Examining Perceptions of Systematic Integration of Instructional Technology in a Teacher Education Program

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Abstract

In this article, the authors describe a systematic effort by a department of special education to integrate technology into teaching through a one-to-one laptop initiative and to examine preservice teachers' perceptions concerning their experiences with the initiative. The authors investigate beliefs about preservice teachers' proficiency in using technology for teaching, their attitudes toward the use of technology for teaching, and their perceptions of the integration of instructional technology practices by faculty across three semesters using both qualitative and quantitative methods. Preservice teachers' perceptions of their ability to integrate technology in their teaching increased whereas their attitudes toward integrating technology remained consistently high across program semesters. They believed that faculty effectively integrated and modeled the use of technology in their instruction. Implications of the results are discussed.

Keywords

instructional technology, teacher education, special education

Throughout the past decade, technology use in elementary and secondary education classrooms has increased dramatically. This increase has been bolstered by research findings that point out the benefits of instructional technology on student achievement and attitudes toward instruction (Lowther, Ross, & Morrison, 2003; Wenglinsky, 2005/2006). Consistently, three factors have been shown to be critical to the successful implementation of technology-enhanced instruction: (a) professional development, (b) teachers who believe themselves competent to integrate technology for teaching, and (c) positive teacher attitudes toward technology (Penuel, 2006; Watson, 2006).

According to Rockman (2004), at least one of every six U.S. school districts has a laptop program. Initiatives such as Microsoft's *Anytime, Anywhere Learning Program* and Apple's *One-to-One* allow teachers to use laptop computers in their instruction and students to have access to wireless technology at school and often also at home. Technology is routinely incorporated into teaching in familiar ways such as by using word processing to write and revise essays and using the Internet to conduct research. Other, more sophisticated uses of technology in teaching include teachers and students using their laptops with software such as *Inspiration* to brainstorm ideas before writing, preparing multimedia presentations with PowerPoint™ and iMovie, and developing spreadsheets and graphs using

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Excel (Mouza, 2006). In many K-12 classrooms, electronic portfolios have replaced traditional paper-and-pencil assessment, allowing students to use their laptops to demonstrate learning in multiple ways.

Compared to K-12 schools, university level teacher education programs have been slower to emphasize instructional technology across the curriculum (Brown, 2006; Lewis, Murphy, Richards, & Carmen, 2005). More recently, however, efforts to increase the integration of technology into teacher education programs have intensified (Kay, 2006). National teacher education organizations have called for increased attention to technology in the curriculum, and many colleges of education across the country have begun to embrace the use of laptops as a mechanism for integrating technology in teaching. These efforts have included encouraging collaboration among faculty and students within university classrooms and in K-12–based field settings (Brown & Warschauer, 2006; Lewis et al., 2005).

Rationale for the Study

Lipscomb and Doppen (2004/2005) summarized the results of several recent studies highlighting the need for teacher preparation programs to integrate instructional technology throughout the curriculum instead of teaching technology skills in isolation (e.g., a 3-hour course on the use of technology in education). Although there are many examples of how various teacher education programs have attempted to integrate instructional technology (Graham, Culatta, Pratt, & West, 2004; Monroe & Tolman, 2004), little is known about the effect of these efforts on preservice teacher outcomes, in particular when programs make a concerted effort to systematically integrate technology throughout the curriculum.

Kay (2006) reviewed 68 journal articles describing how technology was introduced to preservice teachers. He concluded that the vast majority of the studies examined had severe limitations and that further research should include a comprehensive description of the participants and the program, the incorporation of both qualitative and quantitative data, and the evaluation of preservice teachers' attitudes and abilities.

This article describes a department of special education's attempt to integrate systematically technology within an undergraduate teacher education program through a one-to-one laptop initiative and to evaluate the effect of these efforts on preservice teacher outcomes. The department in this study is situated in a large southeastern university and includes undergraduate, graduate, and doctoral programs in special education. There are 13 full-time faculty on the main campus, 3 of whom teach extensively at the undergraduate level. The undergraduate program graduates 20 to 30 full-time students and 10 to 15 part-time students per year. The purpose of the study was threefold: (a) to examine preservice teachers' self-perceptions of proficiency with technology for teaching, (b) to examine preservice teachers' attitudes toward the use of technology for teaching, and (c) to evaluate the effectiveness of faculty instruction related to the integration of technology.

