

Handbook of Research on Instructional Systems and Technology

Volume I

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Information Science
REFERENCE

INFORMATION SCIENCE REFERENCE

Hershey • New York

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Cover Design: Lisa Tosheff
Printed at: Yurchak Printing Inc.

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue, Suite 200
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: <http://www.igi-global.com/reference>

and in the United Kingdom by
Information Science Reference (an imprint of IGI Global)
3 Henrietta Street
Covent Garden
London WC2E 8LU
Tel: 44 20 7240 0856
Fax: 44 20 7379 0609
Web site: <http://www.eurospanonline.com>

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Handbook of research on instructional systems and technology / Terry Kidd & Holim Song, editors.

p. cm.

Summary: "This book provides information on different styles of instructional design methodologies, tips, and strategies on how to use technology to facilitate active learning and techniques to help faculty and researchers develop online instructional and teaching materials. It enables libraries to provide a foundational reference for researchers, educators, administrators, and others in the context of instructional systems and technology"--Provided by publisher.

Includes bibliographical references and index.

ISBN 978-1-59904-865-9 (hardcover) -- ISBN 978-1-59904-866-6 (ebook)

1. Instructional systems--Design. 2. Educational technology. 3. Educational innovations. I. Kidd, Terry. II. Song, Holim.

LB1028.38.H357 2008

371.33--dc22

2007024155

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this book set is original material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

Chapter XV

Preservice Teachers' Views of Appropriate Technology

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ABSTRACT

National organizations, federal policy, and academic standards all call for technology to be integrated into K-12 classrooms in ways that are likely to influence student achievement. While access to technology is at an all-time high, research on technology use still indicates that teachers do not integrate technology effectively. This chapter focuses on preparing preservice teachers to integrate technology into their classroom. We present a synthesis of literature on technology in teacher education programs as well as findings from a research study on preservice teacher's shifting perceptions of technology integration over approximately a year. Lastly, we provide implications for future research studies regarding the influence of teacher education programs on preservice teachers' technology integration development.

INTRODUCTION

National educational organizations (International Society for Technology in Education [ISTE], 2002a; 20002b; National Research Council, 1996), policy makers (No Child Left Behind, 2001; Office of Technology Assessment, 1995; President's Committee of Advisors on Science and Technology, 1997; U.S. Department of Education

[USDoE], 2004), and teacher accreditation associations (National Council for Accreditation of Teacher Education, 2001) cite the need to support teachers' integration of technology in ways that improve student learning. This viewpoint is especially apparent among educational researchers (Bransford, Brown, & Cocking, 2000; Jonassen & Reeves, 1996) who advocate using technology as a tool to improve learning in K-12 schools.

Most studies that have attempted to link technology use to student learning have had mixed results (Roschelle, Pea, Hoadley, Gordin, & Means, 2001). However, some studies have found that using technology to support students' higher-order thinking skills has significantly impacted student learning on large-scale tests (Wenglinsky, 1998), problem solving assessments (Cognition and Technology Group at Vanderbilt [CTGV], 1992, 1997), and other measures of student learning (Schacter, 1999).

The International Society for Technology in Education's National Educational Technology Standards for Students (NETS-S) call for technology to be integrated across content areas in ways that support students' communication as well as problem solving and research activities (ISTE, 2002a, 2002b). These recommendations for technology use align closely to learning environments that are constructivist (Cobb, 1994), constructionist (Papert, 1980), learner-centered (McCombs & Whisler, 1997; Sandholtz, Ringstaff, & Dwyer, 1997), and open-ended (Hannafin, Hall, Land, & Hill, 1994). In these approaches, students use technology as cognitive tools to create their own understanding of content from their experience (Jonassen et al., 1996).

While access to technology is no longer a major problem, placing computers in classrooms does not ensure their effective use (Cuban, 2001). Numerous large-scale survey studies (e.g., Milken Family Foundation, 2000; USDoE, 1998; Smerdon et al., 2000) indicated that less than 25% of teachers feel prepared to use technology in their teaching. Subsequently another survey study of 4,083 teachers found that 4-12 grade technology use is limited to drill and practice activities (Becker, 2001). Clearly, teachers are in need of more support in order to implement technology in ways that will impact their student's learning.

In this chapter, we discuss issues related to preservice teachers learning how to integrate

technology into K-12 classrooms. In doing so, we share the findings from a research study that examined preservice teachers' changing perceptions of technology during two semesters of their practicum. Lastly, we discuss implications for research around preservice teachers learning how to integrate technology.

