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The Impact of a NCLB-EETT Funded Professional Development Program on Teacher Self-Efficacy and Resultant Implementation

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Abstract
In response to the need to train teachers to effectively integrate technology into elementary and secondary education, a teacher professional development program funded by a federal grant provided a selection of instructional technology integration courses to K–12 teachers. This study investigated the impact of these courses on the course participants' self-efficacy in learning about and implementing instructional technology. The study also explored the differential effects of these courses on participants' self-efficacy due to different demographic characteristics. The data analyses from the pre-/post-/follow-up surveys completed by 377 course participants revealed that the grant-funded courses did increase participants' confidence and competence in technology integration. No significant difference was found on course effects between participants with different demographic characteristics. The qualitative data from interviews with the course participants confirmed the survey results, and the positive perceptions of the course effectiveness from the participants suggested an overall success of the program. (Keywords: instructional technology integration, K–12, self-efficacy, teacher professional development.)

INTRODUCTION

The use of technology in schools to enhance the teaching and learning process has been a major focus in school development from the infrastructure and policy level to curriculum redevelopment for nearly 20 years. Recent reports indicate that schools have, for the most part, been successful at the infrastructure level with more than 90% of schools providing student access to computers with broadband connections to the Internet at a 3.8:1 ratio (Parsad & Jones, 2005; Wells & Lewis, 2006). However, while the use of technology by teachers and students is nearly ubiquitous, the primary use remains largely at lower-level productivity-type tasks such as word processing, e-mail, basic Internet search and electronic presentations (Lanahan, 2002).

Stages of Technology Integration Professional Development

During the relatively short time computers have been in schools, they have repeatedly been recognized for their potential to provide an open, creative learning environment in which students can think and create knowledge at higher levels. Well known examples spanning the years are the Logo programming environment (Papert, 1980), the use of standard productivity tools for knowledge construction (e.g., Jonassen, 1996, 2000), and the structured inquiry of WebQuests (Dodge, 1995). The "catch," also recognized long ago, is that technology must become personally meaningful before faculty can use it to help others (Bozeman & Spuck, 1991; Hall, George, & Rutherford, 1977; Kell, Harvey, & Drexler, 1990), which logically leads to a professional development focus on teacher use of productivity tools before technology integration to enhance student learning. This progression is followed by many longer-term technology training efforts and is epitomized by the new Capstone courses developed by the International Society for Technology in Education [ISTE], funded by the U.S. Department of Education (Seal of Alignment, 2007), and offered through the Public Broadcasting Service's [PBS] Teacherline. This rigorous program consists of three separate courses beginning with a self-directed introductory unit. The second and third courses—Capstone I and Capstone II—are 15-week full-fledged courses; the former focuses on productivity uses of technology by teachers and the latter focuses on enhancing student learning with technology. The courses, based on the National Educational Technology Standards for Teachers and Students [NETS·T & NETS·S], have been adopted in varying degrees by 49 states (Use of NETS by State, 2007).

The above example also illustrates the intensity and time required for teachers to become what can be considered fully competent in using the broad array of technology available to enhance the efficacy of teaching and learning. Clearly, professional development programs cannot match such a program in terms of breadth and depth. To further confound the issue, many varied definitions of "technology integration" exist (Bakia, Mitchell, & Yang, 2007). However, the definition proffered by ISTE stands out:

> Curriculum integration with the use of technology involves the infusion of technology as a tool to enhance the learning in a content area or multidisciplinary setting. Technology enables students to learn in ways not previously possible. Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should become an integral part of how the classroom functions—as accessible as all other classroom tools. (International Society for Technology in Education, 2002, p. 3)

By this definition, many teachers have still not yet progressed much beyond using technology for their own productivity and creating teaching materials for their students (e.g., Ertmer, 2005; Kersaint, Horton, Stohl, & Garofalo, 2003; Paige, Hickok, Ginsburg, & Goodwin, 2003). To reduce this deficit, one of the major components of the No Child Left Behind [NCLB] Act of 2001, signed into law by President George W. Bush, the Enhancing Education Through Technology [EETT] program, also known as E2T2, was established to provide funding for technology integration and teacher professional development (U.S. Department of Education, 2002). Half of the funding is given to school districts based on formula with the remainder dedicated to Title II, part D, regional competitive grants. One of these five-year grants (now extended to a sixth year) was awarded to the Consortium for Interactive Instruction [C.I.I] hosted by WHRO—a local national educational television station located in Southeastern Virginia.

