Increasing Preservice Teachers' Capacity for Technology Integration through the Use of Electronic Models

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According to the most recent report of the National Center for Education Statistics (NCES, 2000), nearly 70 percent of teachers report not feeling well prepared to use computers and the Internet in their teaching. The 1998 Technology in Education Report (Market Data Retrieval) noted that only 7 percent of schools, nationwide, boast a majority of teachers at an advanced skill level (i.e., able to integrate technology into the curriculum).

Even among our newest teachers, instructional use is not as high as might be expected. Contrary to popular belief, preservice and beginning teachers do not use computers significantly more than their more experienced colleagues (Hadley & Sheingold, 1993; NCES, 2000; Sherwood, 1993). Although beginning teachers report *wanting* to use computers, and have gained adequate technical skills, they typically lack knowledge about how to integrate computers within the more routine tasks of teaching and managing their classrooms (Hruskocy, 1999; Novak & Knowles, 1991).

Skills vs. Ideas

Clearly, the growing increase in teachers' technical skills is insufficient to guarantee the effective use of technology in the classroom (Carvin, 1999; Marcinkiewicz, 1994). In order to translate skills into practice, teachers need specific ideas about how to use these skills to achieve meaningful learning outcomes under normal classroom conditions. Traditionally, inservice technology training programs have been software- rather than curriculum-based (Gilmore, 1995). Thus, teachers completed technology courses still not knowing how to create or implement small- or whole-group activities that incorporated meaningful uses of technology (Moersch, 1995). Unfortunately, this also has been true for most teacher education technology courses (Moursund & Bielefeldt, 1999; Yildirim, 2000). Although the majority of teacher preparation programs now require that students take three or more credit hours of technology instruction, recent survey data suggested that most teacher education faculty still do not feel that technology use is being effectively modeled for our future teachers (Schrum, 1999).

Simply stated, few of our current or future teachers have either observed or experienced learning with or from computers (Carlson & Gooden, 1999). While today's teachers are expected to leverage the full potential of powerful conceptual technology tools to meet the changing needs of their students, they have been given few, if any, opportunities to develop their own visions for, or ideas about, meaningful technology use.

The importance of developing a vision for technology use cannot be overstated (Ertmer, 1999). As noted by the Office of Educational Research and Improvement (1993): "Most teachers will find little incentive to tackle the technical and scheduling problems associated with technology unless they have a clear vision of how the technology can improve teaching and learning" (p. 83). Once a clear vision is in place, specific tools and strategies are needed to help teachers address the many unique challenges posed by the translation/integration process: changing roles of teachers, students, and technology; classroom organization, management, and security issues; and assessment methods, among others. As Dexter, Anderson, and Becker (1999) explained, "For teachers to implement any new instructional strategy, they must acquire new knowledge about it and then weave this together with the demands of the curriculum, classroom management, and existing instructional skills" (p. 223). Teachers need information about *how*, as well as *why*, to use technology in meaningful ways. Lack of knowledge regarding either element can significantly decrease the potential impact that these powerful resources might have on student learning.

Self-Efficacy Beliefs

Yet even the best ideas about technology use will remain unused unless teachers believe that they are capable of implementing them in the classroom. In particular, teachers' beliefs about their *ability to use computers* in instruction may be key, given the role self-efficacy is proposed to play in determining behavior. According to Eachus and Cassidy (1999), "self-efficacy has repeatedly been reported as a major factor in understanding the frequency and success with which individuals use computers" (p. 2).

Self-efficacy refers to personal beliefs about one's capability to learn or perform actions at designated levels (Bandura, 1997). According to Bandura, self-efficacy is based, not solely on the level of skill possessed by an individual, but on judgments about what can be done with current skills. That is, self-efficacy comprises beliefs about what one is *capable* of doing, not about whether one *knows* what to do. As such, self-efficacy is thought to mediate the relationship between skill and action. Therefore, without knowledge or skill, performance isn't possible; yet without self-efficacy, performance may not be attempted. According to Bandura, "beliefs of personal efficacy constitute the key factor of human agency" (p. 3). Thus, teachers who have high levels of efficacy regarding teaching with technology are more likely to participate more eagerly, expend more effort, and persist longer on technology-related tasks than teachers who have low levels of efficacy.