BACKGROUND

Numerous authors have cited the need to adequately prepare preservice teachers to integrate technology into K-12 classrooms (e.g., Earle, 2002; Schrum, 1999; Vetter, Sologuk, & Stammen, 2001). While most preservice teachers take an educational technology course (Persichitte, Tharp, & Caffarella, 1997), research on these courses have found them to be isolated from methods classes and providing only basic technology skills (Moursund & Bielefeldt, 1999). Further, preservice teachers leave this course with the ability to use technology but no experience in teaching with technology (Ertmer, 1999). Schrum (1999) wrote that preservice teachers need adequate exposure to (a) technology in a skills-based course, (b) the integration of technology into methods courses, and (c) technology rich field placements.

Factors Contributing to Preservice Teachers' Perceptions

Various researchers (e.g., Beyerbach, Walsh, & Vannatta, 2001; Mims, 2005; Wang, 2002) interviewed preservice teachers and found that their views of technology use in the classroom paralleled their own K-12 experiences. These findings support the mantra that teachers tend to employ the pedagogies that they experienced during their K-12 schooling. These studies also concluded that preservice teachers primarily saw technology as a teacher-centered tool to increase

teacher productivity, support teacher's presentations (e.g., PowerPoint lectures) and facilitate teacher's information gathering on the Internet. While research has focused on preservice teacher perceptions of classroom technology use, there is a literature gap of studies that examine how preservice teachers' perceptions of technology change during their teacher education programs and how their uses of technology are influenced by their beliefs. Longitudinal research is needed that would examine how preservice teachers' perceptions of technology develop during their teacher education program.

EXAMINING PRESERVICE TEACHERS' PERCEPTIONS OF APPROPRIATE TECHNOLOGY USE

In this section, we discuss our findings from a qualitative study, in which we interviewed preservice teachers across two semesters. Participants were enrolled in an early childhood program (pre-kindergarten to grade 5 certification) at a major university in the southeastern United States. Specifically, we wanted to examine:

1. What are preservice teachers' perceptions of appropriate uses of technology in elementary school classrooms?
2. How do preservice teachers' experiences in a teacher education program influence their perceptions of appropriate uses of technology over time?

Participants

We used purposeful, selective sampling (Patton, 2002) to recruit participants during the spring semester of their sophomore year. All participants were enrolled in an educational technology course required of students prior to entrance into the

early childhood education program. Initially, we selected six participants for our study (Table 1). All participants were Caucasian females that applied for admission to the early childhood education program prior to Fall Semester, 2004. The age range of participants was from their late teens to early twenties. Participants varied in terms of their hometown. Four of the participants came from an affluent suburban school district. The other two participants attended K-12 schooling in rural areas. Despite the varying educational settings, all of the participants reported that they had used computers prior to beginning the educational technology course. Table 1 describes participants' experiences with technology before the study. Following the first semester of data collection, our participant pool narrowed to five because one person was not accepted into the early childhood education program and selected a major unrelated to education.

Data Collection and Analysis

Participants were first interviewed during the last week of the technology course. These interviews, lasting about 45 minutes each, focused on participant perceptions of technology use in K-5 classrooms, perceptions of e-portfolios and reflective activities as professional development tools, and thoughts about what teaching in actual classrooms looks like. Approximately 11 months after the first round of interviews, we again interviewed five of these participants. This interview focused exclusively on preservice teacher perceptions of technology use and the role of technology in elementary classrooms. Figures 1 and 2 show the interview protocols that were used during the study.

Since the aim of our study was to generate a better understanding of preservice teacher perceptions of technology, we used a form of inductive analysis modeled after principles of grounded