Professional Development Model

The professional development model successfully proposed by the WHRO/C.I.I. consortium consists of two major components. The first is to offer selected six-week online courses provided by PBS Teacherline® to any teacher or staff member of its 18 participating school districts in southeastern Virginia. At the time of this writing, a wide variety of courses have been delivered ranging from specific foci on particular subject areas (e.g. "Integrating the Internet into the K–2 Language Arts Curriculum) to the use of specific software (e.g., "Teaching and Learning with Graphic Organizers: Featuring *Inspiration*") to technology-reliant pedagogies (e.g., "Utilizing Technology in Creating a Problem-Based Curriculum"). Some basic productivity courses are available but the vast majority is focused on using technology to enhance students' higher-order thinking and learning. The second component is comprised of two related one-week, face-to-face technology immersion courses offered during the summer: TechTrek I deals primarily with the uses of productivity tools, and TechTrek II concentrates on enhancing teaching/learning via technology within a problem/project-based learning environment. All PBS Teacherline and TechTrek courses sponsored by this project are staffed by local facilitators. Notably, participants can take as many courses as they wish.

Effectiveness Evaluation

Since the NCLB Act is intended to improve student learning, measuring student knowledge levels is the obvious—and most desirable—path to assess the impact of the funded efforts. However, because the "treatment" in this particular effort is a professional development program for teachers in 18 school districts who self-select to take one or more courses offered by the program, measuring student achievement at the classroom level is not a viable option. Many confounding variables likely obscure student learning differences that could be attributed to teacher changes resulting from grant-inspired pedagogical modification. Therefore, the next best approach should be to examine changes experienced by the grant participants. One of the most accepted methods for doing so is the assessment of self-efficacy as an indicator of one's ability to implement a particular course of action which, in this case, is the implementation of technology-based/enhanced teaching and learning strategies.

Self-efficacy and Institutional Environments

Self-efficacy is a form of motivation and is therefore related to one's intention and persistence to engage in specific behaviors in situations that may be influenced by environmental factors, such as resources, peer influence, and administrative support (Bandura, 1986, 1997; Schunk & Pajares, 2002). In a school faculty context, self-efficacy refers to a teacher's desire to implement the teaching strategies he/she believes to be appropriate and efficacious and, perhaps more importantly, the tenacity with which he/she will persist in trying to do so given the academic "climate" of their school. School climate consists of various aspects including levels of access to needed resources, the congruence, compatibility and/or acceptance of the teacher's epistemology, resultant teaching/learning strategies with those of other teachers, and the level of support from school administrators and even parents (Ertmer, 2005; Zhao et al., 2002). A consideration of these types of environmental factors might lead to a "chicken and egg" argument about what should come first: the infrastructure, administrative support, curricular orientation toward technology-enhanced teaching and learning, or educating teachers about the instructional advantages technology offers in order to modify their epistemological and pedagogical orientations? However, that argument is largely moot. As reported above, reasonably up-to-date technology is available in schools and access for teachers and students is good. More specifically, the schools from which the sample of this study was drawn provide good access to hardware, software, technical support, instructional support, and, importantly, high levels of administrative support (Overbaugh & Lu, 2007). Therefore, it is reasonable to conclude that teachers who wish to implement curricular change that they believe to be advantageous and—critically—that they believe they can implement successfully, will not be faced with environmental obstacles. Therefore, examining changes in teachers' beliefs about teaching and learning with technology is a sagacious way to infer classroom implementation.

Self-efficacy and Teacher/Student Performance

According to Bandura (1997), building self-efficacy is an important first step toward developing the capacity to perform a particular skill. Pajares (1992) also argued that there is a strong relationship between teachers' educational beliefs and their instructional decisions and classroom practices. In the context of instructional technology, it is generally believed that to effectively use technologies in the classroom, only possessing technological skills is not enough; teachers must first believe that they are capable of implementing them in instruction. Olivier and Shapiro (1993) supported the notion by stating that without a sufficient level of self-efficacy for performing computer tasks, technology integration may not even be attempted. An oft-cited study by Marcinkiewicz (1993/94) reported that elementary teachers' use of computers for teaching was associated with their belief in their ability to do so, a finding repeated by Lumpe and Chambers (2001) in other grade levels with similar results. Furthermore, teachers' self-efficacy was found to be related to student achievement. On the basis of their extensive literature review on the theory and practice of self-efficacy, Tucker and his associates posited that teachers' sense of efficacy is one of the few teacher characteristics consistently related to student achievement (Tucker et al., 2005). Berman and McLaughlin (1977) concluded, after evaluating 100 Title III Elementary and Secondary Education Act [ESEA] projects, that a teacher's sense of efficacy was positively related to improved student outcomes. A significant positive relationship was also found between teacher efficacy and the Metropolitan Achievement test scores for students in high school basic skills in math and language (Ashton & Webb, 1986). Given these and other aspects of the importance of teachers' self-efficacy on their learning and using technology, and the resultant impacts on student achievement, it is of practical value to probe the program participants' self-efficacy as an indicator of the success of the program.