This study represents an initial attempt to address some of the limitations of prior studies reported by Kay (2006). Major characteristics of the program are described including specific examples across multiple semesters, the participants are described, and both quantitative and qualitative findings are reported related to participant attitudes and abilities. In addition, preservice teachers' perceptions of their instructor's use of technology and the effectiveness of strategies that faculty used to integrate technology in their teaching are discussed.

Program Description

The goal of the laptop initiative in the special education department was to integrate the use of wireless technology throughout the undergraduate program's curriculum in the form of a one-to-one laptop initiative where all students and faculty use laptops to integrate

Table 1. Core Special Education Courses and Linked Practicum for Instructional Technology Integration and Survey Administration Timeline

Semester	Course	Practicum	Instructional Technology Emphasis	Measure	Time of Semester
1 (fall—Year 1)	Foundations of Special Education	Level 1—one day per week	basic understanding of available technology applications and use for learning & teaching purposes	self-perception of ability; attitudes toward integration of technology in teaching	beginning and end
2 (spring—Year 1)	Clinical Teaching, Introduction to Mental Retardation and Developmental Disabilities	Level 2—two days per week (elementary school)	acquisition-to-proficient level of understanding of integration of technology for learning and teaching purposes	self-perception of ability; attitudes toward integration of technology in teaching	end
4 (fall—Year 2)	Education of Adolescents and Adults With Disabilities	Level 3—two days per week (secondary school)	advanced understanding of integration of technology for learning and teaching purposes	self-perception of ability; perceptions of how courses integrated technology	end

instructional technology during classes and field experiences. Preservice teachers in this special education teacher preparation program are seated as cohorts and complete their program in five semesters (fall, spring, summer, fall, spring). Core special education courses and the three linked practica (Level 1, Level 2, Level 3) occur during the first, second, and fourth semesters. During the summer semester, preservice teachers in the program take any out-of-department courses they have not yet taken. During the fifth semester, preservice teachers complete their final internship. Within this context, the laptop initiative is structured such that preservice teachers receive support from faculty and other staff across multiple semesters to become proficient in the use of technology for learning and teaching purposes. Particular emphasis on the integration of instructional technology occurs during the three semesters where students take their special education core courses and their three related practica (Semester 1—fall, Year 1; Semester 2—spring, Year 1; and Semester 4—fall, Year 2). Moreover, specific core special education courses and practica were selected for special emphasis on the integration of instructional technology. Table 1 shows these courses, the semester in which each is offered, and the linked practicum. During this study, faculty who taught these courses and who supervised the practica worked closely together to plan the integration of technology in their teaching in a developmental fashion. Initially, the goal was to move students from initial acquisition of instructional technology skills to proficiency using technology skills for their own learning. Ultimately, the goal was for our students to be proficient in the use of instructional technology in their own teaching. Faculty modeled the integration of technology for teaching by emphasizing both the technical skills and the processes

needed to successfully infuse technology in teaching. Examples of how the program accomplished these goals are described in the next section.

Program Activities

Semester 1—Fall (Year 1)

During the first semester in the program, special education preservice teachers focused on learning about their laptops, the related software applications, and examining the use of technology in the context of learning and teaching. They participated in one half-day workshop at the beginning of the semester and a second half-day workshop during the middle of the semester; both workshops emphasized familiarity with the various software and hardware applications on the laptops. In their Foundations of Special Education course, approximately 45 minutes of 3 hours of class time were dedicated to the learning of technology available to them via preservice teachers' laptops. Moreover, throughout the course, preservice teachers used their laptops and available applications to learn and demonstrate understanding of course content. For example, students engaged in a semester-long Webquest developed by the instructor, where they learned about the various software applications on their laptops (e.g., Inspiration®, Kidspiration®, iPhoto®, iMovie®, and how to use the Internet for learning purposes) and how these applications could be applied to the needs of students with disabilities. In addition, the instructor purposefully modeled the use of these same technology applications to introduce course content and to have preservice teachers apply the use of the technology for learning purposes in the university classroom. For example, the instructor used technology such as Inspiration® software to assist preservice teachers in making connections between concepts related to the identification of students with emotional/behavioral disorders (EBD). Preservice teachers then created their own semantic maps using Inspiration® software to create study aides for the chapter on EBD and to share their maps with each other. Preservice teachers also were required to complete a disability narrative and an Individualized Education Plan (IEP) using multimedia applications based on their work with a student with developmental disabilities as part of their Level 1 practicum experience.