Preservice Teachers' Views of Appropriate Technology

Table 1. Description of the participants

Participant	Major	Description
Elaine	Early childhood education	Elaine was very computer savvy before beginning this study and often told us about using presentation software and other resources for fun as a young child. She had some Web page design experience prior to the technology course. Half of Elaine's family is involved in education and she wants to teach 2 nd grade and then earn her Masters degree. She spent a lot of time observing classrooms prior to this study. She also coaches a soccer team for 6-year-old girls.
Katie	Early childhood education	Katie is from a large urban city. She began the study as a Sophomore in college planning to enroll in the early childhood education program and has not spent any time in the classroom other than her own K12 schooling but co-coaches soccer to a group of girls under six years old. She especially wants to teach 3 rd grade but states that 2 nd or 4 th grade would also be okay.
Lucy	Early childhood education	Lucy describes herself as not very computer literate. She doesn't have a computer at home and says that she rarely uses them for anything but word processing and Internet. When enrolling for the introductory computer class, she was worried that she would be far behind other students in terms of ability. While her mother teaches 3 rd grade, she only became interested in the major after attempting mathematics, pre-med, and advertising. She feels she can make the best contribution in life through teaching. At the beginning of our study, she had already volunteered for several hours in elementary schools as well as helping in her mother's classroom. She had just been accepted into the early childhood education program at the beginning of this study and had not completed any coursework within the program.
Sandra	Early childhood education	Prior to participating in our study, Sandra spent a lot of time observing in a 1 st and 3 rd grade classroom. When she graduates from the early childhood program, she wants to teach 1 st grade. Prior to this study, she was also moderately comfortable using computer technologies.
Melissa	Early childhood education	Melissa came from a small town in the southeastern United States. She described her education as coming from a poor, insufficient school system that could only provide one computer in her classroom. While she had a computer at home, she mostly used it for email and instant messaging. Melissa describes teaching as the next best thing to working in a nursery—which doesn't pay enough. At the beginning of this study, she had been admitted into the early childhood education program but had not completed any coursework. She also spent very little time observing elementary classrooms prior to our research but taught bible study. While she originally wanted to teach 2 nd or 3 rd grade, she later added Kindergarten and 1 st grade to the list based on field experiences.
Kelly	Family and consumer science	Kelly has wanted to be a teacher since she was seven years old. Originally, she planned on entering the early childhood program. However, after being rejected from that program she decided to enter family and consumer science. Prior to our study, she had spent two semesters of extensive observation in elementary classrooms. Kelly grew up in the suburbs of a large southeastern city. Prior to the introductory computer class she felt comfortable using windows-based computers.

theory (Charmaz, 2002; Dey, 1999; Strauss & Corbin, 1998). These methods included verbatim transcription, iterative steps of data collection and analysis, open coding, memoing, and thematic coding techniques (Coffey & Atkinson, 1996).

Three interview transcripts were randomly selected and coded by both researchers. The

researchers met to discuss their codes and any data that could not clearly be coded. After the researchers discussed data, they individually recoded the interviews and compared their codes. After we established rater agreement, each interview was read independently by at least one of the researchers. Analysis began by open coding

Figure 1. Interview I protocol

1. What courses are you currently involved in?
2. What prompted you to take the educational technology course this semester?
3. Do you plan on teaching when you graduate from UGA?
 - a. Have you been accepted to a specific program?
 - b. What experiences have you had with children?
4. What grade would you like to teach?
 - a. Why that particular grade?
 - b. What do you think students at that grade will be like?
5. How do you think technology can help students at that grade level?
6. What are some effective ways to integrate technology?
7. What are some ineffective ways to integrate technology?
8. Thinking about EDIT 2010, let's talk about some of the activities.
 - a. E-portfolios
 - b. Productivity tools
 - c. For each activity, what is the benefit?
9. In summary, what have you learned from your technology course?

Figure 2. Interview II protocol

1. Do you plan on teaching when you graduate?
 2. What teacher education program are you in?
 3. What are some examples of educational technologies?
 4. What experiences have you had with technology in the COE last year?
 - a. What experiences have you had with technology in your methods courses?
 - b. What experiences have you had with technology in your field experiences?
 5. What grade are you working with in your field experience?
 6. What are students in that grade able to do with technology?
 7. What are some effective ways to integrate technology?
- What are some ineffective ways to integrate technology?

each transcript (Strauss et al., 1998). After the initial coding, codes were reviewed, sorted, and refined to look for concepts (Strauss et al., 1998). Following this process, we reread our transcripts looking for these concepts to ensure that they emerged from our data. Data from our transcripts were then entered into a spreadsheet and labeled with codes, sub-codes, and memos in adjacent columns. Data were then examined within each code and assertions formed. The data were then revisited in order to verify or refute each asser-

tion. These assertions were then used to analyze data from our next round of interviews.

FINDINGS

Technology is a Teacher's Tool

During both rounds of interviews our participants responded to the question, "What role do you think technology will have in your classroom?"

with examples of technology that focused on teacher productivity and organization. Specifically, participants stressed using technology in ways that increase teacher productivity, present materials to captivate students, and supplement lesson materials and discussions. These prominent themes are described in this section.