The purpose of this study was to investigate whether these short-term instructional technology courses provided by the WHRO/C.I.I. consortium helped participants develop both competence and confidence to integrate technology into their curricula by examining participants' self-efficacy levels before and after the course training. This study also explored course effectiveness in relation to participants' demographic factors. The research questions addressed were: 1) Did the WHRO/C.I.I. instructional technology courses sponsored by the NCLB-EETT professional development program increase participants' self-efficacy for technology integration in the classroom?, and 2) Did the WHRO/C.I.I. instructional technology courses sponsored by the NCLB-EETT professional development program have any differential effects on participants' self efficacy due to demographic factors: (a) age, (b) gender, (c) education level, (d) school level, (e) school location, and (f) the number of WHRO-C.I.I. courses previously taken?

METHOD

The data presented here were collected from the WHRO/C.I.I. teacher professional development program funded by the NCLB-EETT grant. The study was essentially a quantitative design with pre-/post-/follow-up measures. To triangulate the data, qualitative data were also collected from interviews with the program participants as a secondary source of data to help better understand the effectiveness of the program and its impact on participants' competence and confidence in technology integration.

Sample

The sample consisted of PK–12 in-service teachers from 18 WHRO/C.I.I. consortium member school districts in southeastern Virginia who voluntarily took one or more of the grant-funded courses (free to teachers) during the second and third grant fiscal years (2004–2006), which included 75 six-week PBS Teacherline courses and six one-week summer TechTrek courses. All participants were required to complete an online pre-course survey before they were exposed to any course content and activities. They completed the same survey immediately after the course (post-survey), and again several months after the course ended (follow-up survey). The sample consists of 377 participants who completed the pre-/post-/follow-up surveys, of which 58 (15%) were male teachers, and 319 (85%) were females. Two hundred and twenty-four (59%) had not taken any previous WHRO-C.I.I. courses, 121 (32%) had taken 1–3 courses, and 32 (9%) had taken more than four courses. Regarding school location, 124 (33%) participants taught in urban schools, 185 (49%) in suburban schools, and 68 (18%) in rural schools. In terms of participants' age, 16 (4%) were under 25 years old, 52 (14%) were between 25 and 30, 83 (22%) were between 31 and 40, 117 (31%) were between 41 and 50, and 109 (29%) were over 50 years old. As far as participants' education level was concerned, 157 (42%) had earned bachelor or associate degrees, 199 (53%) had master's degrees, and 21 (5%) had post graduate degree or specialty certificates. One hundred and seventy-one (45%) participants taught in elementary or prekindergarten schools, 79 (21%) taught in middle schools, 82 (22%) taught in high schools, and 45 (12%) participants did not provide this information in the survey.

Treatment

Funded by the NCLB-EETT grant, WHRO/C.I.I. has been offering its participating school districts six-week-long asynchronous online courses provided by PBS Teacherline. The design and structure of PBS TeacherLine courses are based on best practices and current research that highlight the importance of online learning communities. The key course features and elements include: 1) group interaction among learners and facilitators through a *Discussion Board* (one of the functions of *Blackboard*) to create a supportive learning community, 2) threaded discussion initiated by course facilitator at scheduled internals to allow learners to be engaged in high-quality focused theme discussion, 3) purposeful virtual spaces to enable learners and facilitators to share personal information through e-mail, and 4) session assignments and a final project reflecting the overall goals and objectives of the course. Most courses can be used to satisfy teacher professional development requirements and earn graduate credits.

In addition to the online courses, WHRO-C.I.I. also offers face-to-face technology immersion courses—Tech Trek I and Tech Trek II. These weeklong summer courses are designed to increase participants' technical competence and help them develop technology enhanced curriculum lessons to strengthen student learning. Participants are provided with intensive hands-on technology experience guided by the course facilitators and assisted by computer lab assistants. These courses are also eligible for graduate credits.

Instruments

Self-Efficacy Survey. A 17-item Self-Efficacy instrument was developed by the authors specifically for this program, comprising four domains: (a) Technology and Curriculum Standards (assessing participants' knowledge and understanding of the national and state standards corresponding to the course content—referred to as "Standards" hereafter), (b) Product/Productivity (assessing participants' use of new technologies/instructional strategies to prepare and present instructional materials—referred to as "Product" hereafter), (c) Process/Learning (assessing the use of new technologies/instructional strategies to enhance learning by participants' students—referred to as "Process" hereafter), and (d) Course Delivery Method and Media (assessing the efficiency and effectiveness of the technology tools via which the course was delivered—referred to as "Medium" hereafter). However, a single, generalized self-efficacy instrument would not be suitable for this research because "self-efficacy beliefs are both more task- and situation-specific and [because] individuals make use of these judgments in reference to some type of goal" (Pajares, 1996, p. 546). Therefore, a base instrument consisting essentially of "root" barrier questions was designed and, for each course, the questions in the first three domains were altered slightly to align with the outcomes specific to each course. For example, Item 7 in "Product" was worded as "I feel confident that I can identify quality guidelines for teaching vocabulary" for a language arts course, and as "I feel confident that I can identify quality online resources for use in my addition/subtraction lessons" for a math course. Participants were asked to rate how confident they were in performing the task stated in each item on a 4-point Likert-scale ranging from "*no confidence at all*" to "*complete confidence*". The Self-Efficacy survey instrument was pilot tested and refined during the first grant year—2003. The final instrument had composite alpha reliability coefficients of .94 for "Standards," .91 for "Product," .94 for "Process," and .93 for "Medium."