Semester 2—Spring (Year 1)

During the second semester, preservice teachers were encouraged to apply what they learned about technology applications to real educational contexts. Two courses, Introduction to Mental Retardation and Developmental Disabilities and Clinical Teaching, and the Level 2 practicum served as the primary contexts for continued instructional technology development. The Introduction to Mental Retardation and Developmental Disabilities course contains a field experience at a school with a large population of students with significant disabilities. Preservice teachers were required to work with a particular student in the setting and develop or modify classroom material targeting a specific need that took into consideration the student's disability characteristics and IEP goals. They developed a multimedia presentation describing the student's characteristics and the efficacy of the product they created in meeting the identified instructional goal. In addition to this project, preservice teachers were also expected to gain an understanding of how disability may affect children and families. Preservice teachers used their laptops to showcase their work with the students through multimedia applications (i.e., digital photography, digital video, sound, music, graphics). These final products were shared with supervising teachers in whose classrooms the projects were completed. Supervising teachers commented on the power of the multimedia products in helping them to understand how the preservice teachers related to their students and how they made meaning of their experiences with the children.

Through the Clinical Teaching course, preservice teachers' initial course in teaching methods for students with disabilities, and their Level 2 practicum, they engaged in one-to-one beginning reading instruction for students with reading difficulties at an elementary school. As part of this experience, preservice teachers were encouraged to use their laptops and appropriate software to enhance their instructional sessions. To support this activity, a workshop that exposed them to various reading related technology applications was provided. For example, preservice teachers were shown how to develop stop-action video where letters can be manipulated on a white-board such that words can be formed letter-by-letter and sound can be integrated to prompt students' thinking. Such video clips can be tailored for individual student needs and can be used by the student with or without teacher support.

Preservice teachers used their laptops in different ways to enhance their reading instruction. For example, one preservice teacher used the imbedded video camera function on her laptop to capture her student reading text as they worked on increasing the student's reading fluency. Using video editing software on the laptop, she was able to create short video clips of the student at different times during the semester. The preservice teacher and the student were able to see and hear changes in the student's reading accuracy, rate, and prosody through this innovative use of technology.

Another preservice teacher integrated the use of Inspiration® software to create a visual and audio wordbank of newly learned words. This software application includes an audio feature that reads text when the cursor is placed on a word. This provided students a multisensory way to review and practice words that they were currently learning to read. In addition, preservice teachers in this course developed an instructional technology lesson plan that required them to integrate the use of at least three technology applications to teach a specified learning objective for one or more students in their practicum setting.

Semester 4—Fall (Year 2)

After a summer session where preservice teachers completed courses outside of the special education core, they completed their fourth semester in the program, the semester prior to their final internship. During this semester, preservice teachers demonstrated the knowledge and skills they had gained in the use of technology during the past semesters within a classroom instructional context. The course, Education of Adolescents and Adults, and the Level 3 practicum, where students plan and engage in instruction in whole class settings, were the contexts for addressing this goal. Preservice teachers were required to demonstrate their abilities to plan and implement differentiated use of instructional technology in a whole class setting through the completion of a content specific unit plan. In the unit plan, students had to incorporate multiple examples of the integration of technology incorporating higher order thinking. Preservice teachers also developed a charter school proposal that required extensive Internet research and multimedia presentations. This activity required students to review the literature on effective schools, identify characteristics that they would want to incorporate in their charter school, develop an administration and teaching and learning plan for their school, and present their proposal using multimedia. Use of technology continued to be modeled throughout the course (e.g., effective use of PowerPoint™, online discussions, "paperless" assignments, and online multimedia examples of critical course content). As a culminating experience for the semester, preservice teachers were required to develop a presentation titled "What I Learned" depicting their growth as special education teachers throughout the semester. For this project, they continued to enhance their abilities to develop interactive multimedia presentations and to use effective presentation/teaching practices.