If self-efficacy beliefs are key to performance and increased self-efficacy can lead to increased performance (Christoph, Schoenfeld Jr., & Tansky, 1999; Schunk, 1981), how can we help teachers increase their efficacy for technology use? Researchers in the area of self-efficacy (Bandura, 1997; Schunk, 2000) describe four primary sources of information that can influence judgments of efficacy: personal mastery (successful task completion), vicarious experiences (observing models), social persuasion ("I know you can do this!"), and physiological indicators (emotional arousal, relaxation).

Next to personal mastery, vicarious experience is thought to provide the most valid information for assessing efficacy (Schunk, 2000). According to Olivier and Shapiro (1993): "Vicarious experiences with the computer increase one's feelings of control and confidence. These encounters also make an individual want to learn more about the technology, thus reducing and eventually eliminating the fear of the unknown factor. As the fear and anxiety diminish and positive experiences add up, self-efficacy and the willingness to cope with mastering the task will increase" (p. 83). Given the logistical difficulties involved in providing preservice teachers with enactive experiences related to successful technology integration, teacher educators have turned to modeling as a feasible, yet powerful method for increasing teachers' ideas about and self-efficacy for technology integration (Schrum, 1999). Not only can models provide information about *how* to enact meaningful technology use, but they can increase observers' confidence for generating the same behaviors. Furthermore, providing access to multiple models increases both the amount of information available about how to accomplish the performance and the probability that observers will perceive themselves as similar to at least one of the models (Schunk, 2000), thus increasing their confidence for also performing successfully.

Electronic Models

Still, the use of models does not guarantee either learning or later performance. Many factors have been shown to influence observers' responses to models, including the prestige and competence of the models, consequences experienced by the models, perceived similarity of the models to the learners, as well as learners' own self-efficacy in regard to performing the behaviors (Schunk, 2000). In addition, research has yet to establish whether models, presented electronically, can be used to achieve results similar to those achieved with live models. Will learners perceive themselves as similar to models that are presented electronically? Will they regard the models as both realistic and relevant? Given the increasing potential to present models of exemplary technology use via multimedia technologies, it is important to determine the extent to which pre- and inservice teachers can benefit from observing these types of electronic models.

Purpose

This study was designed to examine the effects of electronic models on preservice teachers' perceived ideas about and self-efficacy regarding technology integration. Specifically, exemplary technology-using teachers were presented via a CD-ROM teacher development tool, called VisionQuest. VisionQuest features the classroom practices of six k-12 teachers and is designed to support users' reflections on both the underlying beliefs and classroom strategies that enable exemplary technology use. Given the few opportunities preservice teachers have to observe exemplary technology use in actual classrooms during student teaching or observation sessions (Carlson & Gooden, 1999; Vannatta & Reinhart, 1999), VisionQuest was developed to provide these opportunities. Specifically, the research questions guiding data collection and analysis included:

- ◆ What effect does observing exemplary technology-using teachers, presented electronically, have on preservice teachers' perceptions of ideas about technology integration?
- ◆ What effect does observing electronic exemplary technology-using teachers, presented electronically, have on preservice teachers' perceptions of self-efficacy regarding technology integration?
- ◆ What are students' perceptions of the use of electronic models for learning about technology integration?

Methods

Overview

A pretest-posttest research design was used to examine increases in preservice teachers' ideas about and self-efficacy regarding technology integration following two 50-minute class sessions in which students used VisionQuest, a CD-ROM teacher development tool designed to present exemplary models of classroom technology use. Participants' perceptions of their learning experiences were collected via classroom observations and interviews with a sample of 10 purposefully selected students. Both quantitative (paired t-tests) and qualitative (pattern seeking) analysis methods were used to examine the extent to which electronic models offered a viable method for increasing preservice teachers' capacity for technology integration.