Technology is Primarily a Productivity Tool for Teachers

Every participant shared that they primarily saw computers as a tool to help them search for, write, and organize lesson and unit plans, keep student records, and communicate with parents and other teachers. Teachers cited e-mail, newsletters, and Web sites as modes of communicating and accessing information. They often referred to these technology uses as “extremely important” or “vital” to teachers in locating, organizing, and consolidating their materials. Sandra mentioned “organization is a huge deal and [technology] will help keep my life a lot less hectic.” Every participant reported that technology, especially computers and the Internet, would help them find and create lesson plans, diversify presentation methods, stay organized, and archive past activities for future use in portfolios and other tools.

Technology Can Captivate Students

Although preservice teachers perceived teacher productivity as an important element of classroom technology use, they also liked it for gaining and maintaining student attention. Unlike traditional classroom lessons, our participants believed that technology allows teachers to more easily include visual aids, sounds, and pictures into classroom activities. Our participants believed that these uses were helpful in diversifying presentation

methods and keeping students engaged in the lesson at hand. During her first interview, Elaine mentioned the importance of these visual effects while discussing presentation software:

If you do a slide show, I don't think it would captivate [students] at all if you're just showing them slides. But, if you add sound...or movies or something, that's a little more stimulating than just a blank picture and words...I think that would definitely be captivating for a young child.

When talking about adding pictures and sounds to teacher-made PowerPoint presentations, Katie said it “helps [students] remember things and actually stay entertained.” Participants made comments similar to these in both interviews. Each believed that technology could greatly enhance student motivation by spicing up traditional presentations.

Four of our participants also mentioned using technology to benefit multiple learning styles. During her first interview, Kelly stated “I am a visual learner. When I see [something], I remember it. So instead of just talking about it, it's important to have pictures and slides and a PowerPoint thing where the words are on the screen to help different types of learners.” Other participants made similar comments and extended learning styles to audio-visual and kinesthetic activities. During her second interview, Lucy talked about technology use to aid writing skills. “[For] some kids it's a lot easier for them to push a button than it is for them to manipulate a pencil. So it gives them a way to communicate without having to perfect their handwriting.” She admitted that students eventually need to learn how to write on paper; however, she reported that computer technologies have the potential to be a powerful tool to develop students' literacy and communication skills.

Technology Can Supplement Instruction

Our participants felt that technology was important to reinforce instruction. Sandra summed up these feelings when she mentioned, "I really think that [technology] is a great supplement for kids and learning." However, none of them viewed technology as an integral part of classroom instruction. When asked if technology could ever replace teacher instruction, participants had their doubts. Lucy stated, "I don't think so...it could maybe, but I would like to think that it couldn't. I would like to think that I [the teacher] would be the one to communicate and then technology would be what [students] manipulate." Although they saw a place for technology in the classroom, it always supplemented more traditional instruction. Indeed, during their second interviews two of our participants claimed that teachers could easily replace every benefit of computer technology with supplementary materials. These participants believed that while technology influenced student motivation and learning styles, it did not add anything new to the classroom.

Students' Uses of Technology

While teacher-centered uses of technology were prevalent during our first round of interviews, participants also mentioned a few student uses. One difference between the first and second round of data collection was the balance between student and teacher-centered uses of technology in the classroom. During the second round of interviews, participants had more ideas for student-centered uses of technology. However, every participant followed up references to student-centered uses with phrases such as, "possibly" or "maybe that would be appropriate." Participants had ideas about student-centered technology-rich activities, but seemed leery about whether or not they were

appropriate for students. These mainly focused on four categories: presentation of information, research, information organization, and career skills.

Presentation of Information

While our participants felt that teacher-centered technology uses were important for student motivation, they also felt that student-centered activities played a role in diversifying activities and maintaining student interest. However, when participants were asked to give examples of student-centered uses of technology, they mentioned using technology to improve teacher's presentation of content (e.g., PowerPoint presentations). All participants emphasized technology's capability to present pictures, animations, and student movies as alternatives for traditional classroom presentations. Two participants referred to their educational psychology course and reported that these alternative presentation methods would increase students' interest, aid audio-visual learners, and enrich classroom activities.

Research

Activities where technology supported research projects (e.g., searching for information using Google) were the most cited example of student technology use during both rounds of interviews. All of our participants indicated that technology could help locate information—either by communicating with others, finding source materials, or locating supplementary audio-visual information. Our participants frequently reported that the Internet was a replacement for traditional library research. They recognized the amount of information available on the Web and planned to have their students access it. However, they were not without qualms about Internet research. Although they compared the Internet to a library, they were

far more cautious about Internet source credibility and wonder how they will teach their students to judge quality over quantity of information.