Method

Participants

Participants ($n = 13$) in the study were undergraduate special education majors who were part of the College of Education's laptop initiative and made up the department's first "laptop" cohort. Although the original cohort consisted of 19 total students, several students either dropped out of the program or decided to go part-time rather than follow the full-time program. Of this original number, 13 students matriculated through the program together. The purpose of the initiative was to engage preservice teachers in integrating technology into K-12 instruction. Faculty who participated in the laptop initiative also committed to modeling the use of technology as an instructional tool and infusing technology into course content. As previously described, each semester focuses on specific goals associated with the use of technology for learning and teaching purposes. Of the 13 participants, 11 were female and 2 were male. Eleven were White and two were Hispanic. All were native English speakers. They ranged in age from 19 to 27 with the majority (85%; $n = 11$) ranging from 20 to 25 years of age.

Data Collection

Data collection consisted of both quantitative and qualitative methods (pre- and postsurveys with both Likert-type questions and open-ended questions). Survey items were categorized into three quantitative measures: (a) self-perception of ability to use technology for teaching (16 items), (b) attitudes toward the integration of technology in teaching (8 items), and (c) perceptions of how faculty integrated technology into their teaching for specific special education courses (5 items).

The instrument used to measure self-perception of ability to use technology for teaching included 16 Likert-type items on a 5-point scale ranging from *no knowledge/ability* to *expert knowledge/ability*. The items addressed participants' perceptions of their abilities to use basic to advanced technology applications. For example, basic applications included word processors, spreadsheet or database programs, sending and receiving e-mail, and searching for information, including teaching resources on the Internet. More advanced applications included developing PowerPoint™ presentations; importing audio, graphics, digital photos, and video into existing documents (e.g., newsletter, brochure) or presentations; evaluating Internet teaching resources; developing newsletters and brochures; using real-time discussion boards; teaching students how to use technology; and using various other software and online applications (i.e., Inspiration™, Kidspiration™, WebQuests, and Internet Scavenger Hunts). The instrument used to measure attitudes toward the integration of technology in teaching included eight Likert-type items on a 5-point scale ranging from *strongly agree* to *strongly disagree*. Participants responded to statements about the use of technology for teaching: "Computers are valuable tools that can be used to improve the quality of education." "Computer-related technologies should be used by teachers more than they are now." "In the future, I will integrate technology much more for teaching." "Computer-related technologies are of little value for instruction because they are too difficult to use." "Overall, I think the computer is a very important instructional tool." "I do not feel comfortable using technology in my teaching." "I feel it is important for educators to be able to use technology." "Technology should be used to improve learning throughout the curriculum." The instrument used to measure perceptions of faculty members' integration of technology into their teaching for specific special education courses included five Likert-type items on a 5-point scale ranging from *strongly disagree* to *strongly agree*. Participants responded to statements that related directly to the use of instructional technology by faculty in courses: "I was eager to participate in scheduled online discussions." "Technology helped me to apply what I learned to real-world problems." "I have learned

useful technological skills that I can transfer to my practice." "I enjoyed interacting with the instructor or other students by way of real-time or time-delayed electronic communication." "The use of technology in my courses has enhanced my learning experience."

During the first class meeting of Semester 1, preservice teachers were provided with an overview of the study, including how confidentiality of responses would be maintained, and were asked to participate in the study. Informed consent was obtained per Institutional Review Board guidelines. *Self-perception of ability to use technology for teaching* was measured at four points during the three semesters (beginning of Semester 1, end of Semester 1, end of Semester 2, and end of Semester 4). *Attitudes toward integration of technology in teaching* were measured at three points during the first two semesters (beginning of Semester 1, end of Semester 1, and end of Semester 2). The administration of this measure was intended to occur at the end of Semester 4; however, logistical circumstances at the end of the semester prevented us from administering the measure. *Perceptions of how faculty integrated technology into their teaching* were measured at two points during the second and third semesters (end of Semester 2 and end of Semester 4). The rationale for including this measure at these points in the program was that it is in these semesters that preservice teachers actively applied the use of technology for teaching purposes in their practica. Also, during the second and third semesters, participants responded to seven open-ended items that pertained to their experiences in the laptop initiative. Open-ended questions were included for the purpose of collecting qualitative data that might provide additional insight into our preservice teachers' experiences. Table 1 shows the administration timeline for each measure.

Data Analysis

Analysis was completed using data from only those students who completed each semester of the study ($N = 13$). Reliability of survey items for each measure was established using Cronbach's alpha. The following correlation coefficients were established for items in each section of the survey: (a) self-perception of ability to use technology for teaching (Cronbach alpha = .96), (b) attitudes about using technology for teaching (Cronbach alpha = .91), and (c) perceptions of course integration of technology (Cronbach alpha = .78). The Statistical Package for the Social Sciences (SPSS) was used to analyze the quantitative data using repeated measures for self-perception of ability, attitudes toward integration of technology in teaching, and perceptions of how faculty integrated technology in their courses.

