Jl. of Technology and Teacher Education (2006) **14**(1), 151-165

Technology Professional Development: Long-Term Effects on Teacher Self-Efficacy

GEORGE WATSON
Marshall University
Milton, WV USA
watson@marshall.edu

The West Virginia K-12 RuralNet Project was an NSF funded program to train inservice teachers on integrating the Internet into science and mathematics curriculum. The program involved training inservice teachers through an intensive summer workshop and supplemental online courses. This study examines the effects of the project on the long-term self-efficacy of inservice teachers and their use of the Internet in the classroom. The specific research questions addressed are: Do professional development programs affect the long-term self-efficacy of inservice teachers? Did the addition of online courses and follow-up to the program affect self-efficacy levels? Finally, do certain external factors, specifically years of teaching experience, college technology courses, professional development, or participation in other similar professional development programs play a role in teacher self-efficacy?

The findings indicate that: (a) Teachers improved level of self-efficacy after the summer workshops remained high even years after their involvement in the program, (b) that combining an intense summer workshop with additional online courses shows a significant difference in some aspects of self-efficacy over just having a professional development workshop, and (c) certain external factors do affect teacher self-efficacy over the long-term.

BACKGROUND

The RuralNet Project was a project funded by the National Science Foundation that trained K-12 inservice teachers on using the Internet as an effective classroom resource for science and mathematics education. The project ran from 1995-1999 and trained approximately 1000 teachers in the state of West Virginia. The grant was administered through West Virginia University and delivered cooperatively with Marshall University. Teachers entering the program received an intensive five-day summer workshop, and had the option of continuing the learning process through two online courses given over the fall and spring semesters.

The summer workshops covered basic skills as well as classroom integration issues. Teachers learned the basics of using the Internet, e-mail, and how to find information using search engines. In addition, they learned how to effectively integrate the Internet into the lesson planning and teaching processes. They had the option of taking the workshop for college credit through either educational institution.

The online courses also served to reinforce basic skills as well as begin the process for teachers of developing technology integrated unit plans. The two courses were taken consecutively and covered an entire academic year (fall and spring). The first online course emphasized basic Internet skills and ended with teachers researching and developing an idea for a unit integrating the Internet. The second course took the teachers' concepts and walked them through the process of unit planning with the Internet. When finished the teachers submitted their work to the RuralNet database, which allowed all participants access to the work. This gave participants a library of integrated unit plans covering all grade levels.

LITERATURE REVIEW

Self-efficacy may be defined as a belief in one's own abilities to perform an action or activity necessary to achieve a goal or task (Bandura, 1997). Studies have shown a link between a high level of self-efficacy on the part of a teacher and higher student achievement (Ross, Hogaboam-Gray, & Hannay, 2001; Cannon & Scharmann, 1996). Low self-efficacy has been shown to have a negative impact on performance. In the study by Ross et al., students in grades K-3 were studied to determine how changes in teacher computer efficacy affected them. Specifically, the students were evaluated on changes in basic and advanced computer skills and computer self-efficacy as they moved from one grade to another. Students who moved from

teachers with high self-efficacy to teachers with a low level did not improve their skills and efficacy as much as students moving from teachers with low to high levels. A study of 776 employees at a major university found that increased performance with computer-related tasks was significantly related to employee's having a high level of computer self-efficacy, while at the same time those employees with low computer efficacy performed at a lower level (Harrison, Rainer, Hochwarter, & Thompson, 1997).

Today, most teachers and students have easy access to the Internet. The explosive growth of computers and the Internet into the classroom over the last 10 years has been made with initiatives from federal, state, and local authorities. Statistics from the National Center for Education Statistics show that in 1994, only 35% of public schools had access to the Internet, by 1999 it was 99%. Internet access in individual classrooms rose from 3% in 1994 to 87% in 2001. The ratio of students to school computers with Internet access has improved from 12.1 to 1 in 1998 to 5.4 to 1 in 2001. At the same time the speed of the Internet connections has also increased dramatically. The same NCES study found that 74% of schools used a dial-up connection in 1996, where 55% used T1/DS1 lines in 2001. This improvement directly relates to the changing needs of the workplace. In 2001, 54% of all American workers used computers in their jobs (National Center for Education Statistics [NCES], 2002).

