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Introduction

In an effort to prepare students for the information age, public schools are increasing access to technology tools by installing more hardware and software, connecting classrooms to the Internet, and providing cable and satellite capabilities (Zehr, 1997, 1998). Yet, despite the increased availability and support for classroom computer use, relatively few teachers have fully integrated computers into their teaching (Becker, 2000; Marcinkiewicz, 1996). Teachers' uses of computers are likely to be influenced by multiple factors, including the accessibility of hardware and relevant software, the nature of the curriculum, personal capabilities, and external constraints such as time, equipment, and technical support (Albion, 1999). However, according to Ertmer (1999), "Even if every first-order [external] barrier were removed, teachers would not automatically use technology to achieve the kind of meaningful outcomes advocated" (p. 51).

There is substantial evidence to suggest that teachers' beliefs in their capacity to work effectively with technology—that is, their *self-efficacy* for technology integration—may be a significant factor in determining patterns of classroom computer use (Albion, 1999; Oliver & Shapiro, 1993). For example, 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). Compeau, Higgins, and Huff (1999) conducted a longitudinal study with 394 subscribers to a periodical over a one-year interval to test the influence of computer self-efficacy beliefs, outcome expectations, affect, and anxiety on computer use. Their findings provided strong confirmation that computer self-efficacy beliefs had a significant positive influence on computer use. Another study conducted by Albion (1996) investigated student teachers' dispositions toward computers and their uses of computers in primary school classrooms during a final-year practicum. Results suggested that lack of confidence for teaching with computers was an important factor influencing the levels of computer use by student teachers. Taken together, these studies suggest that teachers' beliefs—and self-efficacy beliefs in particular—are useful indicators of levels of technology integration. Certainly, they provide sufficient reason to undertake further investigations in this area and to consider approaches to teacher education and professional development that might be effective in increasing self-efficacy for teaching with technology.

Bandura (1986) identified four sources of information used to judge self-efficacy: successful performance attainment, observing the performances of others (vicarious learning), verbal persuasion indicating that one possesses certain capabilities, and physiological states by which one judges capability, strength, and vulnerability. Although performance accomplishments are considered to be the most robust source of self-efficacy information, vicarious learning is also a powerful source (Bandura, 1986, 1997). That is, viewing others successfully accomplishing a particular task can increase

Discussion

The results of this study indicated that preservice teachers who were exposed to vicarious experiences that were related to successful technology integration (with and without goal setting) experienced significantly greater increases in judgments of self-efficacy for technology integration than those who were not exposed to these vicarious experiences. These results support previous research regarding the benefits of vicarious learning on judgments of self-efficacy (Albion, 1996; Downes, 1993; Ertmer et al., 2003; Handler, 1993) and highlight the potential benefit to providing preservice teachers with opportunities for observing exemplary technology-using teachers as one way to increase their self-efficacy for effectively using technology in their own classrooms. Specifically, in this study, vicarious learning experiences were provided through an electronic instructional tool, the VisionQuest CD. This type of modeling helps eliminate logistical problems that might be associated with direct classroom observations and can be easily incorporated into a teacher education program as either a self-paced reflection tool or an instructor-led class activity. Other forms of electronic vicarious learning experiences, such as those provided by videos and web pages, may also bring about similar effects on self-efficacy beliefs for technology integration.

The results of this study also indicated that preservice teachers who used specific goals, with and without vicarious experiences, experienced significantly greater increases in judgments of self-efficacy for technology integration than those who were not assigned any goals. These results also support previous research regarding the benefits of goal setting on self-efficacy beliefs (Bandura, 1997; Schunk, 2001; Schunk & Ertmer, 1999). Thus, providing preservice teachers with goals seems to be an effective way to enhance efficacy levels for technology integration, which can be easily achieved by making the link between class objectives and learning goals explicit.

More important, the results of this study showed that preservice teachers who were exposed to vicarious learning experiences and who were assigned specific goals experienced significantly greater increases in judgments of computer self-efficacy than those who received only one of these two conditions. These results support the suggestion made by others (Gist & Mitchell, 1992; Neck & Manz, 1992) regarding effective strategies for increasing self-efficacy as well as the possible benefit to be gained by combining strategies. Thus, teacher educators might consider using both strategies when helping preservice teachers learn about technology integration. For example, instructors might anticipate increases in students' self-efficacy for technology integration when exemplary uses of technology in K–12 classrooms are presented and students explore these uses according to specific goals. What makes this practice more desirable is that both the exemplary uses and goals can be easily incorporated into software packages or other forms of electronic delivery.

Limitations and Suggestions for Future Work

The characteristics of the participants in this study may limit generalizability to participants with different characteristics. For example, the participants in this study were primarily female residential undergraduate students at the beginning of their teacher education programs (i.e., 67% female with an average age of less than 20, with over half being freshmen). In addition, participants did not demonstrate much initial understanding of computer uses and technology integration in teaching. These characteristics of the participants would make it difficult to generalize the results of this study to preservice teachers in other programs who might have different characteristics, although careful descriptions of the participants' characteristics may help increase the generalizability of the findings of this study.

Another unique feature of this study was that the experiment was administered to the participants during a regular two-hour lab session of the course, which would be considered a relatively short treatment time. Therefore, there would be no indication of long-term, lasting effects of the treatment from the results of this study.

In addition, the goals used in this study were structured in such a way that they may have been used by the students as a form of advance organizer. Therefore, it is arguable that the effect observed on self-efficacy beliefs might be, at least in part, due to the role of cognitive scaffolding these goals played in affecting participants' self-efficacy. It should be advisable that the cognitive scaffolding features of these goals be removed to determine whether the findings of this study are replicable.

Therefore, for future research work, considerations might be made to administer the experiment over a longer period of time to investigate the long-term effects of vicarious learning experiences and goal setting. If any differences or interesting patterns were found in preservice teachers' self-efficacy beliefs compared with the one-time brief exposure to vicarious learning experiences and goal setting, meaningful implications might be made to the benefit of teacher education programs. The results of this study should also be further qualified by using the same research design and experiment with preservice teachers in different types of teacher education programs, where students' characteristics vary from one to another. Last, it would be important to examine the actual technology use by the students who have achieved high levels of computer self-efficacy, to further verify the hypothesized relationship between high efficacy and actual classroom use.

APPENDIX

2.A

Computer Technology Integration Survey

DIRECTION

The purpose of this survey is to determine how you feel about integrating technology into classroom teaching. For each statement below, indicate the strength of your agreement or disagreement by circling one of the five scales. Below is a definition of technology integration with accompanying examples:

TECHNOLOGY INTEGRATION

Using computers to support students as they construct their own knowledge through the completion of authentic, meaningful tasks.

Examples:

- Students working on research projects, obtaining information from the Internet.
- Students constructing web pages to show their projects to others.
- Students using application software to create student products (such as composing music, developing PowerPoint presentations, developing HyperStudio stacks).

Using the above as a baseline, please circle one response for each of the statements in the table:

	SD = Strongly Disagree **D** = Disagree **NA/ND** = Neither Agree nor Disagree	**A** = Agree **SA** = Strongly Agree
1.	I feel confident that I understand computer capabilities well enough to maximize them in my classroom.	SD D NA/ND A SA
2.	I feel confident that I have the skills necessary to use the computer for instruction.	SD D NA/ND A SA
3.	I feel confident that I can successfully teach relevant subject content with appropriate use of technology.	SD D NA/ND A SA
4.	I feel confident in my ability to evaluate software for teaching and learning.	SD D NA/ND A SA

Continued