Interview Protocol. To guide the interviews with the participants, a semi-structured interview protocol was constructed by the authors based on a review of literature, and the goals of the program. The questions focused on participants' attitudes toward the impact of the course(s) on their technology competencies, their confidence and willingness to integrate what they learned in the course(s) in their instruction, and their perceived effects of using technology on their students' learning. *The Interview Protocol* was reviewed by two university professors with expertise in research methodology, and pilot tested with 10 participants in the first grant year (2003-4). Revisions were made according to experts' comments and the results of the pilot tests.

Procedure

Self-Efficacy Survey. The self-efficacy instrument was created and delivered with the *Inquisite* survey software. All participants were requested to complete the pre-course survey and post-course survey at the beginning and end of each course monitored by the course facilitators via the course delivery tool (*Blackboard*). The follow-up survey URL was e-mailed to all participants by the program evaluators (the authors) a few months (3-6) after they completed the course, allowing sufficient time for them to implement the new technology/strategies they learned from the courses. Two reminder e-mails were sent to non-respondents at one-week intervals. A total number of 962 participants completed the pre-survey and post-survey. Due to various reasons (moving, e-mail failure, disregard, technical problems, etc.), 456 participants (47%) responded to the follow-up survey. After data cleaning, 337 matched valid data sets remained. Data confidentiality was guaranteed.

Interview. Potential interviewees were selected randomly from the course participants and contacted via e-mail by the authors, requesting their voluntary participation in the interviews. Because of e-mail delivery failure, time conflict, availability, and negligence, 51 participants were finalized to be interviewed, among whom an overwhelming majority was female (N=47/92%). A large proportion of the interviewees were PK–6 teachers (N=22/43%); the number of middle and high school teachers was very close (N=14/27% and N=12/24% respectively); and the remaining three interviewees (6%) were either school administrators or technology resource personnel. Half the interviewees taught in suburban schools (N=26/51%), over one third taught in urban schools (N=17/33%), and about one sixth (N=8/16%) taught in rural schools. More older teachers participated in the interviews: Seventeen (33%) were over 50 years old, sixteen (31%) were between 41 and 50, thirteen (26%) were between 31 and 40, only five (10%) were between 25 and 30 years old, and none of the interviewees were below 25 years old. The interviews took place about the same time the follow-up survey was administered. All interviews lasted about 30 to 40 minutes and were conducted face to face at a location selected by the interviewees. While guided by the semi-structured interview protocol, the researcher probed respondents for further information when appropriate. Participants were assured that their responses would be confidential and be seen only by the grant evaluators (the authors). All interviews were audio taped and transcribed, and member checks were applied during the interviews for clarification, explanation, and confirmation whenever necessary.

Data Analysis

Self-Efficacy Survey. To examine the changes in participants' self-efficacy levels related to instructional technology integration as a result of taking the professional development courses, one-way repeated measures analysis of variance [ANOVA] were conducted. The within-subject factor was the survey administration time with three levels (pre-survey, post-survey, and follow-up survey), and the dependent variables were the three categories in the Self-Efficacy Survey—*Standards, Product,* and *Process*. As the fourth category—*Medium*—solely tested the effectiveness of the course delivery tools and had no relation to the purpose of this study, it was excluded in the current data analysis.

To assess whether the courses had any differential effects on participants' self efficacy due to demographic variables, a two-step data analysis plan was followed. First, a stepwise multiple regression was conducted to identify the possible demographic variables that predict participants' overall self-efficacy levels in instructional technology integration. Second, one-way analysis of covariance [ANCOVA] was performed on the three self-efficacy measures (*Standards, Product, Process*) from the post-survey data (dependent variables) to evaluate the course effects on the significant demographic variables from the regression analysis (independent variables), adjusted for differences on the pre-survey measures (covariate).

Interviews. The transcripts from the audiotapes recorded during the interviews were analyzed using a qualitative approach to search for categories, themes and patterns emerging from the data (Patton, 2001). The qualitative data in this study served as a complementary data source to help explain the quantitative results and better understand the course impacts on participants' learning and implementing instructional technology. Using the qualitative data analysis software—*NVivo,* the transcripts were first coded by one author, and then reviewed and revised by the other author. Whenever a discrepancy occurred, full discussions were carried out between the authors until agreement was achieved.