This growth of the Internet over the last decade has spawned many attempts at helping teachers harness the power of the Internet as a classroom resource. As the use of computers in schools grows, so has the need to develop ways to incorporate the new technologies into a useable framework that helps students grow and learn more. The speed of these changes has left teachers feeling unprepared and anxious about using computers in the classroom. In one study, only 20% of teachers surveyed felt prepared to integrate technology into the classroom (Norman, 2000). Even in studies that produced better results (33% felt prepared), a vast majority of teachers still felt inadequate in using computers (NCES, 2000).

Teacher lack of preparedness to use computers and the Internet begins at the preservice level. An examination of the students entering an education degree program reveals surprising differences between education majors and noneducation majors. In a 10-year study of undergraduate students, Reed, Ervin, and Oughton (1995) found that education majors have a higher computer anxiety and less computer experience than students in other majors. Another study by Reehm, Long, and Dickey (2001) found that preservice teachers score lower on some measures of computer skills and knowledge than their peers. They felt that the lack of elective computer courses for preservice teachers and little emphasis on technology in core education courses were part of the cause of the disparity.

Would more computer classes and professional development training overcome both the deficit in skill and the low self-efficacy towards computers? Obviously, a good training seminar on using PowerPoint software will increase the technical expertise of the recipient, but can it also increase the learner's self-efficacy and desire to incorporate it into the curriculum? Research clearly indicates training teachers to use technology lowers anxiety and; increase efficacy while improving their skills. Gonzales, Pickett, Hupert, and Martin (2003) found that teachers who had training with technology were much more confident about using technology in their classrooms. Leh (2000) and Ross et al. (2001), found that preservice and inservice teachers taking a college technology integration course had a higher comfort level, confidence, and attitude toward the use of computers, and were more inclined to integrate new technologies into their classrooms. Sottile, Watson, and Iddings (1998), Koul and Rubba (1999), and Dean (2001) all found that professional development workshops for inservice teachers increased the computer self-efficacy levels of the participants.

There have been several long-term studies of technology use, proficiency, and feelings of efficacy in regards to computer and Internet use with mixed results. A three year study of preservice teachers found that feelings of self-efficacy and computer technology increased significantly between years one and two, and maintained a high level of efficacy during year three (Milbraith & Kinzie, 2000). Another study, by American Institutes for Research (AIR) for the U.S. Department of Education (2000) examined the Eisenhower Professional Development Program, the federal government program devoted to developing the knowledge and skills of inservice teachers. This study of 30 elementary, middle, and secondary schools, and over 430 teachers during the 1996-1997, 1997-1998, and 1998-1999 school years found little change in overall teaching practice. Their conclusion indicated that the teachers' inability to develop improved strategies was related to the wide variation in amount and quality of professional development received over the course of the study.

The efforts to change the way we teach and use technology have increased dramatically. In an effort to improve student achievement in schools President George W. Bush signed into law the No Child Left Behind Act of 2001 (NCLB). This law reauthorizes the Elementary and Secondary Education Act of 1965 (ESEA) but, among other things, changes the way funds are allocated to schools and holds schools accountable for student achievement. Title II of the law focuses on improving teacher quality as determined by subject area content knowledge and teaching effectiveness. To accomplish this NCLB creates the Improving Teacher Quality State Grants program to

allow individual states to fund professional development activities that are research driven, measurable, and promote the higher qualifications needed by teachers as well as the improvement of student achievement. Programs under the NCLB umbrella, including the Improving Teacher Quality State Grants program, totalled almost $23.7 billion for the 2003 fiscal year (U.S. Department of Education, 2002).