Information Organization

During the first round of interviews, participants also discussed technology's ability to facilitate student's organization of material through *Inspiration*, a concept-mapping program that they had used in their technology course. Katie commented, "Inspiration was good because the diagrams help organize information and just help my students incorporate the information and embed it." All participants in their first interview reported that *Inspiration* would be appropriate for older elementary students to use. Further, they espoused that *Kidspiration*, the K-3 version of *Inspiration*, would be beneficial, despite only hearing about it in their technology course.

Career Skills

The last student-centered approach indicated by four of our participants relates more the social value of technology skills. Most participants stated that teaching their students how to use technology is worthwhile because it is an important life career skill. Melissa sums up this use. "In the real world they [students] will be using technology. So if you go ahead and get them started on it now, it will be easier for them later." During both rounds of interviews, our participants mentioned the role technology plays in being successful in society. They think that at some point, their students must know these skills in order to maintain a job.

The Influence of Teacher Education Experiences on Participants' Perceptions

During the first round of interviews, all participants demonstrated a high amount of certainty

about technologies that they could use in their classroom, but shared doubt related to the characteristics of students and the K-5 curriculum. During the second round of interviews, students had a clearer sense on the characteristics of students and the elementary school content. However, while they recalled the names of technologies that they had learned about in the educational technology course, participants were uncertain about how technology could be used with their new knowledge about students and K-5 curriculum. We analyzed our interview data in order to better understand how the teacher education program influences their views of appropriate technology uses.

Introductory Computer Course

In participants' section of this course, the instructor structured activities so that participants would use technology, create an authentic product (e.g., attendance sheet, PowerPoint presentation for teachers, newsletter) and then complete a reflection about how these technologies could be used in classrooms. Many participants reported that they learned how to use specific technologies and they felt like they could integrate them into an elementary school classroom.

During the first round of interviews, participants reported software uses exactly as they had been introduced; those software introduced as productivity tools (e.g., Excel and Word) were referred to as productivity tools, while student software (e.g., KidPix, *Inspiration*) were referred to as student-centered applications.

While the technology course did not address specific logistics about how to integrate technology into a classroom, after the course participants reported that they had developed technology skills as well as a sense on how students might use technology in elementary classrooms. All of them felt like they could incorporate some technology into their teaching. However, ideas about technology

integration explicitly mirrored activities from their introductory technology course.

Methods Courses

Participants began taking methods courses during the semester after their technology course. Approximately 11 months passed between the two rounds of interviews. At the time of the second round of interviews, participants were near the end of their second semester of methods courses. One participant had reported using *Geometer's Sketchpad* (Key Curriculum Press, 2002), a dynamic geometry software program that they explored during the course; the other participants were in a different section of the course and did not work with *Geometer's Sketchpad*. All participants reported that they worked with and discussed the appropriate use of calculators during their mathematics methods course.

During their language arts course, participants were required to find two interactive Web sites, which they presented to the whole class. While this activity brought technology into the methods course, there was very little connection to the integration of technology. Sandra explained, "It is mainly a summary. They showed us the site and every aspect of the site, but we didn't talk about how kids could use it." Participants reported that technology was rarely used and never modeled during the methods courses. During the interviews, participants had to be prompted repeatedly for the answers detailed here. Participants reported that technology integration was ignored in their methods courses because it was not the focus.

Field Placements

Katie compared field placements to learning a language in a foreign country. "Say you're taking Spanish and you actually went to Spain. You get so much more out of that interacting and us-

ing the language and I think it's the same with teaching."

At time of the second interview, participants reported a lot of uncertainty related to technology's role in the elementary school curriculum. Participants reported that the educational technology course provided information about technology, the methods courses provided information about content and the field experience was going to tie all of the pieces together. Lucy felt that her lack of knowledge about how to integrate technology would be fixed by spending more time in schools:

I'm thinking that I'll figure out [how to integrate technology] once I start going to more schools and start getting more experience in schools. Last semester I was only in schools one day a week for an hour, but now I'll be there 5 days a week for 8 hours a day. It will become clearer to me how to use [technology].

