PROMOTING CLASSROOM TECHNOLOGY USE

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The purpose of this study was to test two hypotheses: (1) that participation in a course providing theory and practice in the classroom use of technology promotes its use and results in gained competence in technology use; and (2) that functional relations exist among the availability of technology in the classroom, technology utilization, and competence in technology use. Fifty-five graduate students participated in a course in the classroom use of technology tools. Statistically significant differences emerged between pretests and posttests on technology use, pointing to the effectiveness of the interventions. Further, as hypothesized, competence in the use of technology in the classroom proved to be a direct function of the degree of technology utilization.

The No Child Left Behind (NCLB) legislation requires that technology be integrated into instruction to promote learning. Over 40 states have technology standards for K-12 students ("State Data Tables," 2003). However, teachers who have been in the field for more than 10 years often do not have the expertise to use technology with their students. Their education coursework may not have included technology training, and they may not have obtained the necessary technology skills on their own. Further, many schools have been lax in offering their faculty members technology training with appropriate follow-up and support. Teachers who have received technology training often report that it has consisted of a single session with no follow-up or support.

There is wide variability in training to enable teachers to use technology tools in their classrooms. Many states mandate technology standards for teachers, but only 11 states require teacher candidates to pass a test ("State Data Tables," 2003). Some states require that teacher candidates take an educational technology course, whereas other states do not have this requirement for teacher certification. Researchers report that teacher-training programs generally fail to provide future teachers with the experiences necessary to prepare them to effectively use technology in their classrooms (Baylor & Ritchie, 2002; Clouse & Alexander, 1998; Ertmer, Conklin, & Lewandowski, 2001; Russell, Bebell, O'Dwyer, & O'Connor, 2003; Wiencke, 2002). Although newer teachers may be comfortable working

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with technology, they may not have been exposed to applications for the classroom. These newer teachers have more recently completed teacher education programs, many of which focus on how to use technology rather than on how to teach with technology and integrate it into everyday teaching. Models of teaching based on their own experiences as students do not include the integration of technology into instruction. Russell et al. further posit that although teachers use technology outside the classroom, especially for preparation and professional communication via e-mail, they infrequently use technology in the classroom. Ertmer et al. (2001) comment that knowing how to use word processing, e-mail, and the Internet does not mean facilitation of these skills will occur in classroom instruction. Once teachers are in the classroom, opportunities for learning to use technology are rare, since most training programs for in-service teachers lack a model for integration (Clouse, & Alexander, 1998) and many schools have not yet incorporated technology into regular instruction (Russell et al., 2003). Gooler, Kautzer, and Knuth, (2000) explain that the teacher plays a key role in determining not only how but how well technologies are used in classrooms, and thus the extent to which technologies improve student performance. Khamis (1987) reports that merely placing a computer into the classroom of untrained teachers is ineffective, since untrained teachers are likely to use computers to do daily trivial things. These inconsistencies point to the need for developing teachers' classroom technology competence.

Teachers need both the time and the opportunity to gain competence in instructional technology (Harris, 2000). Some researchers report that teachers progress through stages as they develop technology integration competence. At each stage, teachers need particular support and professional development (Gooler et al., 2000; Harris, 2000). A compilation of research suggests that effective professional development in learning to use technology to teach should have relevance for the teacher and include modeling, hands-on practice, continuing support, collaboration, and easy access to the technology.

Modeling

As mentioned earlier, many teachers do not have good models for integrating technology into their teaching. Baylor and Ritchie (2002) note that teachers tend to teach the way they were taught. Providing appropriate models so that teachers can observe and then practice is useful for many teaching applications (Dunne & Harvard, 1992). Clouse and Alexander (1998) claim that the best training is through observation and collaboration with full-time teachers who use technology effectively in their classrooms.

Mager (1992) suggests that modeling by peers is a good training strategy to help self-efficacy (a personal judgment about one's ability to carry out a particular course of action or do a specific thing.) Although the present study focuses on competence, it should be noted that self-efficacy/confidence is an important consideration for teachers in their decision to use technology in their classrooms.