Role of Researchers

The research team consisted of a faculty member and five students enrolled in an advanced educational technology research course at a large Midwestern university. Students had varied background experiences, in both k-12 and post-secondary classrooms, and were seeking masters (n=1) or doctoral degrees (n=4) in educational technology. The team worked collaboratively to design the study and develop appropriate data collection instruments. Each researcher collected survey, interview, and observation data from students in one of the six course sections participating in the study. Survey data were combined and analyzed by the team; interview and observation data were used primarily to triangulate quantitative results.

Description of Site and Participants

Of the 103 students enrolled in six sections of an undergraduate educational technology course, 69 students signed a consent form and completed all three data collection measures needed for the study. Classroom Applications of Educational Technology is a one-credit optional course focused on the *application* of skills learned in the required 2-credit introductory (skills-based) course. This optional course is designed to meet the needs of students who either require an extra technology-related credit-hour or simply wish to learn more about how to use their new skills in the classroom. Participants ranged in age from 18-34 years, with a mean of 20 years. The majority of the students were female (65%), sophomores or juniors (71%), and majoring in Elementary Education (60%). Eighty-seven percent of the participants had computers at home and, at the time of the study (week 10 in the semester), indicated that they used computers primarily for word processing (98%), electronic mail (99%), and browsing the Internet (98%). When asked to rate current levels of computer skills, from novice to advanced, 75% of the students rated their skills at an intermediate level while 9% rated themselves as beginners; 16% rated themselves as advanced. None of the students rated themselves as novice users.

Description of VisionQuest

As an instructional tool, VisionQuest (VQ) is designed to provide opportunities for users to explore models of effective technology integration. Users examine the steps that three sets of teachers have taken to achieve their current levels of technology use. Cases include a high school team of three biology teachers, a middle school music teacher, and an elementary team of two second-grade teachers at a science and technology magnet school. Users examine how teachers' pedagogical visions of classroom practice have shaped their integration journeys, including how they got started, the roadblocks and challenges they faced, as well as the incentives that moved them forward (highlighted by the components on the Roadmap Island of Figure 1). The cases illustrate that technology integration can be successfully achieved in a variety of contexts despite differences in settings, resources, and student backgrounds. Users examine, both within- and across-cases, the relationships among teachers' beliefs (related to classroom organization; the role of the teacher, students, and technology; curricular emphases; and assessment practices) and current classroom practices related to technology (illustrated by the components on the Path and Destination Islands of Figure 1).

VisionQuest induces user reflection through the use of video segments, augmented by electronic artifacts (lesson plans, student products) from teachers' classrooms. Cases are constructed such that users can explore teachers' classrooms

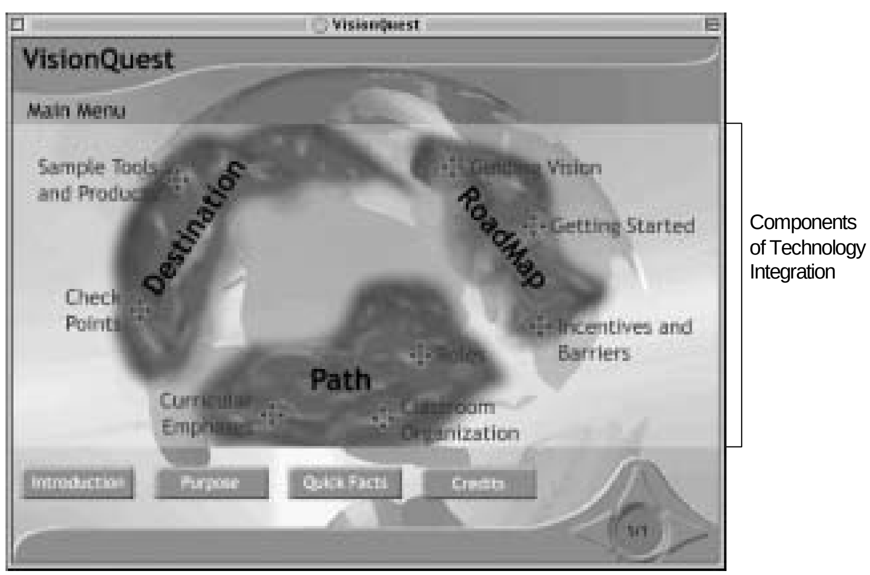

Figure 1. Screen shot from main menu depicting 8 components of technology integration. A background globe emphasizes the metaphor of a technology integration "journey."

either one at a time (case by case) or thematically (i.e., comparing components of technology integration across cases). Each case contains a variety of elements that combine to illustrate how teachers' visions for technology use are translated into practice (see Figure 2). Users examine how teachers planned for integration, how they currently implement technology within their classrooms, and how they assess the impact of their efforts.