During their second interview, participants reported that they had seen students using technology a few times during their field placements. Participants reported that students were pulled out of the classroom to use technology in a computer laboratory environment, where each student had their own computer. Sandra observed a class playing mathematics-related games in the school's computer lab during their weekly computer time, which lasted 45 minutes. Melissa reported that her kindergarten class visited the computer lab to work on a Thanksgiving activity, where students made a turkey using a computer-assisted drawing program. Melissa also observed them using computers for educational games, "There was one computer in there and it was kind of like a center...they could go there and play games, kind of do what they wanted to."

While technology was seldom integrated into their classrooms, access to technology did not appear to be a problem. Participants reported that

there was a teacher computer as well as one to three computers in every classroom. The classroom teacher told participants that the computers were used for centers, typing and classroom projects. Since participants never observed those computers being used, it is hard to conclude whether or not the classroom teachers' statements were accurate. Regardless, at the time of second interview participants had seen very few examples of technology being integrated into the K-5 curriculum.

Participants' Looming Uncertainties

What are Appropriate Uses of Technology for Students?

The introductory computer class was the first time our participants were exposed to technology-rich, student-centered activities. Although we first interviewed our participants near the conclusion of their technology course, these interviews tended to focus on teacher-centered uses of technology. When student activities were addressed, they were usually supplemental to instruction, simple in nature, and focused on presenting information (e.g., students could make a PowerPoint presentation with lions in it if they were studying lions in school). During the second interview, participants reported a lot of doubt about the abilities of younger elementary students in using technology and what technologies would be appropriate for early elementary students. Even Elaine, who had used technology more than the other participants as a K-12 student and reported having very student-centered beliefs had her doubts during her second interview. When asked about the role of technology in her classroom, she mentioned "I want to teach 2nd grade so I don't know if ... I haven't learned what [types of technology] children are able to use."

Katie also reported uncertainty and thought that more classes would help her figure things out.

I don't know about the age and them doing that. I guess they would be like really simple PowerPoint presentations. I think it would be more of something I would use. But I think that could change. I know that I am just early on in my classes, so I don't even know what they would be capable of yet.

Clearly, there is a dependence on learning about technology from their methods courses and field experiences.

Participants claim that they will learn how to teach with technology later. All of our participants also mentioned their current inability to teach with technology during their first interview. Melissa summarized:

I think I'll be better prepared [to teach with technology] than I am right now, or when I started, but I don't think I can just bounce into a classroom and say 'okay today we are going to make PowerPoint presentations and then present them to the class.' I think I need to be a lot more comfortable myself using it before I can show them how to use it.

Not only did our participants question students' abilities to use technologies, but also their own ability to teach with them.

Participants continued to weigh heavily on their classroom observations as a place where they would learn about teaching with technology. Elaine had already experienced gaining a better understanding through observation. During her second interview Elaine mentioned, "I know that PowerPoint can be useful in any classroom 'cause when I did my observation I saw a couple classes using PowerPoint on the projectors." Other par-

ticipants made similar comments about learning through their classroom observations.

How does Technology Align with Content and Pedagogies?

Participants questioned how they would support classroom technologies and their appropriateness a lot more during the second interview. When asked about how she plans on using technology, Elaine responded, "I don't know, I don't even know really what kind of requirements there are in elementary classrooms in those subjects yet so I don't even know um where [technology] would be useful." She also mentioned concerns about having time to use technology and still prepare students for standardized tests. While participants want to use technology in their classrooms, their naïve understanding of classroom requirements and procedures inhibits their ability to plan those activities. Even after realizing that students can use computer equipment, they are uncertain about how to proceed because they lack the required content standards and teacher methods.

Lastly, two participants also questioned the importance of technology for student-purposes—though they discussed potential uses of it for student-centered purposes. Lucy best captures these sentiments stating, "technology is not vital because we haven't always had it and people have gotten along without it just fine." These participants feel that everything completed using technology can also be completed without it. She claimed that everything done in PowerPoint could also be done with markers and poster board. She also warned that teaching students to write papers on the computer "makes them feel that everything they do on the computer is finalized" because "it makes it look really good and perfect and that's not necessarily the case." Because technology

can create problems for students and teachers, a few participants concluded that it was not really necessary at all.

The Expectation of the Field Experiences

When asked how they would remedy the previously mentioned concerns and prepare to implement technology in their future teaching, all of our participants espoused that K-12 teaching experiences would provide the answers. Sandra sums up our participant's feelings when she stated, "I haven't worked with kids and technology yet. I know I'm about to start my Block 2 field experience so I'm hoping that I will get the chance to have technology to use during my teaching there."