Using technology effectively in the classroom is also a major thrust of NCLB. As part of the reorganization of the federal effort to improve education implemented by NCLB, the Enhancing Education Through Technology Program (Ed Tech) was established. Under this program, funds are provided to states to use in elementary and secondary schools to support and implement effective use of technology (U.S. Department of Education, 2002). Part of the guidelines call for 25% of any grant to go towards teacher professional development, which is short of the 30% recommended by the President's Committee of Advisors on Science and Technology (1997) but significantly higher than the 14% typically spent on technology professional development by schools and educational agencies (Skinner, 2002). With a 2003 budget of almost $700 million, the need to spend these monies on effective professional development is paramount (U.S. Department of Education, 2002).

Good professional development would help increase teacher use of computers and the Internet. Research indicates that the level of a teacher's computer and Internet self-efficacy also effects student achievement and self-efficacy. A study of student math achievement test scores revealed a link between higher scores and teachers who had professional development in technology and computers (Norman, 2000). Christensen (2003) studied a professional development program that had inservice teachers participating in two days of needs-based technology integration training with a follow-up day of training every six weeks throughout the academic year, and compared the results with that of a control group of teachers that did not receive any training. The results indicated that the training had a positive effect on teacher attitudes and anxiety, while also indicating a time-lagged effect on students' attitudes and anxiety with computers.

RESEARCH RATIONALE

Over the years many studies examined the effect of professional development on teacher attitudes, self-efficacy, and level of use, some of which have been cited in the previous section. Comparatively little research has

been done concerning the long-term impact these seminars, workshops, and courses have had on the attitudes of teachers towards using computers and the Internet in the classroom. Data suggests that approximately 15% of money allocated for technology is used for teacher training, even though the U.S. Department of Education recommends that school districts allocate 30% (President's Committee of Advisors on Science and Technology, 1997). Hundreds of millions of dollars are spent each year on teacher training and yet very little is known about its benefit over the long-term. One of the requirements of No Child Left Behind, is that states and local school districts must show improvement in teacher quality and technology integration, which stresses the importance of researching what professional development methods work effectively in meeting these goals (U.S. Department of Education, 2002). Beyond professional development, the calls to hold schools accountable for student achievement make it even more imperative that research is done on professional developments' effect on the classroom environment.

Previous research shows a positive relationship between training and teacher self-efficacy with technology and its residual effect on student achievement and technology self-efficacy. Examining whether these positive attitudes are maintained over time can go along way to determining how future professional development monies should be spent. Also, determining if professional development should include follow-up training to improve the effect of mini-courses and workshops helps to determine how best to deliver instruction to teachers. Finally, knowing what role external factors may play in teacher comfort and confidence would also help in planning for professional development that really changes the way teachers use technology in the classroom.

METHOD

The subjects were 389 teachers who had participated in the West Virginia K-12 RuralNet Program during the 1996-1997 school years. The NSF funded program was designed to teach teachers how to use the Internet as a classroom resource. During the summer of 1996 teachers received a five day intensive training on using the Internet, including such skills as e-mail, searching the Web, downloading, and integrating the web into the classroom. The teachers then had the option of taking both a fall semester online course and spring online course that further examined the Internet and its role in the classroom. By the end of the spring course teachers had developed unit plans that featured usage of the Internet by students.

At the time, the teachers were surveyed before and after the workshop using the Personal Internet Teaching Efficacy Beliefs Scale (PITEBS) (Koul & Rubba, 1999). The PITEBS instrument was an 11 question survey that used a five point Likert scale, where 1 = strongly agree and 5 = strongly disagree. Their results indicated a significant increase in teacher self-efficacy. No further studies using the PITEBS instrument were conducted to evaluate any changes in self-efficacy as teachers participated in the online courses.

Six years after the teachers completed the workshops and online courses the PITEBS instrument was again mailed to them. Of the original 389 teachers, only 296 could be found still working in the state. This attrition could be related to retirements, leaving the teacher profession, movement of teachers out of state, inability to track teachers if they transferred from one school district to another, changes in name due to marriage or divorce, or teachers leaving the classroom to take administrative or higher education positions. Of the 296 surveys mailed, 97 were returned (32.8%), though three were deemed unusable as the information provided was missing or incomplete.