Hands-on Practice

Before teachers can infuse technology into the curriculum, they need to have appropriate skills, knowledge, and attitude (Baylor & Ritchie, 2002; Gooler et al., 2000). Clouse and Alexander (1998) suggest that the most effective training programs must provide practical hands-on experiences and meaningful activities that are appropriate for an individual's level of expertise. Teachers need time to reflect on new learning and integrate this new knowledge into practice through experimentation and then reflect on these outcomes further so that appropriate adjustments can be made (Gooler et al., 2000). Khamis (1987) agrees that teachers need time to practice to improve their competence and further suggests a team strategy of requiring teachers to participate in

student activities led by a more experienced team member.

Continuing Support

Continuing support is an important ingredient if teachers are to use technology in the classroom (Gooler et al., 2000). Introductory teacher training is unlikely to guarantee continued use of technologies. Support is needed to help teachers infuse technology into the curriculum as well as to provide technical expertise to insure that the equipment is functioning properly.

Collaboration

Well-designed training programs provide opportunities for participants to interact and collaborate so that they can learn together and from each other (Gooler et al., 2000). A collegial and collaborative culture in which colleagues can exchange knowledge and ideas and provide constructive feedback and encouragement to their peers fosters the growth of (and is cultivated in) a learning community. Teachers should be in a supportive environment when trying something new (Harris, 2000).

Ease of Access

Teachers, administrators, and students who have easy access to technology are more likely to take the time to practice with it to improve their skills (Khamis, 1987). Harris (2000) reports on exemplary uses of technology in several school projects in southeastern states. In one program, participating teachers received laptops; in another project there were two computers in each classroom, and in yet another project there was a two-to-one ratio of students to computers. Harris reasons that easy and regular access to computers is necessary if teachers are to plan lessons requiring children to use the Internet or to prepare reports using presentation software.

PURPOSE

The purpose of this study was to test two hypotheses: (1) that participation in a course providing theory and practice in the classroom use of technology (i.e., e-mail, Web site use, automated library resources, computer software, Internet virtual field trips, video cameras, PowerPoint, and Blackboard) promotes the use of technology and results in gained competence in technology use; and (2) that functional relations exist among the availability of technology in the classroom, technology utilization, and competence in technology use.

The model in Figure 1 was used to guide the research effort. In this model, we hypothesized that availability of technology (AT*)* would engender the use of technology (UT), that UT would engender the use of Internet Web sites (UW), and that these conditions would engender competence in the use of technology (CU).

METHOD

The study was conducted during the fall 2002 and spring 2003 semesters in three graduate educational technology classes. One instructor taught all the classes.

Sample

Fifty-five students in master's programs in a large urban university participated in the study. Most of the participants were employed as teachers in an urban school district. The technological skills of the participants ranged between none to moderate expertise in the facilitation of students' use of technology in the classroom. The availability of technological resources for teachers in their schools ranged from none to the availability of several computers in their classrooms.

Procedure

The course included theory as well as opportunities to practice newly learned skills

to achieve competence with technology. Both the course instructor and more experienced class members provided ongoing support for novice technology users.

A variety of activities were designed to give participants hands-on experiences with the technology, as recommended in the research. Participants found information on Web sites and navigated electronic library resources. They learned to send file attachments and became proficient with e-mail. They researched a topic and used PowerPoint to develop a presentation. Participants prepared and shared virtual field trip lessons using topics suitable for their own students.

Collaboration was encouraged, recognizing a preference to work with a partner when learning something new (Rosenfeld, 1992). PowerPoint assignments were completed in small groups and presented to the class. It was anticipated that being a part of a group would be less threatening than developing and making a solo presentation, particularly since the PowerPoint program was new to many participants. The virtual field trip (VFT) lessons were presented individually, but participants could opt to collaborate on the development of the plans. The VFT lessons were presented to small groups so that this would be a less-threatening environment for those who had newly learned about this technology-driven activity. The presentations gave participants the opportunity to try out the technology with an audience (practice), and also provided participants with several models to emulate, as recommended in the research.