Our participants received little exposure to technology integration during their methods courses. Katie stated that she hadn't taken any classes that mentioned how to implement technology into the classroom. Elaine mentioned that college faculty probably didn't discuss technology because they had their hands full covering other topics and teaching methods. "I guess its just one of those things where they have a job to do. They are teaching me just one aspect of [teaching] and they're probably not going to think about incorporating my other classes really." Since our participants were not hearing about technology from their education faculty they turned to their classroom teachers. During their observations they noted technology use. They learned that elementary students could use technology. Based on these observations, they also hoped that they will be able to both use technology when they student teach and understand when and how to make it appropriate for their students.

DISCUSSION

A Small Step Toward Understanding Preservice Teachers' Perceptions

The data presented here serves as a step toward better understanding preservice teachers' changing perceptions of technology and their appropriate uses in elementary school classrooms. Participants' focus on teacher-directed uses of technology support findings from prior research studies (e.g., Beyerbach et al., 2001; Mims, 2005; Wang, 2002). However, our study extended those studies by examining participants' views across time. During the second interview, all participants included considerably more recommendations for technology use that facilitated student-centered activities. It appears that over time, these participants expanded their views of the role of technology in learning. However, the lack of discussion and modeling of exemplary technology integration has caused participants some uncertainty about the appropriateness, value, and logistics of integrating technology into elementary schools.

Preservice Teachers Need More Support Regarding Integration

Despite having an expanded view of appropriate student technology uses, their views are not consistent with the ISTE's (2002a, 2002b) vision of technology as a tool to support problem solving, communication, and higher-order thinking skills. Participants reported numerous options for teacher and student uses of technology. However, these uses focused on teacher productivity and the presentation of material rather than on higher order cognitive processes. Our findings support the findings of NCES's (1999) survey that teachers do not feel comfortable incorporating technology in their classrooms. Each participant reported a desire and a need to see more models

and uses of technology integration during their field experiences.

The Role of the Technology Course, the Methods Courses, and the Field Experiences

Participants noted that teacher education faculty failed to model effective technology use within their own course; this is not a surprise (Moursund, et al., 1999). Based on participants' perceptions that the technology course teaches about technology, the methods course teaches about content and the field experience ties the pieces together, field experiences are essential for supporting preservice teachers' technology integration development. However, this reliance that the field experiences will provide all the answers is problematic. Prior research (Becker, 2001; NCES, 1999) has shown that field experiences typically do not adequately prepare preservice teachers to learn how to integrate technology effectively.

Two Different Monsters: Technology Skills and Technology Integration

Based on our findings it is clear that preservice teachers require exposure to technology throughout their program experiences. Educational technology courses are skills-based and tools-focused experiences; preservice teachers need to have adequate skills using technology if they are going to integrate them effectively (Ertmer, 1999). However, preservice teachers need to have those skills and technology integration skills developed throughout the remainder of their teacher education program. In the current study, participants seemed certain that software that they used during the educational technology course would be appropriate for K-5 students. However, nearly a year later, after two semesters of methods courses, participants expressed doubt since they had seen

very little connection between the technology they had learned about and the curriculum they were preparing to teach. While the development of preservice teachers' technology skills is critical to integration, the alignment between technology and the K-5 curriculum is even more so.

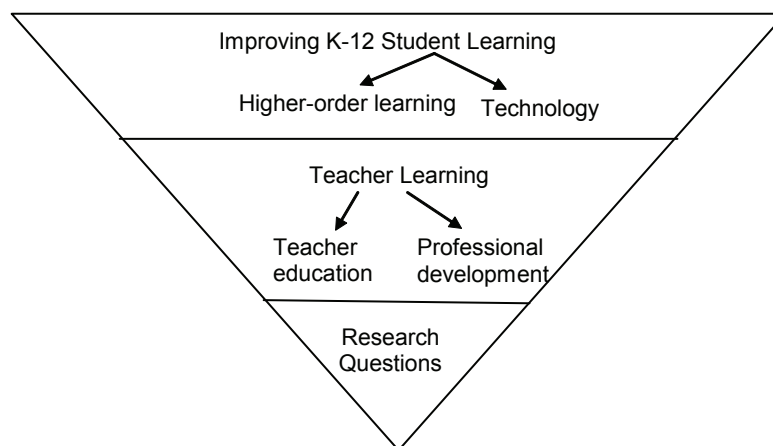
One possible solution is the incorporation of instructional design models during the educational technology courses, methods courses, and field experiences. Various instructional design models for K-12 education exist (e.g., Heinich, Molenda, Russell, & Smaldino, 2002; Morrison & Lowther, 2005). During the educational technology course, preservice teachers should be charged with designing technology-rich instruction. Later, during their methods courses, preservice teachers should design instruction that integrates technology into specific content areas that they are learning about. Likewise, field experiences should require the design and implementation of technology-rich student-centered instruction. This approach will increase the likelihood that preservice teachers can effectively plan and teach technology-rich lessons that are likely to impact student learning.