The surveys were then examined for the three research questions: How much does professional development raise computer self-efficacy over the long-term and, is there a significant difference between professional development that involves workshops and online instruction with training that does not include the online component? Finally, what external factors (years teaching experience, taking other college technology courses, and other Internet professional development programs, and technology professional development work) play a role in levels of self-efficacy over time? For purposes of this study, "professional development programs" is defined as federally funded, indepth programs that might be similar to the RuralNet project, and "other technology professional development" is defined as nonfederally funded workshops, seminars, inschool meetings, or other staff development activities.

To answer the first research question, the mean self-efficacy score of the whole group (N=94) was directly compared with the 1996 survey results. For the second question, the survey results were divided into teachers who had completed both the workshops and the online courses (*completers*) from those who had only participated in the summer workshops (*noncompleters*) using an independent samples t-test. The third research question involved subdividing *completers* and *noncompleters* by the four external factors examined, completing an analysis of variance for each factor. For example, teacher results were examined based on categorizing by years of experience (four groups), then examined again by further dividing them into *completers* and *noncompleters*.

RESULTS

In the initial 1996 survey (N=155), the pretest mean for all participants was 29.70 and the posttest mean was 37.56, a significant difference. In this study the mean of all respondents was 37.48, which was slightly lower than the posttest from the original study, but not significantly so. This slight decrease could be due to several factors, including but not limited to smaller sample size and the time between the treatment and the survey.

When looking at the independent t-test of those who had only taken the workshop with those who also taken the online courses, there was a difference between the groups, but not a significant one. The mean for teachers taking the workshop was 37.28 and the mean for teachers taking both the workshop and online courses was 38.76, giving a value of $p<.062$.

When taking a closer look at the results of the survey there were some significant differences noted in 3 of the 11 questions between the two groups of teachers. The question "Even when I try very hard, I do not teach as well using the Internet as I teach using other ways." had a somewhat significant difference ($p<.05$). There were very significant ($p<.01$) differences in the questions "I am not very effective in monitoring activities that involve using the Internet." and "I generally teach ineffectively when using the Internet" (Table 1).

When looking at how taking college credit technology courses affected the survey results there were 5 out of 13 questions that had significant differences. For all respondents the questions, "When teaching using the Internet, I usually welcome student questions" and, "I don't know what to do to turn students on to using the Internet" had highly significant differences (values $p<.002$ and $p<.005$ respectively). There were also significant differences in three other questions. They were: "I am not very effective in monitoring activities that involve using the Internet," "I wonder if I have the necessary skill to teach using the Internet," and, "When a student has difficulty understanding how to use the Internet, I am usually at a loss as to how to help the student understand it better." Examining the subgroups of *completers* and *noncompleters* found that only one question had a significant difference for *completers*, "I am continually finding better ways to teach with the Internet." *Noncompleters* did not have a significant difference for that question, but did for four of the five questions that were found to be significant for all respondents (Table 2).

Table 1

Independent T-Test Significant Results Between Completers and Noncompleters

		Number surveyed (N=)*	Mean Score	Significance (2-tailed, equal variances assumed) (p=)
"Even when I try very hard, I do not teach as well using the Internet as I teach using other ways."	Group 1**	12	4.17	.037
	Group 2	80	3.51	
"I am not very effective in monitoring activities that involve using the Internet."	Group 1	12	1.83	.003
	Group 2	81	2.15	
"I generally teach ineffectively when using the Internet."	Group 1	12	4.58	.006
	Group 2	80	4.01	

* The variations in the Group 2 number of responses due to some answers being omitted by respondents. Group 2 had a total of 82 respondents.

**Group 1 = Teachers who completed both the workshops and the fall and spring on-line courses. Group 2 = teachers who completed the summer workshops but not the tonline courses.