At the time of the study, VisionQuest was in beta format. Although navigational features were still somewhat rudimentary, "workarounds" were built in so that students could effectively use the software to complete the tasks assigned.

Procedures

Demographic information was collected from the participants during the first class session of the semester. During weeks 10 and 11, as part of their normal class activities, all students worked with VisionQuest, completing two different tasks. During the tenth week, students evaluated VisionQuest as an example of professional development software, using an evaluation form provided by the instructor. During this week, questions were specifically directed toward software quality (e.g., directions for use, navigation, video quality) and not software content. Although the majority of these data are not relevant to this study, two questions provided information about students' perceptions of the VQ models and will be discussed later. Students focused on content the following week, when they used VisionQuest to examine, individually, the beliefs and classroom practices of the teachers included on the CD-ROM. Responding to a set of guiding questions

Figure 2. Screen shot from a content page of VisionQuest.

provided by the instructor, students described (on paper) how the different teachers prepared their classrooms for technology use, how they used various grouping strategies to manage their rooms, how they managed classroom "chaos," and so on. In response to a final question, students listed the components of classroom organization that the three groups of teachers had considered prior to implementing technology in their classrooms.

Data Collection

At the beginning of the tenth class session, prior to evaluating VQ, students completed an online survey designed to collect three types of information. First, information was collected regarding students' computer ownership, current use, and perceptions of skills and comfort using computers (e.g., "I enjoy working with computers." "When using computers, I can deal with most difficulties I encounter."). Eight items comprised this initial section. The second section included seven items regarding students' *ideas* for technology use (see Figure 3). Items were presented in a Likert-style format; students were asked to rate their level of agreement (from 1-strongly disagree to 5-strongly agree) with statements related to the possession of specific ideas regarding technology use. The third section used the same seven items as the second section but with an emphasis on the possession of *confidence* rather than ideas (e.g., "I am confident I can use one computer effectively during large group instruction." "I am confident I can use technology effectively to teach content."). Students used the same rating scale (from 1-strongly disagree to 5-strongly agree) to record their levels of confidence. Students' responses to the online surveys, prior to using VQ, comprised pretest measures of students' perceived ideas about and self-efficacy regarding technology integration.

At the end of the eleventh class session, after students had explored the ideas presented by the models on VQ regarding classroom management strategies, they completed the second and third parts of the online survey again. These measurements served as posttest indices of students' perceived ideas about and self-efficacy regarding technology integration. In addition, four items were included to explore students' perceptions of using VQ as a modeling tool (e.g., "I can relate to the examples of teachers shown in VQ." "I can relate to the examples of technology shown in VQ.").

During both class sessions in which students interacted with VQ, one or two researchers were in attendance, making observations of students' engagement with the software. Observations provided evidence of the holding quality of the software and also provided useful information for the selection of interviewees. Students (one or two per section) were purposefully selected for interviews by the observing researcher based on noted levels of interest, with an attempt to choose one highly- and one less-engaged student from each section. Each researcher conducted one or two interviews, each lasting from 15-20 minutes. Using a structured protocol, interviews focused on identifying specific ideas (about classroom organization, assessment practices, etc.) that students gained from VisionQuest and the extent to which they thought they would use these ideas in their classrooms. We were particularly interested in knowing whether students regarded the VQ models as real and whether they believed that they had learned from them, just as they might learn from live models. Interviews were audiotaped and transcribed by the interviewer.

Data Analysis

Demographic data were tallied and percentages calculated to identify general characteristics of participants. Changes in students' perceptions of their ideas about and self-efficacy regarding technology integration were determined using paired t-

Figure 3. Screen shot from online survey: "Ideas about Technology Integration Survey."

tests. Pearson correlations were calculated to determine relationships among ideas and confidence (pre and post) and specific demographic characteristics.