The use of Blackboard (a distance learning management program) allowed for continued discussion outside class on the discussion board or through small group discussion forums. Weekly announcements were publicized to relay information about the class prior to meeting. Grades and course documents (e.g., syllabus and class handouts) were posted on Blackboard, giving participants another opportunity to build their technology competence and allowing the classroom community to meet asynchronously.

The interventions used in this study took into account suggestions from past research. Professional development should be relevant to the teachers and incorporate modeling, hands-on practice, continuing support, collaboration, and easy access to the technology. In most instances, participants chose topics for their projects and assignments. For example, the VFT lesson plans were developed for use in participant teachers' own classrooms. One participant commented, "You tried to make this class useful for our professional lives. You did not have us working in hypotheticals which I really appreciated" (Participant's response to the course feedback survey, spring 2003). Another observed, "We were exposed to many useful and interesting activities that would all be wonderful to use with kids" (Participant's response to the course feedback survey, spring 2003). A third participant wrote,

> We were involved doing projects where we could see practical use in the classroom. In the other education classes I have taken, they gave us a lot of theory about instruction and management, but these were things that we could use right away. I guess you applied the theories with us that we are being told to use. We are being taught to deliver the instruction in a way that makes it relevant to the students. This was very relevant to our situations. You also made sure that the course did not just get wrapped up in the technology. There were always connections to the educational reasons for using the technology. (Participant's response to the course feedback survey, spring 2003)

Modeling and hands-on practice were provided through in-class presentations—participants had hands-on experiences developing PowerPoint presentations and they modeled technology use for each other. A participant remarked, "I liked both the PowerPoint and the VFT. Both presentations were educative and informative. In addition, these assignments enabled us to learn from each other" (Participant's response to the course feedback survey, spring 2003). Another echoed that she "loved the opportunities that we had as a class to learn

from each other" (Participant's response to the course feedback survey, spring 2003).

During the semester there was continuing support from the instructor as well as from classmates. A collaborative environment was encouraged with many opportunities for participants to work together in class and asynchronously through Blackboard. A participant wrote, "I enjoyed all the group activities. I love exchanging thoughts and ideas with others" (Participant's response to the course feedback survey, fall 2002). Another wrote, "I have truly enjoyed working together with the other students. With their different background and knowledge I have gained great knowledge for myself and my students. Every time I had a chance to work with them, I felt like I came out of that experience even stronger and better" (Participant's response to the course feedback survey, fall 2002).

The class met in a computer lab, providing easy access to the technology, but outside of the class participants worked in varied environments. All participants reported having a computer at home and all had Internet access either at home or at school. Of the 53 respondents to the end of semester Survey of Technology Use Questionnaire (STUQ 2), eight reported that they had no computer access at school; three additional respondents had no Internet access at school. This means that over 20% of the participants in this study could not facilitate online activities in their classes.

It should be noted that available technology is not always in good working order. One participant reported that of four computers in his classroom, only one worked. Teachers often recount that the school does not provide quick technical support to fix computers when they malfunction. This may cause teachers to avoid the use of technology altogether. When teachers report on the number of computers that are in their classrooms, they also should report on the status of these computers. Are they in working condition? How old are they? Do they have the memory and speed to support graphical and audio downloads? Technology that does not match users' needs will not be used.

Instrumentation

The Survey of Technology Use Questionnaire (STUQ) was administered at the beginning of each semester (STUQ 1), and again at the end of each semester (STUQ 2). Participants were queried (using a 4-point Likert scale) regarding their perceived competence in the use of e-mail, Web site use, automated library resources, computer software, Internet virtual field trips (VFTs), video cameras, PowerPoint, and Blackboard/WebCT. The activities were grouped into two categories, technology use (automated library resources, computer software, video cameras, PowerPoint) and Internet and Web Site use (Blackboard, e-mail, VFTs). The information gleaned with STUQ 1 and STUQ 2 was deemed as indicative of the participants' use of and perceived competence with the various technologies before and after participation in the study.