Table 2

ANOVA Results for External Factor College Credit Technology Courses Taken[1]

Question	All respondents	Completers	Non-completers
"I am continually finding better ways to teach with the Internet."	Not significant[2]	$p<.011$	Not significant
"I am not very effective in monitoring activities that involve using the Internet."	$p<.025$	Not significant	Not significant
"I wonder if I have the necessary skill to teach using the Internet."	$p<.037$	Not significant	$p<.019$
"When teaching using the Internet, I usually welcome student questions."	$p<.002$	Not significant	$p<.015$
"I don't know what to do to turn students on to using the Internet."	$p<.005$	Not significant	$p<.009$
"When a student has difficulty understanding how to use the Internet, I am usually at a loss as to how to help the student understand it better."	$p<.024$	Not significant	$p<.049$

[1]Respondents were placed into four categories: Zero hours taken, 1-6 hours, 7-12 hours, and more than 13.

[2]p values greater than .05.

The data indicates that teachers who complete the workshop and online courses had improved their feelings of self-efficacy to the point that any college credit courses taken in the years since the treatment had no effect on it. College credit courses taken by the teachers after RuralNet added content knowledge but were nonfactors to feelings of confidence by the teachers. This is not to imply that college credit courses are not worthy endeavors, but that the added online courses and connection to the summer workshop removed feelings of inadequacy. The one-week summer workshop by itself did not completely eliminate any preworkshop feelings on self-efficacy, but the workshop with the added online courses did.

The factor *technology professional development programs* was looked at by grouping the respondents into two groups, those that had taken them since RuralNet and those that had not. An independent sample *t*-test was performed (equal variances not assumed) to see the results. Looking at the external factor other professional development programs yielded some interesting results. Foremost was the realization that all but one of the completer-group respondents had participated in another professional development program since RuralNet. This meant that *t*-test results could not be obtained for the completer sub-group, since *t*-tests require that each sub-group have at least two sets of data. Clearly, though, this group was more interested in the uses of Internet and computer technology than the noncompleter group, but there was no way to determine in this study if that strong interest was enhanced by the RuralNet program or was there before they participated in it. There was a significant difference in almost half the survey questions for noncompleter respondents, indicating that continuing professional development can affect feelings of self-efficacy.

The external factor *other professional development* also had a high number of questions with significant differences, with 5 out of 13 questions were either significant (2) or highly significant (4) (Table 4). *Other professional development* consists of things like one day workshops, seminars, school meetings, planning sessions, or other training typically run or coordinated by the local school district. Interestingly, only one question had a somewhat significant difference for the completer sub-group, which was, "I find it difficult to explain to students how the Internet works." Noncompleters had very significant differences in four questions and somewhat significant difference in one other.

Table 3

Independent Samples *T*-Test for External Factor Technology Professional Development Programs[1]

Question	All respondents	Completers[2]	Non-completers
"I know how to teach effectively using the Internet."	$p<.029$	NA	$p<.036$
"I am not effective in monitoring activities that involve using the Internet."	$p<.005$	NA	$p<.014$
"I understand how to use the Internet well enough to be effective in teaching with it."	$p<.018$	NA	$p<.024$
"I am typically able to answer students' Internet questions."	$p<.008$	NA	$p<.012$
"I wonder if I have the necessary skill to teach using the Internet."	$p<.006$	NA	$p<.007$
"When a student has difficulty understanding how to use the Internet, I am usually at a loss as to how to help the student understand it better."	$p<.010$	NA	$p<.015$

[1]Respondents were placed into two groups by whether they had participated in a program or not.
[2]All but one completer had participated in at least one other professional development program, rendering the independent samples *t*-test impossible for this group.

Examining this data shows a relationship between completer feelings of self-efficacy and professional development. It would seem that the high levels of self-efficacy completers gained from the RuralNet program were not positively or negatively affected by staff development workshops and classes. They may have gained new content knowledge or technical skills at these sessions but they did not improve on their already high level of self-efficacy. Noncompleters, on the other hand, did have a significant difference on several of the survey questions. This may be because there confidence level was lower and therefore had more room for improvement.