FUTURE TRENDS: IMPLICATIONS FOR RESEARCH

Longitudinal Studies about Preservice Teachers' Beliefs

This study provided a look at preservice teachers' views of appropriate technology use during the beginning of their teacher education program. Future studies should continue to build on this work by examining preservice teachers' views through graduation and into the induction years of their teaching career. While various models (e.g., Hooper & Rieber, 1995; Sandholtz et al., 1997) propose stages of teachers' technology use, the empirical research behind these models is elusive. Longitudinal research that examines preservice teachers' views from the beginning of their teacher education program through their first few years as a full-time teacher would provide empirical data about participants' beliefs related to technology integration over time.

Figure 3. Researching the influence of teacher education programs



Studying Components of Teacher Education Programs

As previously indicated, preservice teachers are introduced to technology integration through an educational technology course, methods courses, and their field experiences. Future studies should examine all three of these program components and the influence that each of these has on preservice teachers' beliefs and instructional practices. The present study attempted to move in that direction by asking participants to discuss their various experiences. However, more data sources such as class syllabi, field notes from courses and field experiences, and faculty interviews are needed to provide a more holistic picture of the programs' influences on preservice teachers. By evaluating the various components of teacher education programs, researchers can identify the experiences that have the greatest influence on preservice teachers' beliefs about technology integration. Those influential experiences can be optimized, while those experiences that are not influential can be revised and modified to better meet preservice teachers' needs.

Examining Preservice Teachers' Beliefs and Practice

While examinations of preservice teachers' beliefs provide valuable insight into their perceptions about technology integration, numerous studies (Buck Institute for Education, 2002; Mullens, 1998) cite discrepancies between teachers' beliefs and their instructional practices. Data related to teachers' beliefs should be triangulated with *in situ* data about participants' instructional practices. These data sources may include observation data (e.g., videos, field notes) or lesson artifacts. Research studies that examine these multiple types of data have the potential to substantially contribute to our understanding of the relationship

between teachers' beliefs and practices (Fennema et al., 1996).

Making Links between Preservice Teachers' Beliefs, Practices, and Student Learning

The primary goal of teacher education programs is to prepare preservice teachers to improve student learning. Therefore, it is necessary for research agendas to make links between data related to preservice teachers' beliefs about technology, technology-rich lessons, and related student-learning outcomes. Figure 3 diagrams how prior research related to technology's impact on student learning (Schacter, 1999) and prior research related to teacher education programs can help link teacher education programs to preservice teachers' beliefs, their practices, and related student learning measures. Such studies should use multiple data sources, including self-reported data sources (survey and interview data) and more objective measures such as classroom observations and the analysis of videos and artifacts.

CONCLUSION

There is a critical need for teachers to integrate technology in ways likely to support student learning. While teacher education programs introduce preservice teachers to technology, they often exit the program with the ability to use technology, but not necessarily the ability to effectively teach with it. The data presented here serves as a small step to better understanding preservice teacher's perceptions of appropriate uses of technology during their teacher education program. Lastly, if we are to advance the body of knowledge related to technology-related preservice experiences, multiple data sources must be collected to examine multiple outcome levels.

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KEY TERMS

International Society for Technology in Education (ISTE): National organization that has published instructional standards related to the appropriate use of technology in K-12 schools. Available URL: <http://www.iste.org>.

National Educational Technology Standards for Students (NETS-S): National standards published by ISTE that describe performance-based skills that students should be expected to demonstrate. Available URL: <http://www.iste.org>

Preservice Teacher: An individual who is currently enrolled in a teacher education program that provides initial certification.

Productivity Tool: Software or technology that a teacher uses to complete a job. Examples include software such as Microsoft Word or Microsoft Excel that could be used to create a grade book, attendance sheet, seating chart, or newsletter.

Technology Integration: The use of technology in an instructional setting to support the learning of content (e.g., mathematics, science, language arts, history).