Findings

Findings are presented according to three primary areas: (a) preservice teachers' self-perception of their ability to use technology for teaching, (b) preservice teachers' attitudes toward use of technology in teaching, and (c) preservice teachers' perceptions of how faculty in their special education courses effectively integrated technology in their instruction. Descriptions of findings for each area are separately reported.

Self-Perception of Ability

Preservice teachers' self-perception of their ability to use technology for teaching increased across the three semesters. Significant differences were found from pretest to posttest for each semester of the study. Posttest means for each semester show continued increases in preservice teachers' self-perception of ability (Cohen's $d = 1.58$, 1.98, and 2.42, respectively). The greatest increase in self-perception of ability occurred during preservice teachers' first semester (pretest to posttest1). Table 2 shows the results for this analysis. Skills for which preservice teachers showed the greatest gains (range = +1.62 – +2.15) in self-perception of ability included use of real-time discussion boards, use of various software

Table 2. Self-Perception of Ability to Use Technology for Teaching

Test	*M*	*SD*	*N*	*M* Difference	*SE*	Cohen's *d*
Pre (Semester 1)	2.90	.648	13			
Post1 (Semester 1)	3.89	.654	13	–0.990*	.207	1.58
Post2 (Semester 2)	3.97	.462	13	–1.066*	.159	1.98
Post3 (Semester 4)	4.21	.465	13	–1.313*	.193	2.42

*Significant at the .05 level.

Table 3. Attitude Toward Use of Technology for Teaching

Test	*M*	*SD*	*N*	*M* Difference	*SE*	Cohen's *d*
Pre (Semester 1)	4.22	.218	13			
Post1 (Semester 1)	4.41	.249	13	–.183	.153	.85
Post2 (Semester 2)	4.33	.280	13	–.110	.140	.46

and online applications (i.e., Inspiration®, Kidspiration®, WebQuests, Internet Scavenger Hunts), developing brochures and newsletters, and the integration of video clips and digital photography into instructional materials. Two skills for which mean gains were less than +1.00 were send and receive e-mail (+.16) and search for information on the Internet (+.46).

Attitudes Toward Use of Technology in Teaching

Preservice teachers' attitudes toward the use of technology in teaching did not change across Semesters 1 and 2, the two semesters during which these data were collected. No significant differences were found between pretest and subsequent posttests. However, effect sizes indicate a large effect for pretest1 to posttest1 (Cohen's d = .85) and a medium effect for pretest1 to posttest2 (Cohen's d = .46). Table 3 shows the results for this analysis. Of the eight items for this measure, the item that showed the most gain (+.49) was, "I think computers make work more enjoyable." Overall, however, means for each semester were above 4.0, suggesting that participants' attitudes about technology integration were quite positive at the start.

Student Perception of how Courses Integrated Technology

Preservice teachers' perceptions of faculty's integration of technology in their special education courses during Semesters 2 and 3 were consistent. No significant differences were found between semesters (Cohen's d = .04). Overall, preservice teachers rated the courses fairly high (approximately 4.0 out of a 5-point scale). Table 4 shows the results of this analysis. Items for which participants rated the courses highest were, "I have learned useful technological skills that I can transfer to my practice" (M = 4.3), and "The use of technology in my courses has enhanced my learning experience" (M = 4.23). The lowest rated items were, "I was eager to participate in scheduled online discussions" (M = 3.35), and "I enjoyed interacting with the instructor and other students by way of real-time or time-delayed electronic communication boards" (M = 3.58).

Open-Ended Responses

Open-ended questions were included in the surveys administered at the end of the spring 2005 and fall 2005 semesters. These two semesters emphasized instructional methods

Table 4. Student Perception of how Courses Integrated Technology

Test	*M*	*SD*	*N*	*M* Difference	*SE*	Cohen's *d*
Semester 2	3.89	.586	13	.399	.163	
Semester 3	3.86	.888	13	.829	.246	.04

in special education. As a result, additional questions were included that specifically addressed the use of technology in instruction, both faculty instruction and participants' own instruction. Participants responded to the following prompts: (a) their feelings at the end of the course, (b) perceptions about barriers using technology, (c) perceptions about the benefits of using technology, (d) suggestions to improve technology use, (e) perceived supports needed to enrich their experience with technology, (f) perceptions about how they will apply knowledge gained with technology in their practice, and (g) additional comments.