Table 4
ANOVA Results for External Factor Other Technology Professional Development[1]

Question	All respondents	Completers	Non-completers
"I am not very effective in monitoring activities that involve using the Internet."	Not significant	Not significant	$p<.030$
"I understand how to use the Internet well enough to be effective in teaching with it."	$p<.042$	Not significant	Not significant
"I find it difficult to explain to students how the Internet works."	Not significant	$p<.050$	Not significant
"I am typically able to answer students' Internet questions."	$p<.032$	Not significant	$p<.009$
"Given a choice, I would not invite the principal to evaluate my teaching when I use the Internet in a lesson."	$p<.003$	Not significant	$p<.005$
"I don't know what to do to turn students on to using the Internet."	$p<.012$	Not significant	$p<.011$
"When a student has difficulty understanding how to use the Internet, I am usually at a loss as to how to help the student understand it better."	$p<.022$	Not significant	$p<.007$

[1]Four groups were created based on contact hours: Zero hours, 1-10 hours, 11-20 hours, and over 21 hours.

When looking at the factor *years of teaching experience* as a factor influencing self-efficacy there were three questions that yielded significant differences between the groups. Two questions were significant to completers and one for noncompleters. This was the only factor that had more questions with significant differences for completers than noncompleters (Table 5). It would seem that years of teaching experience does not have a pronounced effect on feelings of self-efficacy in relation to completers and noncompleters. It is a somewhat muddled picture, where teacher experience relates to questions on teaching effectiveness, but does not readily breakdown when looking at the two groups of teachers.

Table 5
ANOVA Results for External Factor Years of Teaching Experience[1]

Question	All respondents	Completers	Non-completers
"I am continually finding better ways to teach with the Internet."	Not significant	$p<.015$	Not significant
"I know how to teach effectively using the Internet."	$p<.014$	Not significant	$p<.034$
"I understand how to use the Internet well enough to be effective in teaching with it."	$p<.004$	Not significant	Not significant
"When teaching using the Internet, I usually welcome student questions."	Not significant	$p<.040$	Not significant
"When a student has difficulty understanding how to use the Internet, I am usually at a loss as to how to help the student understand it better."	$p<.029$	Not significant	Not significant

[1]Four groups were created by grouping teachers by years of experience: 1-10 years, 11-20 years, 21-30 years, and 31+ years.

DISCUSSION

The results indicate that teacher training has a long-term effect on teacher self-efficacy towards using the Internet in the classroom. There was only a slight downward, statistically insignificant, change in feelings of self-efficacy from the postworkshop survey and the survey conducted seven years later. This could be explained by the time lapse between the treatment and the survey instrument. The further examination of the effect of online supplemental training indicated some interesting differences between completers and noncompleters on individual survey questions.

There were some interesting results when looking at how external factors affected the survey groups. When evaluating by any of the four external factors, college credit technology courses, teaching experience, other Internet development programs, or other technology professional development there was only one question that had a significant difference between groups, "When a student has difficulty understanding how to use the Internet, I am usually at a loss as to how to help the student understand it better." Beyond this there were some subtle differences between the factors "factoring for college credit courses," "and professional development programs," and "other professional development." For both categories of professional development, as well as teaching experience, there were significant differences on question six, "I understand how to use the Internet well enough to

be effective in teaching with it" and question eight, "I am typically able to answer students' Internet questions." There was no significant difference found for these questions when factoring for college credit classes. It is possible that teachers are better able to ask specific questions relating to their students in professional development settings that tend to be more specific in their nature, since often the participants are from the same school and share similar experiences and students. College courses are often more theory-based, and students tend to be from a variety of backgrounds that inhibit the exploration of specific problems or situations.

While it is difficult to examine what outside factors over time may have affected the teachers' feelings of self-efficacy using the Internet, it is significant to note that the self-efficacy levels remain high over time. The inservice teachers have experienced the growth of the Internet in schools, used the technology over time, and are just as comfortable with it today as they were in 1996-1997. Any potential pitfalls (lack of computers, slow connections, bureaucracy, parent resistance, etc.) have not increased their anxiety about using the Internet as an educational tool. This hints at the success of this type of professional programs in changing the classroom teaching environment. The long-term contact between the inservice teachers and the project, through the online courses, would appear to provide teachers with the extra help they need to feel confident about the Internet in the classroom. This extra help seems to have allowed teachers to better bridge the cap between the theory of using the Internet and the classroom application of what they learned.