Additional data were collected through a course feedback survey. Questions asked about participants' classroom use of technology at the end of the course, for example, whether they had tried a virtual field trip (VFT) prior to the class and whether they had tried a VFT since it had been discussed in class. It should be noted that a course goal was that participants would use technology tools with their own students.

Method of Data Analysis

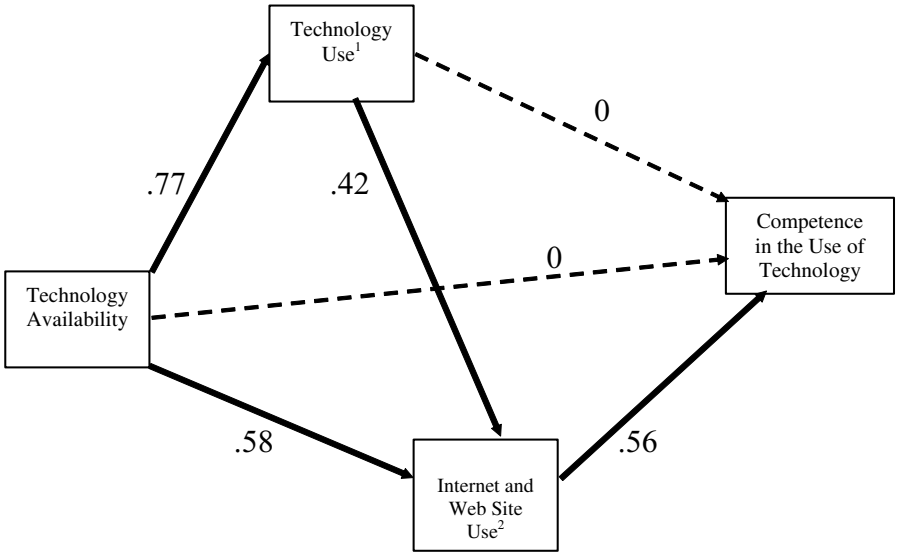
To test the first hypothesis posed for investigation, one-tailed paired comparison *t* tests were performed to ascertain gains in the use of technology in the classroom and competence in the use of this technology. To address the second hypothesis, path analysis was performed to test the model as shown in Figure 1.

RESULTS

The *t* test outcomes appear in Table 1. As shown in this table, a statistically significant gain emerged for competence in the use of

TABLE 1
T Test Outcomes

	M	*SD*	*t*	*p*
Pretest	11.85	5.34	−11.06	.00
Posttest	19.10	3.34		



Note: The coefficients for the heavy-lined linkages, in the form of standardized regression weights, are statistically significant beyond the .05 level.
[1]Automated library resources, computer software, video cameras, PowerPoint
[2]BlackBoard (distance learning software), e-mail, virtual field trips.

FIGURE 1
Hypothetical model and path analysis outcomes

technology from pre- to posttest. (CU) from STUQ 1 (M = 11.85, SD = 5.34) to STUQ 2 (M = 19.10, SD = 3.34): t = –11.06, df = 47, p = .00)—suggesting that the interventions were successful in raising the participants' competence in using technology in the classroom.

Figure 1 shows the path analysis outcomes. As hypothesized, competence in the use of technology in the classroom proved to be a direct function of the degree of use of this technology, most directly on the use of Internet Web sites (β = .56, p < .05); the degree to which teachers use the Internet proved to be dependent on both the availability of computer technology in the schools (β = .58, p < .05), and the general use of this technology (β = .42, p < .05); and the use of this technology proved to be a function of the degree to which it is available to teachers in the schools (β = .77, p < .05).