At the end of their first semester in the program, students noted that they had learned a great deal, although they expressed high levels of stress and felt somewhat overwhelmed with the workload. They identified logistical concerns (e.g., time, difficulties with hardware malfunctions), difficulty learning the applications, and course delivery methods (e.g., PowerPoint's not effective, high level of faculty expectations, and how course was organized) as barriers. One participant noted a decrease in personal interactions as a barrier. Benefits included increased communication, enhancement of course products, and the learning experience (e.g., taking notes, visual learning tools, increased interest, and authenticity). They also believed that technology boosted their creativity.

Participants' suggestions for improving technology use included decreasing the workload, having more time to become proficient with technology, upgrading hardware and peripherals, and suggestions for how the course instructor could better integrate technology. There were few responses to the question addressing needed supports to enrich the technology experience. Mostly, suggestions centered on students' initial needs as learners related to becoming proficient with their laptops and associated software applications (e.g., more modeling, better explanation, and more time to process). When asked how they would apply what they have learned in their practice, participants' comments centered on how they would use specific software applications in their teaching. Two students indicated that they did not know or would do nothing. Additional comments simply reiterated many of the ideas from the previous questions (e.g., stress, learned a lot, and time).

At the end of Semester 4 (fall—Year 2), participants expressed a sense of accomplishment and confidence with their use of technology. Logistical and hardware issues continued to be identified as barriers. In addition, three participants noted technology as a factor in classmates having difficulty staying on task. Perceived benefits were very similar to the previous semester (e.g., communication, enhanced creativity); although, at this point in time, the nature of some responses revealed participants' apparent increased comfort level with their use of technology (e.g., technology made it easier to complete assignments, to locate learning resources in class, and to develop assignments for K-12 students in their field experience). There were few comments related to suggestions for improving technology use. However, all but one response related to the desire for having even more technology integrated into their courses. One response requested having dedicated classes on technology. When asked how they would apply technology in their practice, again, participants identified specific hardware and software applications they would use. It is interesting that responses mostly identified technology applications that they would use but did not describe how they

would use them to teach or enhance instruction. Moreover, the nature of these responses indicated a very didactic instructional approach with no concrete examples: "I would teach Inspiration®." "I would use technology to differentiate instruction."

Overall, several themes emerged over the two semesters. Stress and workload were consistent issues for participants. Barriers included logistical concerns involving hardware and software problems (computer crashes, difficulty learning specific software applications) and the manner in which training was provided. Two additional themes emerged. Enhanced learning on the part of participants was one theme. A second theme was the voicing of personal technology learning needs by preservice teachers (more interesting, needing more time to process learning). Consistently, participants' descriptions of how they would use technology in their teaching were limited to saying that they would use this or that particular software or hardware application. There was no elaboration on how they would use the software to enhance students' learning.

Discussion and Implications

In general, the results of this study suggest that a systematically structured technology integration plan for teacher education programs can be implemented by faculty working collaboratively and can positively affect preservice teachers' self-perceptions of instructional technology abilities. In addition, such an approach can positively affect the use of instructional technology by faculty in the university classroom. In this study, preservice teachers' perceptions of their abilities to integrate the use of technology in their teaching increased. Their attitudes toward integrating technology in teaching remained consistently high across program semesters. Moreover, preservice teachers believed that faculty effectively integrated and modeled the use of technology in their instruction.

These results, in many ways, parallel the K-12 literature on the use of technology for teaching. As specified previously, the three factors that have been shown to be critical to the successful implementation of technology-enhanced instruction in K-12 schools are professional development, teachers who believe themselves competent to integrate technology for teaching, and positive teacher attitudes toward technology (Penuel, 2006; Watson, 2006). In terms of enhancing professional development for preservice teachers, the results of our study suggest that preservice teachers can benefit from the systematic integration of instructional technology in their teacher preparation programs. In particular, the preservice teachers in this study believed that they increased in their instructional technology abilities. Overall, they responded positively to faculty members' integration of technology in their teaching. However, despite faculty attempts, preservice teachers had difficulty describing in detail how they would integrate technology for teaching in the future at the conclusion of this study.