QUANTITATIVE RESULTS

The first research question investigated the course effects on participants' self-efficacy in technology integration. Three repeated measures ANOVAs were performed on the three self-efficacy measures (*Standards, Product,* and *Process*—dependent variables) to examine the changes in participants' self-efficacy levels from the pre-survey to post-survey, and to the follow-up survey (independent

Table 1: ANOVA Results for Participants' Self-Efficacy

Dependent Variables	Wilks' Λ	df	F	p	η2
Standards	.37	2	107.61	.00*	.37
Product	.63	2	108.56	.00*	.38
Process	.55	2	155.05	.00*	.45

** Significant at .05 level*

variables). The overall ANOVAs were significant on all the three dependent measures, and the effect sizes were large: on *Standards*, Wilks' $\Lambda = .37$, F (2, 375) = 107.61, $p < .01$, $\eta^2 = .37$; on *Product,* Wilks' $\Lambda = .63$, F (2, 375) = 108.56, $p < .01$, $\eta^2 = .38$; on *Process*, Wilks' $\Lambda = .55$, F (2, 375) = 155.05, $p < .01$, $\eta^2 = .45$ (Table 1). Following the significant ANOVAs, three pairwise comparisons (pre-post; pre-follow-up; post-follow-up) were conducted on each dependent variable to assess which means differed significantly from each other. The paired-sample *t*-test comparisons (Table 2) revealed that there were significant differences in the means between the pre-survey and post-survey, and between the pre-survey and follow-up survey on all three dependent variables, whereas no significant differences were found between the post-survey and follow-up survey on any of the dependent variables. The descriptive statistics (Table 3 and Figure 1) show that there was a large mean increase in participants' self-efficacy levels from the pre-survey to post-survey on all three dependent variables, with the biggest increase in "*Process.*" Participants' self-efficacy levels stayed stable on each of the three dependent variables from the post-survey to follow-up survey even though there was a slight decrease. This result indicated that the courses did help the participants gain competence and confidence in instructional technology integration.

Table 2: The Paired-Sample T-Test Comparisons on Participants' Self-Efficacy

Dependent Variable		Mean Difference	SD	df	t	p
Standard	Pre vs. Post	2.85	3.10	376	17.86	.00*
	Pre vs. Follow-up	2.72	3.28	376	16.08	.00*
	Post vs. Follow-up	.14	1.79	376	1.50	.14
Product	Pre vs. Post	2.52	2.83	376	17.33	.00*
	Pre vs. Follow-up	2.40	2.83	376	16.45	.00*
	Post vs. Follow-up	.13	1.49	376	1.66	.10
Process	Pre vs. Post	3.97	3.71	376	20.82	.00*
	Pre vs. Follow-up	3.69	4.04	376	17.75	.00*
	Post vs. Follow-up	.28	2.10	376	2.62	.07

** Significant at .05 level*

Table 3: Descriptive Statistics on Participants' Self-Efficacy

Dependent Variables	Pre-Survey		Post-Survey		Follow-up	
	M	SD	M	SD	M	SD
Standards	12.24	3.08	15.10	1.45	14.96	1.48
Product	12.84	2.75	15.36	1.21	15.23	1.29
Process	14.70	3.73	18.68	1.75	18.39	1.95

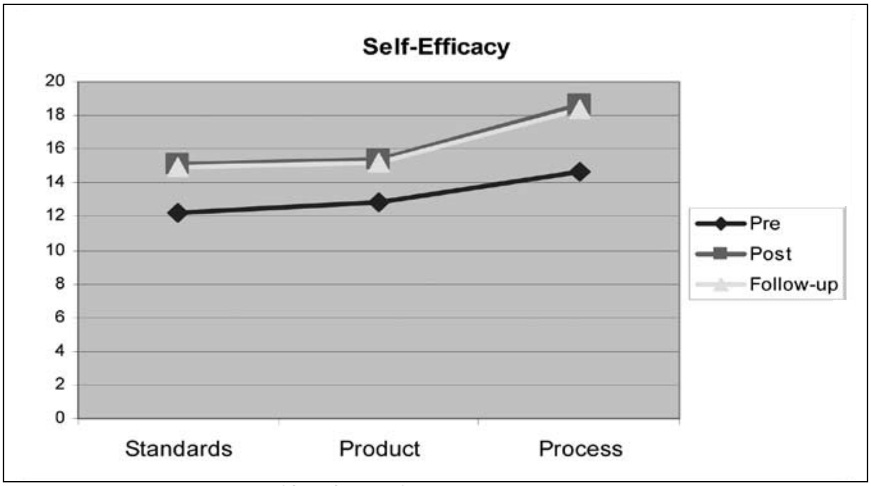

Figure 1: Participant Self-Efficacy by Survey-Time

To address the second research question, whether the NCLB-EETT sponsored courses had any differential effects on participants' self efficacy due to the demographic variables, a stepwise multiple regression was first conducted to determine which demographic variables were related to participants' overall self-efficacy in instructional technology integration. Using participants' overall self-efficacy scores—sum of the three self-efficacy categories (Regression was first performed on the three categories separately, and then on the sum of the three. The results were very close) recorded in the pre-survey as the criterion variable, six demographic variables (predictors) were entered into the equation: age, gender, school location, school level, education level, and the number of WHRO/C.I.I. courses previously taken (# of previous courses). The regression analysis produced a model of two variables that best predicted participants' overall self-efficacy: # of previous courses ($R^2 = .03$, $R_{adj} = .02$; $F(1, 324) = 7.17$, $p < .01$), and education level ($R^2 = .04$, $R_{adj} = .03$; $F(1, 323) = 6.26$, $p < .01$). A summary of regression coefficients between each predictor and the criterion variable is presented in Table 4.