Interview transcripts were analyzed using a simple pattern-seeking method to determine students' impressions of the software and the impact it may have had on their ideas and confidence. Analysis efforts focused on comments that either supported or conflicted with quantitative findings in order to validate, extend, or modify initial results. In addition we examined students' perceptions of using electronic models to determine whether this type of modeling tool might present a reasonable alternative to observing live models.

Issues of Validity and Reliability

Reliability was increased through the use of consistent data collection methods. Students in all six sections of the course completed the same online surveys—data were electronically transferred to an Excel spreadsheet, thereby eliminating possible error in entering or organizing the data. Each researcher followed the same procedures while introducing the study, conducting observations, and interviewing participants. In addition, weekly online and in-class discussions among the researchers increased the consistency of research methods used.

Cronbach's alpha was used to measure the internal consistency of the survey instruments. Calculated Cronbach's alphas were .80 on the Ideas survey and .89 on the Self-Efficacy survey, suggesting that the instruments were moderately reliable. Despite the fact that the same measures were used for both pre- and post-assessments, the possibility of experiencing a testing effect is minimal. According to Bandura (2001), previous tests for reactive effects have demonstrated that self-efficacy does not increase as a mere function of assessing one's efficacy: "If merely recording a level of efficacy made it so, personal change would be trivially easy" (p. 6).

Survey measures were evaluated by an expert in the area of self-efficacy and modified based on his suggestions, providing the instruments with a certain amount of face validity. To further increase validity, multiple data sources were used to triangulate findings. For example, observations provided a rough measure of students' levels of engagement, interview comments verified their excitement about the software, and survey measures indicated that students found the VQ examples relevant. Together, these data provide strong evidence of students' engagement in and identification with the models provided on VQ and as such, helped us answer our third research question.

Results

Changing Ideas and Efficacy for Technology Integration

A two-tailed paired t-test ($df = 68$) indicated a significant increase in students' ratings of perceived ideas about technology integration ($t = 8.85$; $p < .0000$) from pre- to post survey. Students' judgments of their ideas for technology integration increased from a pretest mean of 3.72 (*SD* = .44) to a posttest mean of 4.12 (*SD* = .40). A two-tailed paired t-test (*df* = 68) also indicated a significant increase in students' ratings of perceived self-efficacy regarding technology integration ($t = 3.46$; $p < .000$) from pre to post survey. Students' judgments of confidence increased from a pretest mean of 3.84 (*SD* = .52) to a posttest mean of 4.05 (*SD* = .47).

Since it is fairly easy to achieve high correlation coefficients with larger samples, significance levels were set relatively high in order to discount high coefficients that were not meaningful. That is, we did not consider coefficients to be significant unless the probability of occurrence was less than $p = .0005$. Thus, based on a critical r value (*df* = 66) of .35, correlations among demographic characteristics and pre- and post- ideas and self-efficacy indicated no significant relationships among age, gender, or year in school (freshman, sophomore, etc.) and ratings of computer skills, ideas, or self-efficacy (see Table 1). Although one might expect advanced college students (e.g., juniors and seniors) to have more skills, ideas, or confidence, this was not the case in this study. Furthermore, there were no significant relationships between gender and any variables examined in this study.

Significant correlations were found between students' perceptions of their ideas for technology integration before and after using VisionQuest ($r = .61$); similarly students' perceptions of self-efficacy regarding technology integration ($r = .50$) were significantly correlated before and after using VisionQuest. Additionally, perceptions of ideas and perceptions of confidence were significantly corre-

Table 1. Correlation Coefficients among Selected Demographic Variables and Pre/Post Measures of Ideas and Self-Efficacy

	Age	Class	Gender	Computer Skills	Pre Ideas	Post Ideas	Pre SE	Post SE
Age								
Class	.73							
Gender	.18	.14						
Computer Skills	-.15	-.13	-.02					
Pre Ideas	-.09	-.09	-.12	.34				
Post Ideas	-.19	-.14	-.09	.28	.61*			
Pre SE	.05	.02	-.10	.18	.72*	.52*		
Post SE	-.14	-.09	-.12	.26	.48*	.84*	.50*	1.00