Although it was pleasing to know that the preservice teachers grew in terms of their knowledge about specific technology applications for teaching, it was surprising and somewhat disappointing that they were not able to develop a wider understanding of how to apply this knowledge in instructionally relevant ways. Preservice teachers were able to demonstrate their abilities to use technology for developing products both for learning and teaching purposes. However, they were not able to articulate clearly how they would use their growing technology skills to teach students with disabilities. It is unclear whether this outcome is specific to technology or to this group of preservice teachers. Perhaps, this outcome reflects where many preservice teachers are in terms of their development in critically thinking about teaching, with or without technology. Currently, little is known about how preservice teachers acquire proficiency in using technology for teaching. Further investigation is needed to determine the extent to which the development of instructional technology skills for teaching mirrors that of other teaching skills.

An intriguing result of this study was an apparent disconnect between the types of technology applications that it was anticipated preservice teachers would find most important and the ones they actually suggested were most important. This group of special education preservice teachers was composed mostly of traditional age undergraduate juniors and seniors who have grown up with access to technologies such as e-mail, text messaging, and synchronous and asynchronous online communication structures. It was quite surprising that these types of technology applications were not the types that preservice teachers resonated with in terms of importance or use for learning and teaching purposes. Rather, it was the applications with which participants had the least exposure to prior to entering the program that they actually reported as benefiting them the most. In terms of the preservice teachers' learning and professional development, it was expected that they would have seen the relevance of and taken advantage of those technology applications with which they were most familiar more quickly. It was quite interesting to observe that this was really not the case.

For example, online synchronous and asynchronous discussions, a process of communication that many traditional age preservice teachers use in their personal lives (e.g., text messaging, blogging, Facebook, etc.), were applications that participants rated lowest in terms of importance for learning purposes. This perspective played out across semesters in several concrete ways. For example, when several group projects were assigned that involved preservice teachers collaborating outside of class, they did not choose to make use of their available technology to facilitate their collaboration. One application that all students had available to them was video conferencing, where multiple preservice teachers could see and hear one another in real time. Discussion boards and chat rooms also were made available to them as part of their special education courses. None reported taking advantage of any of these technology applications. Several students indicated, however, that the collaborative projects were difficult to complete due to the lack of face-to-face time they had with their group members.

This perplexing situation was only magnified by the fact that these preservice teachers made ample use of real-time chatting and instant messaging for personal communication during classes! This apparent contradiction is both amusing and discouraging. It is amusing because it speaks to where at least some preservice teachers may be developmentally. It is discouraging for the same reason. Despite faculty attempts to channel students' proclivity for virtual communication into productive use for learning and teaching, these attempts were not successful. This situation remained constant across all three semesters of this study.

Several questions have arisen from this study that have implications for further research. Are preservice teachers able to generalize and adapt preexisting technology skills to the teaching context? In this study, technology applications commonly used by traditional age preservice teachers for personal use were the ones that they reported to be least useful for learning and teaching purposes. It is important for us as teacher educators to help facilitate generalization of technology skills among our preservice teachers. Further research that investigates ways that faculty can assist preservice teachers in making this important transition is needed. Teacher educators must help preservice teachers move from individuals who are consumers of technology for personal use to learners and teachers who are consumers, producers, and innovators of technology in the classroom.

In addition, are there generational differences between teacher educators and traditional age preservice teachers as it relates to how technology is viewed as a teaching and learning tool? To what extent do teacher educators and preservice teachers perceive the use of technology for learning and teaching purposes in divergent ways? For many teacher educators, technology is a somewhat new phenomenon. Many of the current technologies

that can be applied to education have developed during their tenure as faculty in higher education. This situation has resulted in many faculty learning these new technologies in the context of their careers as teacher educators; therefore, their perspectives on its use may be more concentrated on learning and teaching. In contrast, the perspectives of preservice teachers about technology have been shaped by it being a continuous part of their personal lives. For them, it may be a greater transition to visualize how familiar technologies can be generalized for learning and teaching purposes. These hypothesized generational differences may explain, at least in part, some of the results of this study. Research into how such technology-related generational differences between faculty and students might affect preservice teacher instructional technology outcomes could prove fruitful.