Next, one-way ANCOVA was performed for the two significant demographic variables from the regression analysis (*"# of previous courses" and "education level"*) to investigate whether the course effects were related one way or the other to these two demographic variables (independent variables). The dependent

Table 4: Coefficients for Final Model

Predictor	*B*	*β*	*t*	*p*	Bivariate *r*	Partial *r*
# of Previous Courses	2.135	.172	3.09	.002	.147	.069
Education Level	-1.994	.-127	-2.29	.023	-.094	-.126

variables were participants' post-survey scores on the three self-efficacy measures (*Standards, Product,* and *Process*), and the covariate was participants' pre-survey scores on the same three self-efficacy measures. The number of technology-related courses previously taken was divided into three groups: 0, 1–3, and 4–6. The education level variable included three categories: bachelor or under, master's, and post-graduate. No significant differences were found on any dependent measures for either independent variable. This result revealed that the WHRO-NCLB courses served equally well participants with various technology and educational background.

Qualitative Results

To triangulate the data and better understand the course effects on participants' learning and instructional technology integration, interviews were conducted with a sample of course participants (N=51) a few months after they completed the course. Interview transcripts were analyzed using an inductive qualitative approach, and the results were consistent with the quantitative findings. A common thread was that the participants had very positive attitudes toward the NCLB-EETT funded courses, and they strongly believed that the courses not only improved their computer skills, but most importantly, gave them the confidence and willingness to meaningfully integrate technology into their curricula which benefited their students. Below is a summary of major findings from the interviews.

First, the NCLB-EETT funded courses were generally perceived as "helpful, useful, informative, and successful." All interviewees expressed their appreciation for the opportunities to work with the experts to update their technology knowledge and skills. They valued the "forced time" to have "real hands-on" practice on what was introduced. They believed that their "awesome and incredible experiences" in the course in which they felt "stretched, challenged, and sometimes overwhelmed by the enormous amount of information on technology and the myriad of ways to use it in the classroom" would definitely impact their teaching and, ultimately, their students.

Second, all interviewees agreed that they had learned a lot of new computer and Internet skills, tools, resources, and instructional strategies which made them more comfortable and confident in using technology. They commented that the new technologies added richness and variety to their professional lives and that the job of teaching became easier to manage. One teacher told the authors excitedly that she was now the most knowledgeable person in technology in her school and she could help other teachers with many computer and Internet issues. A physical therapist stated proudly: "I'm now able to provide Special Ed teachers with more safe and efficient tools, materials and strategies which meet the special needs of individual students, such as those who have visual deficiencies, or those who have audio problems. I should say I can better help teachers improve their teaching with the help of technology." Another teacher revealed personal changes resulting from taking the course: "Before I took the workshop, I was not confident in my computer skills. I often worried that I might destroy the system, or damage the computer because of inappropriate use. I was also concerned whether my documents were traceable or in good format, etc. Now as I know more about computers, I've become more interested in it, and use it more frequently."

Third, some interviewees acknowledged that the NCLB-EETT funded courses expanded their knowledge base in technology and empowered them to use it in more sophisticated, efficient, effective, and meaningful ways. Typical comments were: "I'm now able to use more computer applications and access more online resources;" "I have better Internet search techniques, which was very time consuming for me before;" "I knew some basic functions of Graphic Organizers in the past, but now I'm able to use it at a more complicated and sophisticated level, and thus make it more effectively serve my teaching purpose."

Fourth, most interviewees believed that their learning experience in the course helped them successfully incorporate technology into their instructional practice. One elementary school teacher created an e-story program during the course, which inspired her to write and receive a grant of her own. Her program is now used in the whole school district. Another teacher produced a research project with "*Inspiration*" (a graphic organization software program), which brought in a grant for implementation. Now not only she, but her students and other teachers are able to use "*Inspiration*" for their projects. Some teachers expressed that the courses helped them advance their professional endeavors, as one put it: "The course opened a new world for me. Because I have access to more information, I have to think critically, to evaluate, to make judgments, to select, really—to work at higher levels. Now I'm able to organize the instructional materials and design my lessons in ways that help my students think critically and solve problems."

Fifth, many interviewees reported that their students became more interested in and skillful with technology as a result of their being more capable technology consumers. They were very happy that the courses empowered them to help their students use technology. They said: "As my knowledge in technology increases, my students understand more about technology, and they get excited whenever I try new things;" "Formerly when students did projects, I simply took them to the computer lab to watch videos; now I can introduce them to good Web sites, and show them how to use different computer applications, how to search for information, and how to use other resources to help them in learning. Nowadays, my students are more willing and comfortable to use technology and are able to use it in a wiser and more productive way, not just sticking to games." One teacher approached this issue from a different angle: "The course prepared us to better meet student needs. Our students are a computer generation. Teachers often find themselves falling behind their students. This course really helped teachers to meet the technology challenges by their student."