* p < .0005
Note: SE = self-efficacy

lated. Students who began with greater perceptions of ideas also tended to have higher levels of confidence ($r = .72$). This relationship was even stronger at the time of the posttest ($r = .84$). The coefficient of determination (r-squared = .71) suggests that 71% of the variance in students' confidence ratings could be explained by students' perceptions of their ideas for technology integration. In other words, the more ideas students have about technology integration, the stronger their belief that they can be successful integrating technology into the classroom. As ideas increase, so, too, does confidence for implementing the ideas.

Interestingly, judgments of computer competency (skills) were not highly correlated with either ideas or confidence for technology integration. This supports earlier research findings (Moursund & Bielefeldt, 1999; Yildirim, 2000) that suggest that simple skill training is insufficient to prepare students to use technology in the classroom. Although judgments of computer skills were moderately correlated with students' ideas for using technology prior to VQ ($r = .34$; $p < .001$), this relationship was not significant after using VQ ($r = .28$; $p > .001$). Furthermore, skill competency did not seem to translate into confidence for achieving integration either pre or post VQ ($r = .18$ and .26 respectively). Just because students know how to use word-processing, email, and the Internet, does not mean that they know how to use these skills within classroom instruction or that they are confident trying to do so.

Perceptions of Using Electronic Models

Interviews with 10 students, as well as data obtained through four post-survey items and two software evaluation questions, were used to answer our research question regarding students' perceptions of using electronic models to learn about technology integration. Interviewees were representative of the students enrolled in the class; interviewees included both male and female students who ranged in age from 18-34 years, in skill levels from beginner to advanced, and in confidence levels from "somewhat" to "very" confident.

Two questions on the software evaluation form asked students to rate the relevance of the activities and models observed on VQ. On a scale from 1 (strongly disagree) to 5 (strongly agree), students agreed or strongly agreed that "activities regarding the use of technology were realistic" (mean = 4.46) and that "the video cases of teacher interviews and class activities were relevant" (mean = 4.31). Four similar questions included on the post survey averaged a 3.96 rating, indicating that students' perceived the VQ models to be both realistic and relevant.

Although students had suggestions for improving the software (particularly in terms of navigation, which was unfinished at the time), interview comments were overwhelmingly positive, even from the less-engaged students. Students viewed the models as realistic, indicating that they felt as though they were in the classrooms with the teachers. Students described the "life-like" quality of the videos and how they felt that the teachers were talking directly to them (S: I felt like they were talking to me as a teacher and not as a student). As an example, one student stated:

> I liked it. I liked how I got involved when it showed you (the clips) and you felt like you were right there in the classroom with the students watching them. It's like you're in a movie theater almost because they have such good (videos)... and it shows the students and it shows the teachers—and you feel like you're right there in it.

Because our survey instruments did not provide information about the specific ideas that students may have gained using VQ, we asked students to describe these ideas in our interviews. Students indicated that, by observing the classroom examples on VisionQuest, they had gained ideas about "using stations," "assessment," "group work," "using different activities to teach the same content," "integrating computer research into a music classroom," "using technology to work with different levels of students-special ed and those who excel," "using HyperStudio in a music class," and "establishing a good climate in the class." Students made many comments about how VQ allowed them to see how things were done in a classroom. Three representative comments follow:

> I think actually seeing the teachers in the video clips and how the students are actually using it and how the teachers are using it and incorporating it in their lessons—I think was really good for me. I had ideas going into VisionQuest of how I could use technology in my classroom but actually seeing teachers using it gave me some new ideas of, 'Oh, I didn't think of using it like that.'

> Seeing the teachers use technology helped me to understand how it's done...it's one thing to hear someone talk about different methods, but seeing the classes actually use the technology—that really made me think of how I could do it next year.

> I liked the examples and the students' points of view. They had a lot of good ideas about what they were doing. It's a good way to teach us about what you can do with computers. And we used a computer. This was a good way for us to see what goes on in a classroom. I could see doing things like they did.