References

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W.H. Freeman & Co.

Cannon, J., & Scharmann, L. C. (1996). Influence of a cooperative early field experience on preservice elementary teachers science self-efficacy. *Science Education, 80*, 419-436.

Christensen, R. (2003). Effects of technology integration education on the attitudes of teachers and students. *Journal of Research of Technology in Education, 34*(4), 411-433.

Dean, D. (2001, March). *Infusing technology in K-12 classrooms: A study of one method used to evaluate the impact of a teacher-focused technology integration program.* Society for Information Technology & Teacher Education International Conference, Orlando, FL.

Gonzales, C., Pickett, L., Hupert, N., & Martin, W. (2003). The regional educational technology assistance program: Its effects on teaching practices. *Journal of Research on Technology in Education, 35*(1), 1-18.

Harrison, A., Rainer, R., Hochwarter, W., & Thompson, K. (1997). Testing the self-efficacy-performance linkage of social-cognitive theory. *The Journal of Social Psychology, 137*(1), 79-87.

Koul, R., & Rubba, P. (1999). An analysis of the reliability and validity of personal Internet teaching efficacy beliefs scale. *Electronic Journal of Science Education, 4*(1).

Leh, A. (2000, February). *The impact of the technology course on inservice teachers.* Paper presented at theSociety for Information Technology & Teacher Education International Conference, San Diego, CA.

Milbraith, Y. L., & Kinzie, M. (2000). Computer technology training for prospective teachers: Computer attitudes and perceived self-efficacy. *Journal of Technology and Teacher Education, 8*(4), 373-396.

National Center for Education Statistics. (2000). *Teacher use of computers and Internet in public schools. Stats in brief.* (NCES Publication No. 2000090). Washington, DC: U.S. Government Printing Office.

National Center for Education Statistics. (2002). *Internet access in U.S. public schools and classrooms: 1994-2001.* (NCES Publication No. 2002018). Washington, DC: U.S. Government Printing Office.

Norman, M. (2000). The human side of technology. *Educational Digest, 65*(7), 45-52.

President's Committee of Advisors on Science and Technology, Panel on Educational Technology (1997). *Report to the president on the use of technology to strengthen K-12 education in the United States.* New York: D.E. Shaw & Co.

Reed, W., Ervin, J. & Oughton, J. (1995). Computers and elementary education students: A ten-year analysis. *Journal of Computing in Education, 27*(3), 297-317.

Reehm, S., Long, S., & Dickey, J. (2001, March). *A comparison of preservice, inservice, and nonteacher education majors on technology confidence, ability, and use.* Paper presented at the Society for Information Technology & Teacher Education International Conference, Orlando, FL.

Ross, J., Hogaboam-Gray, A., & Hannay, L. (2001). Effects of teacher efficacy on computer skills and computer cognitions of Canadian students in grades K-3. *The Elementary School Journal, 102*(2), 141-156.

Skinner, R. (2002). Tracking tech trends. *Education Week, 21*(35), 53-67.

Sottile, J., Watson, G., & Iddings, W. (1998, March). *The relationship of computer anxiety and computer competence among rural K-12 math and science teachers.* Paper presented at the annual meeting of the Eastern Educational Research Association, Tampa, FL.

U.S. Department of Education (2000). *Does professional development change teaching practice? Results from a three-year study.* Retrieved August 28, 2005, from: http://www.ed.gov/rschstat/eval/teaching/epdp/report.pdf

U.S. Department of Education (2002). *Guidance on the enhancing education through technology (Ed Tech) program.* Retrieved August 28, 2005, from http://www.ed.gov/programs/edtech/guidance.doc

TITLE: Technology Professional Development: Long-Term Effects on Teacher Self-
SOURCE: Journal of Technology and Teacher Education 14 no1 2006
PAGE(S): 151-65
WN: 0600105884009