Sixth, a considerable number of interviewees shared the notion that technology expands the traditional teaching materials and conventional instructional procedures, allowing teachers to have more alternative approaches, and thus making the teaching/learning process more productive and appealing to students. They repeatedly articulated that whenever technology was incorporated into instruction, students would become more motivated, enthusiastic, focused, attentive, and interactive in the learning process. They also posited that because students liked technology, they enjoyed doing classroom activities with technology, and thus learned better with technology. Comments included: "Because kids are fascinated in and skillful with the computer, using technology in teaching provides kids opportunities to learn and do what they enjoy and are good at, and this makes them learn more actively and be more responsible for their own learning;" "We use technology in collaborative education where regular kids and special kids learn together. Obviously, they are more actively involved in learning activities and have deeper understanding of what is covered;" "Technology helps enrich the teaching and learning experiences for me and my students. For example, in teaching the earth, instead of simply reading and explaining, I show my kids rocks, layers, lava, etc. By doing so, the knowledge makes more sense to them. I can tell students are more engaged in their learning, and understand better;" "The technology tools and the instructional strategies I learned from the course enable me to ask high quality questions that help develop students' critical thinking and problem solving abilities;" "There is a lot of debate on the kind of textbooks and workbooks in terms of their relevance to SOL [the Standards of Learning] tests, which is really frustrating. With the help of Web resources, we don't have to rely solely on the textbooks, and we can get whatever information we think is helpful in preparing students to meet SOL standards."

Seventh, a significant number of interviewees opined that they would like to have follow-up courses offered regularly to help them keep up with new technologies. Some online participants proposed that it would be better for them to meet the instructor face to face at certain points such as at the beginning of the course to orient them to the course format and course content, and/or some time after the course ended to help them resolve new challenges faced when they began to implement what they learned from the course. They also mentioned that course facilitators were very important to the success of the instruction and were very forthcoming with the names of several facilitators who they believed were excellent and had played an important role in developing their competence, confidence, and willingness in learning and implementing technology integration.

Last, it seemed that more interviewees who taught in rural schools than those in urban and suburban schools were concerned about the access to adequate and appropriate technology recourses: They either did not have essential hardware and software, or the devices were too old, slow, and incompatible with new educational software and networks. They also voiced complaints about the unavailability and inefficiency of the technology support staff, which prevented them from efficient and effective technology integration. It appeared that older interviewees were more enthusiastic about the program—they were excited that the courses "opened a new world" which put them on top of the most up-dated instructional technology. In contrast, younger teachers suggested that the courses be organized according to levels of participants' pre-course technology knowledge and skills for maximum benefit.

DISCUSSION

Course Effects on Participants' Technology Integration Self-Efficacy

The primary finding in this study was the elevation of participants' self-efficacy levels from pre- to-post survey and the maintenance of those levels to the follow-up point. The pre- to post-survey results are not particularly interesting as a rise in efficacy immediately following instruction is to be expected. The change does, however, support the validity of the survey items thus reinforcing the process of customizing the items to match the content of each course. The change in efficacy scores is also good because one would suspect that because these courses were taken voluntarily, those who chose to take the extra time to do so are likely teachers who are already motivated, forward-thinking professionals with reasonably high confidence levels to start with. The most impressive finding, though, is the maintenance of the elevated levels over time. Recall that in all cases, the follow-up survey was given some months after each course concluded, allowing sufficient time for participants to implement their new knowledge, skills, and/or instructional strategies. The interviews confirmed that the professional development courses effected change in how participants taught, and many interviewees reported their students were learning more actively and thoroughly.

Standards. The standards domain assessed participants' confidence in what they know and understand about the technology/curriculum learning standards, and in their ability to explain and discuss these standards as well as effectively apply these standards in the curriculum. The significant elevation in this domain is very important albeit a little surprising; Virginia Standards of Learning have been in place since 1995, with significant state and federal initiatives aimed at ensuring that both teachers and students meet those standards. These results suggest that in spite of 12 years of a "standards centric" educational environment, teachers still have not mastered these standards. It is clear that the NCLB-EETT courses were very successful in strengthening teachers' confidence to operationalize the standards and help their students meet standards utilizing new instructional strategies and technological tools.

Product. The product, or productivity domain assessed participants' confidence in using new technologies and techniques to produce, locate, and/or assess materials and resources for use in the classroom ranging from productivity software, to curriculum mapping tools, to online databases and Web resources. In other words, this domain focused on the confidence the participants have to create rich, appropriate, and helpful learning environments using a variety of contemporary resources. The increase in participants' confidence in this domain is notable because, as discussed above, teachers typically become more competent and thus confident in using productivity tools/resources before progressing to curriculum revision and the implementation of new teaching and learning strategies. This finding is also interesting because the majority of the courses focused on technology-enhanced instructional strategies and techniques; therefore, the increase in this domain may indicate that because productivity-type technology use is subsumed within higher-level (process) uses, productivity-level self-efficacy will benefit as well.