Students agreed that it was beneficial to *hear* the teachers in addition to seeing them. Exploring teachers' beliefs helped students understand why teachers made the decisions that they did, and provided cognitive modeling of the integration task. For example, one student noted:

> I think it's really neat how you have the different clips in there, the different classrooms; and you have the students' opinions and the teachers' opinions. It's got their different beliefs and teachers can take that and maybe it will change their philosophy and they can interpret new things into their classroom. I think it's a very good program and it's got a lot of potential.

Another student commented:

> I liked it. I thought it was pretty cool the way you could see what they were doing in all those schools. The interviews were really good because you get a chance to see what they think about their own classrooms and they talk about what they want to do. You could click on the materials or the interviews.

Based on these results it appears as though students both enjoyed and benefited from observing the electronic models provided on VisionQuest. Interview comments suggest that preservice teachers perceived that the use of electronic models was a positive approach that provided "life-like" learning experiences. Neither the highly-engaged nor less-engaged students made any comments to suggest that they found it difficult to identify with the models presented via CD-ROM technology.

Discussion

This study examined preservice teachers' perceived ideas about and self-efficacy regarding technology integration before and after observing electronic models of exemplary technology-using teachers. Sixty-nine students, enrolled in a one-credit technology course, completed online demographic and survey instruments and then used a CD-ROM electronic modeling tool during the tenth and eleventh weeks of the semester. To measure changes in students' perceived ideas and self-efficacy, the online surveys were completed again at the end of the second session.

The results of this study support our hypotheses that electronic models can be used to increase preservice teachers' ideas about and self-efficacy for technology integration. Even though students used VisionQuest for a relatively short period of time over the course of two class sessions (approximately 90 minutes total) and were unable to explore the entire content of the CD-ROM, students showed significant increases in both their perceived ideas about and self-efficacy regarding technology integration. Interview and software evaluation comments indicated that students found the models to be both realistic and relevant. Students described a number of specific ideas that they gained from the models and furthermore, described their intent to apply these ideas within their future classrooms.

The 69 students who participated in this study were not novice computer users; in fact, the majority of our participants (n=63) rated themselves as either intermediate or advanced computer users. In addition, initial ratings of perceived ideas about and self-efficacy regarding technology integration were not exceptionally low (x=3.72 and 3.84, respectively). Still, ratings of perceived ideas and self-efficacy increased significantly from pre- to post- VisionQuest, suggesting that students were able to gain additional ideas and confidence by observing the models on the CD-ROM.

Students' pre- and post- ratings of their ideas and confidence were not significantly correlated with their judgments of skill levels, suggesting that computer skill competency does not translate directly into ideas or confidence for classroom technology use. In fact, students' perceptions of the direct usefulness of their skills may have decreased after seeing how the teachers on VisionQuest were not dependent on high skill levels, although this conjecture requires further examination. However, there were significant correlations between students' perceived ideas and confidence, especially at the time of the posttest (r=.84), suggesting that as students see new ways to use technology and develop new ideas about technology integration, they develop higher levels of confidence about their ability to use technology in a variety of ways.

Based on the correlations obtained, providing preservice teachers with specific integration ideas (e.g., how to organize a classroom that uses technology, how to assess student technology products) via electronic observations of technology-using teachers is likely to be more effective than skills training for increasing their self-efficacy regarding technology integration. Furthermore, by increasing future teachers' self-efficacy, we increase the probability that these behaviors will be implemented in their future classrooms. According to Olivier and Shapiro (1993), "Self-efficacy has been shown to be an excellent predictor of behavior. Individuals with a low sense of self-efficacy will, more often than not, shy away from the best alternative, and, instead, choose an alternative that they believe they can handle" (p. 84). Even when practicum and student teachers possess "positive dispositions towards computer use," they often lack confidence in their ability to teach successfully with computers (Albion, 1999). This lack of confidence for teaching with computers has been shown to influence the levels of computer use by student and beginning teachers (Albion, 1996; Handler, 1993).