Another important question arising from this study is why did participants fail to more completely describe how they would integrate instructional technology in their teaching? Faculty attempted to address the application of technology for teaching by gradually scaffolding preservice teachers' learning and teaching experiences with technology across courses and practica from one semester to another. One potential practice to revisit is how explicit teacher educators must be in terms of modeling each technology application for the purpose of learning and for the purpose of teaching. In this study, faculty modeled how to use technology for both learning and teaching purposes but, perhaps, the amount of modeling time was not sufficient or faculty did not explicitly model technology applications for each of the potential special education teaching contexts that this group of preservice teachers experienced during their special education practica. It is unclear whether preservice teachers in this study were unable to articulate in more detail how they could teach with technology because they were unable to generalize (i.e., what they learned in their university class to their K-12 school placement) or because they were unable to sufficiently understand their K-12 classroom context (i.e., type of setting, learning needs of students) well enough to apply their knowledge of instructional technology. Either possibility, it seems, suggests a developmental component that requires more investigation. To this end, the level of support that preservice teachers need (i.e., explicit modeling) in order to think critically about how they can integrate technology in their teaching is another important area for further research.

In addition to modeling from course faculty in classes, perhaps preservice teachers need to also observe modeling of instructional technology from their supervising teachers in the field. The field placements where this group of preservice teachers completed their practica did not represent settings where use of technology was a priority. The level of technology integration at the school sites was minimal.

What effect do supervising teachers who model use of instructional technology during field experiences have on preservice teachers' abilities to think critically about how they will use it in the future? If the assumption is that such modeling would be beneficial, the wide variations in how individual schools and teachers integrate instructional technology could make the reliance on consistent school-based models difficult. What can teacher preparation programs do when the instructional technology practices they emphasize are not practiced in the schools where their students complete their field experiences? One potential strategy to address this issue is for teacher educators, as field supervisors, to integrate within field experiences opportunities for preservice teachers to use their growing repertoire of instructional technology skills. This would necessitate that faculty be involved in the field to provide prompting and reinforcement of students' integration of technology as they teach. Although faculty were involved in each of the practica during each semester of this study, it is believed that faculty could have provided more explicit prompting and modeling in the field despite the lack of technology integration at the practicum sites.

The results of this study suggest to these researchers that instructional technology needs to be explicitly taught, that it needs to be systematically integrated across a program of study, and that continual support by faculty in field settings is essential if the expectation is for preservice special education teachers to effectively integrate technology in teaching. On some of these points, it is believed that at least a measure of success was achieved, whereas on others, improvement is needed. If improvement is to be made, faculty must have support and professional development to ensure that they can effectively model appropriate uses of technology for teaching. Although faculty in this study were provided support, it was through the collective reflections about what they did, how they did it, and the results that aided them the most to enhance their approaches in integrating instructional technology for teacher preparation. Therefore, an important aspect for professional development among teacher educators is time to share and reflect collaboratively on their instructional technology practices and experiences.

There are at least two points of analysis that were not included in this study but that should be considered for further research. An analysis of preservice teachers' performance-based technology products would provide greater insight into the actual instructional technology skills that preservice teachers develop. Whereas preservice teachers in this study completed many different performance-based products, almost all graded products were comprehensive semester-long projects incorporating multiple preservice special education competencies (assessment, instruction, positive behavior supports, planning, etc.). Evaluation rubrics for these products were not structured such that meaningful analysis of technology specific competencies could be conducted. Moreover, standardization of evaluation across courses and faculty was not possible due to logistical and time issues. Also, following graduates longitudinally during their first few years as beginning teachers to determine how they integrate technology in teaching would provide the field with important information about sustainability. Graduates from the cohort that was studied were not followed during their first few years as beginning teachers. Such data would have greatly informed the program about the sustainability of the instructional technology competencies that preservice teachers developed during their preparation program. Researchers are strongly encouraged to incorporate both of these points of analysis in future studies.

Although this study represents only one cohort of special education preservice teachers from one teacher preparation program, it represents a longitudinal evaluation of a program's implementation plan for instructional technology integration. Also, the study is one attempt to address Kay's (2006) recommendations with regard to research on the integration of instructional technology in preservice teacher preparation programs. There still is much to learn. This study is not without limitations; however, it is believed that the study has resulted in helping one teacher education program in special education to understand more fully both the challenges and the benefits of systematically integrating instructional technology in teacher preparation. Although the results are not generalizable to other populations of preservice teachers due to sample size, it is hoped that these findings encourage others to consider developing systematic approaches to the integration of instructional technology in teacher preparation programs and studying the effect of these approaches.

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