Process. The process domain is perhaps the most important in terms of the teaching/learning process. This domain assessed participants' confidence to develop and implement changes in their basic pedagogy with a focus on generative learning strategies, such as problem-based learning, collaborative learning, cooperative learning, and learning communities enhanced by technology. Notably, the participants had the lowest mean score of confidence level in this area at the pre-test point compared to the *Standards* and *Product* domains (after adjusting for the unequal number of items in each domain), but had a larger increase at the post-test point. This is important and gratifying as these results show that the teachers who participated in the NCLB-EETT grant-funded professional development courses are not only more comfortable with productivity uses of technology and more confident with regard to the learning standards associated with their areas of concentration, but also much more confident that they can lead their students to meet those standards utilizing higher-level thinking and problem-solving skills grounded in new, or at least different, technology-based/enhanced pedagogical approaches. Given the fact that many teachers in the general population are still at basic stages of technology use with little meaningful technology integration (Ertmer, 2005; Kersaint, Horton, Stohl, & Garofalo, 2003; Paige, Hickok, Ginsburg, & Goodwin, 2003), this finding is really encouraging.

Differential Course Effects on Participants' Self-Efficacy

The second aspect of this study was to explore whether these NCLB-EETT grant-funded professional development courses would have differential effects on the self-efficacy of different types of participants based on several demographic variables: (a) age, (b) gender, (c) school level, (d) school location, (e) educational level, and (f) number of WHRO-C.I.I. courses previous taken. Multiple regression analysis indicated only the number of previous courses taken and educational level as being related to course participants' self-efficacy. However, the subsequent ANCOVAs showed that, when controlling for the pre-test self-efficacy effects on these two variables, there were no significant differences across groups with different education levels and different numbers of previous courses. The best explanation for this result is that the variety of course offerings and the design of the courses effectively and consistently met the instructional requirements of all types of participants. A number of factors support this contention. First, the class size of most courses was quite small (average 10–15), which made it possible for facilitators to tailor instruction according to learners' specific needs. Second, each course was led by a facilitator who had constant interaction with the participants and could thus address individual strengths and weaknesses. Third, the facilitators were all teachers in the same public school districts in which the participants taught, and therefore knew the Virginia Standards of Learning as well as local area school characteristics which likely enhanced mutual understanding and communication. Fourth, all online courses had a significant discussion component that enabled participants and facilitators to share ideas, exchange learning and teaching experiences, and help one another with their questions and problems so that participants' individual needs, interest, and concerns were addressed sufficiently and effectively. Last, all courses required the participants to create a curriculum related and technology-enhanced lesson plan as a course final project to reflect the course content and corresponding learning standards, which was supposed to be implemented in their own classrooms. All these factors provide an open, flexible learning environment in which all types of teachers can succeed.

Limitations and Future Research

Researchers interested in this area should address various limitations of the current study. First, the number of previous WHRO-C.I.I. technology-related courses was divided into four groups: 0, 1–3, 4 or more. These four categories were selected for logical convenience rather than via a statistical method derived from the data itself or simply blocking the sample by whole numbers from 0 to 6, which may have obscured possible differences. Second, the analysis was limited to matched pre-, post- and follow-up data sets, which reduced the sample size. Even after implementing a drawing (for gift-certificates to an office/technology supply chain-store), cooperation to complete both the post- and follow-up surveys was disappointing. However, one method utilized to strengthen the validity of the findings was to conduct pre-post and post-follow-up unpaired t-tests, which showed essentially identical results. The low response rate for the follow-up survey might also suggest that the data were positively skewed because those who responded to all surveys may be the more motivated and responsible professionals and thus more likely to maintain high confidence levels over time. Therefore, future research should take measures to maintain the response rate over all data collection points.

Finally, since face-to-face and online instruction are the two course delivery methods utilized for this particular NCLB-EETT funded teacher professional development program, a comparison of outcomes of the two methods as related to cost per participant is warranted. Clearly, any entity that funds programs with the intention to improve teaching and learning has a vested interest in their return on investment (ROI). In addition, such a report may contribute to future competitive grant proposals.

CONCLUSION

This study reports the positive effects of a teacher professional development program during the second and third fiscal years of a Regional, Competitive, NCLB-EETT grant, Title II, Part D, awarded to the WHRO/C.I.I. consortium in southeastern Virginia. The teachers who voluntarily enrolled in one or more of these courses clearly benefited in terms of their operational knowledge of state as well as national technology and content area standards, and their confidence to utilize technology not only for productivity uses, but most importantly, to enhance the teaching/learning process in their classrooms.

Contributors

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