The lack of significant correlations among age, class, gender, and skills, on the one hand, and pre- and post-measurements of ideas and self-efficacy, on the other hand (see Table 1), suggests that all of the students in this study were able to gain ideas and confidence through their interactions with the electronic models. That is, no one group of student was more or less likely to have more ideas or confidence for technology integration. Previous research has suggested that using a variety of models increases the possibility that students will find at least one model they can identify with (Schunk, 2000) and also provides additional information about specific approaches and strategies that teachers have used to achieve integration.

Educational Implications

The results of this study suggest that preservice teachers can benefit from observing teacher models presented via multimedia case examples, such as those featured on VisionQuest. Whether delivered via the Web or CD-ROM, multimedia models are becoming more readily available for use by teacher educators. These types of examples can be incorporated into an educational environment for self-paced exploration, as a small group reflection tool, or as an instructor-led activity. From an instructor's perspective, electronic models can have a positive impact on the authentic nature of a course and simultaneously increase the confidence and integration beliefs of students. This type of modeling can help preservice teachers develop a vision for what technology integration looks like in real classrooms as well as strategies for implementing those visions.

Limitations and Suggestions for Future Study

The primary limitation of this study relates to our inability to isolate specific cause and effect variables. Because VQ was part of the course curriculum for the students who participated, and was scheduled to be used at a specific time in the semester, we were unable to create a control group for this study. However, future efforts will include use of a cross-over design, that is, one that would introduce VQ to a control group at a later time in the semester. This would allow for a more systematic look at the effect of VQ on students' perceived ideas and efficacy.

Participants in this study were fairly homogeneous; generalization to groups differing in age, gender, ethnicity, or levels of computer competency may not be appropriate. As an example, it is unclear whether the use of exemplary models will be equally effective with novice users who are likely to begin their explorations of the CD-ROM with much lower levels of ideas and self-efficacy. There is some evidence to suggest (Snoeyink & Ertmer, 2002) that teachers need at least a very basic skill and confidence level before they can benefit from observing exemplary others. Because our study did not include participants who rated themselves as novice users, we were unable to answer this question.

An additional limitation of this study relates to our inability to determine if students' perceptions of having many ideas for technology integration actually translate into classroom application, as hoped. Although student worksheets and interview comments suggest that students gained new ideas, additional work is needed to determine the extent to which these students are able to carry out these ideas when they actually assume leadership of their own classrooms. Still, according to social learning theory (Bandura, 1997), building self-efficacy is an important first step toward developing the capacity to perform a particular skill. Without a sufficient level of self-efficacy in regard to performing computer tasks, technology integration may not even be attempted (Olivier & Shapiro, 1993). Models can serve informational and motivational functions for observers (Schunk, 2000), yet further research is needed to verify the long-range benefits of increasing self-efficacy through the use of electronic models.

Conclusion

Teachers today face a number of challenges as they begin integrating technology into their classrooms, not the least of which include a lack of specific ideas about how to organize and manage integrated classrooms, uncertainty about how to implement new roles within current classroom routines, as well as a lack of confidence for implementing these new types of ideas and roles. Even as our teachers are gaining more computer skills, they continue to report feeling unprepared to use technology in the classroom (NCES, 2000). As educators begin to realize that skill training is not enough to prepare teachers to integrate technology within the curriculum, their attention must turn to helping both pre- and inservice teachers gain specific ideas and confidence for technology integration. How then, can this be accomplished in the most effective and efficient way?

Although self-efficacy theory suggests that personal successful experience with technology in the classroom is the most powerful means for building teachers' self-efficacy (Bandura, 1997), this is almost impossible to achieve in practice. Simply trying to arrange field *observations* of exemplary technology-using teachers is fraught with difficulty. Even if we were able to find sufficient numbers of exemplary technology-using teachers who were willing to allow visitors in their classrooms, handling the logistics related to scheduling classes, transporting students, and arranging appropriate times to visit would be a nightmare. The use of multimedia materials that incorporate examples of effective classroom use of technology helps eliminate these logistical concerns. Data from this study suggest that providing preservice teachers with opportunities to interact with exemplary technology users, through electronic models, is a viable means for increasing capacity (ideas and self-efficacy) for technology integration.

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