Additional information from the course feedback survey indicates that, by the end of the course, some participants were infusing technology into their own classrooms, while other participants expressed an interest in doing so, but could not because of a variety of problems barring classroom technology use. In addition to inaccessibility, lack of Internet access, and malfunctioning computers, some participants reported that they were working on city-wide testing, were not currently teach-

ing, had scheduling problems, lacked software, or had very young students.

Responses on the course feedback survey indicate that 11 participants tried a VFT with their students since that topic was discussed in class, 18 planned to do so in the future, 9 reported that the VFT was not available or accessible, and 11 responded that they would like to but could not. There were 8 affirmative responses to the question on using PowerPoint with students since the topic was discussed in class, 12 said that they plan to use PowerPoint in the future, and 10 reported that they would like to use PowerPoint but could not. Twelve respondents said that they had tried other technology activities with students, including videotaping and showing videotapes, using software, spreadsheets, a digital camera, Web sites, and other Internet resources.

DISCUSSION

The following discussion involves four issues regarding the findings: support of the hypotheses, implications for policymaking, limitations of the study, and recommendations for further research.

Support of the Hypotheses

The statistical data support the first hypothesis, that participation in a course providing theory and practice in the classroom use of technology engenders such use and results in gained competence in the use of this technology. The data also support the second hypothesis, that functional relations exist among the availability of technology in the classroom, the use of such classroom technology, and competence in its use. The results of this study strongly suggest that when an educational technology course is relevant to students' needs and provides students with modeling, hands-on practice, and continuing support in a collaborative environment, it can lead to competence and future classroom technology use.

Implications for Policy-Making

There are many states that have student technology standards, and the No Child Left Behind legislation also mandates the use of technology to enhance the curriculum and engage students in learning (United States Department of Education, 2002). However, there are few states that have technology requirements for the teachers. If states and school districts want to assure that students reach the technology goals that have been set for them, perhaps an educational technology course should be mandated prior to teacher certification. Schools of education might want to look into offering a required educational technology course if they do not already do so. Perhaps more training should be provided. School district administrators who are interested in hiring technology-savvy teachers could be influential in making a course and/or training a reality.

Ongoing support is also necessary if teachers are to use technology in the classroom. Money has to be allocated for teacher training as well as for technical support. Teachers need to be updated on new software, hardware, and new technology trends. Technology educators should be available in every school so that they are easily accessible to classroom teachers. Technicians also should be readily available. Technology that does not work must be repaired in a timely manner. When technology problems occur, a competent individual must be available to address them quickly. In many places, money seems to be available to purchase technology equipment, but training and upkeep are often forgotten. These factors cannot be ignored. Again, school district administrators can be key to assuring that the necessary support is constant and enduring.

Limitations of the Study

The participants in this study were from an urban university and most teach in a large urban school district. The findings of this study may not be generalizable to other situations.

The present study only looked at perceived competence with technology. There may be other factors that prevent teachers from using technology in the classroom. For example, even when teachers are competent in technology use, if they do not have self-efficacy or confidence, they may not opt to try to use technology tools in the classroom. Several participants mentioned in the course feedback that they felt more confident and/or comfortable with technology use: "I have not been in school for 13 years so I was a little intimidated about having to go back but you made me feel very comfortable and confident" and "I learned a lot of new things for myself and to incorporate in my classroom. It has made me more comfortable with technology" (fall 2002). Another participant commented, "This course helped me be a confident user of the computer" (spring 2003).

Recommendations for Further Research

A future study might examine self-efficacy/confidence and comfort issues after participating in an educational technology course similar to the one described here. Another study might look at the longitudinal effects of educational technology courses and/or training. Will teachers who have taken these kinds of courses and who have reported increased technology competence, continue to be technology-using classroom teachers years after taking the course? What are the factors that influence a teacher to use technology tools in the classroom? What are the factors that prevent a teacher from using these tools? What are the factors that encourage a teacher to keep using technology tools in the classroom?

This study was completed in an urban area. Further research might replicate this study in other environments. The present research is only a beginning.

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