). Digital natives as preservice teachers: What technology preparation is needed? *Journal of Computing in Teacher Education, 25*(3), 87–97.

Ma, Y., Lai, G., Williams, D., Prejean, L., & Ford, M. J. (2008). Exploring the effectiveness of a field experience program in a pedagogical laboratory: The experience of teacher candidates. *Journal of Technology and Teacher Education, 16*(4), 411–433.

MacKinnon, G. R., Aylward, M. L., & Bellefontaine, J. (2006). Electronic discussion: A case study of the range of applications in a laptop university. Computers in the Schools, 23(1/2), 59–71.

McKimmey, P., & Leong, P. (2006). *A laptop initiative in teacher preparation—student reactions.* In E. Pearson & P. Bohman (Eds.), Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2006 (pp. 326–331). Chesapeake, VA: AACE.

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–54.

Monroe, E., & Tolman, M. (2004). Using technology in teacher preparation: Two mature teacher educators negotiate the steep learning curve. *Computers in the Schools, 21*(1), 73–78.

Ni, X., & Branch, R. M. (2004). *Experience of using laptop in higher education institutions: Effects with and of ubiquitous computing under natural conditions.* Paper presented at Association for Educational Communications and Technology Conference, Chicago, IL. (ERIC Document Reproduction Services No ED484993).

Penuel, W. R. (2006). Implementation effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*(3), 329–348.

Pew Research Center. (2010). *The Millennials: Confident. Connected. Open to change.* Retrieved July 13, 2011, from http://pewresearch.org/pubs/1501/millennials-new-survey-generational-personality-upbeat-open-new-ideas-technology-bound

Resta, P., & LeBeouf Tothero, M. (2002). *Establishing a ubiquitous computing environment for teacher preparation students and faculty: The University of Texas at Austin Laptop Initiative.* Retrieved July 13, 2010, from http://www.edb.utexas.edu/education/assets/files/coe/LIFE/UTAustinLaptopInitiative.pdf

Rogers, E. (2003). *Diffusion of innovations.* New York: Free Press.

Smith, S. D., Salaway, G., & Borreson Caruso, J. (2009). T*he ECAR study of undergraduate students and information technology, 2009.* Boulder, CO: EDUCAUSE.

Strudler, N., Archambault, L., Bendixen, L., Anderson, D., & Weiss, R. (2003). Project THREAD: Technology helping restructure educational access and delivery. *Educational Technology Research and Development, 51*(3), 41–56.

Appendix

1. The following questions are intended to gauge your capacity to integrate technology into teaching and learning.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
I can utilize technology to address content standards.	○	○	○	○	○	○	○
I can utilize technology to support learner-centered strategies and activities.	○	○	○	○	○	○	○
I can utilize technology to support higher order thinking.	○	○	○	○	○	○	○
I can manage student learning in a technology enhanced environment.	○	○	○	○	○	○	○
I can utilize technology to support creativity.	○	○	○	○	○	○	○

2. The following questions are intended to gauge your capacity to utilize technology in student assessment and evaluation.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
I can utilize technology to analyze assessment results.	○	○	○	○	○	○	○
I can use grade book software to organize student data.	○	○	○	○	○	○	○
I can use grade book software to analyze student data.	○	○	○	○	○	○	○
I can support the development of student electronic portfolios.	○	○	○	○	○	○	○

3. The following questions are intended to gauge your capacity to utilize technology to support your professional needs.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
I understand how to use technology to communicate with other professionals.	○	○	○	○	○	○	○
I use the Internet to support my continued learning.	○	○	○	○	○	○	○
I use a computer-based calendar to manage my time.	○	○	○	○	○	○	○
I systematically save and organize instructional materials I have developed.	○	○	○	○	○	○	○
I systematically save and organize instructional resources I have found.	○	○	○	○	○	○	○

4. The following questions will gauge your understanding of some of the social and legal issues surrounding the use of technology.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
I understand the Fair Use guidelines concerning U.S. copyright law.	○	○	○	○	○	○	○
I can describe the disparities that exist between access to technology (such as the Internet) and individuals of various socio-economic backgrounds.	○	○	○	○	○	○	○
I can describe the pros and cons of filtering content in schools.	○	○	○	○	○	○	○
I can describe societal concerns regarding the ongoing advancements of technology.	○	○	○	○	○	○	○
I am familiar with a variety of assistive technologies that can be used with students with special needs.	○	○	○	○	○	○	○
I can describe Universal Design for learning principles.	○	○	○	○	○	○	○
I can describe the elements necessary for an Acceptable Use Policy.	○	○	○	○	○	○	○

5. The following question will gauge your current use of various technology tools. Select the choice the most accurately represents your use of the various technologies.

	I've never heard of this technology.	I've heard of this technology but have never used it.	I've used it a few times.	Once or twice a year	A few times a month	Weekly	Daily
Blogs	○	○	○	○	○	○	○
Email	○	○	○	○	○	○	○
Facebook	○	○	○	○	○	○	○
Instant Messenger	○	○	○	○	○	○	○
iPod (including iShuffle, Nano, etc.)	○	○	○	○	○	○	○
iTunes	○	○	○	○	○	○	○
MySpace	○	○	○	○	○	○	○
Podcast	○	○	○	○	○	○	○
Probeware	○	○	○	○	○	○	○
Second Life	○	○	○	○	○	○	○
Skype	○	○	○	○	○	○	○
Streaming Media	○	○	○	○	○	○	○
The Web	○	○	○	○	○	○	○
Vodcast (video podcast)	○	○	○	○	○	○	○
Web Search Engines (e.g. Google)	○	○	○	○	○	○	○
Wikis	○	○	○	○	○	○	○

6. List other types of technology you use on a regular basis that were not included in this list.

7. This question measures your comfort level with using various technology software and tools.

	Total Novice	Just starting out, but I have used it.	Still Learning but can do some things	Average User	Slightly better than average	Proficient, but not an expert	Expert User
Email	○	○	○	○	○	○	○
Grade Books	○	○	○	○	○	○	○
Graphic Programs (e.g. Photoshop)	○	○	○	○	○	○	○
HTML Editors (e.g. NVU, Composer, FrontPage, Dreamweaver)	○	○	○	○	○	○	○
HyperStudio	○	○	○	○	○	○	○
Instant Messaging	○	○	○	○	○	○	○
Multimedia Authoring (e.g. Flash, Director)	○	○	○	○	○	○	○
Search Engines	○	○	○	○	○	○	○
Skype	○	○	○	○	○	○	○
Spreadsheets	○	○	○	○	○	○	○
Web Browsers	○	○	○	○	○	○	○
Word Processors	○	○	○	○	○	○	○

8. List other software you use on a regular basis that was not included in this list.

9. Approximately what percentage of your time in all classes was spent using technology?

10. Approximately what percentage of your assignments required technology other than word processing to complete?

11. What types of technology did the assignments require or allow you to use ?