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Investigating the Effectiveness of Futurekids Professional Development

A Treatment-Control Groups Study

SUBMITTED TO

FUTUREKIDS, INC.

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About CPP

The Center for Positive Practices exists to assist organizations and social systems in planning, implementing, and evaluating programmatic and systemwide practices to better meet the needs of their clients. We seek to work together with all sectors in society to find positive solutions to systemic problems. We emphasize culturally sensitive methods and collaboration between our clients and ourselves.

We are dedicated advocates of under-served children and communities, whose historical lagging in social justice may be attributed to inequitable policies, programs, processes, resources, and practices throughout the greater social system. We have chosen to specialize in positive practices because that is what communities in any system can most rapidly and effectively change to improve their commitment to their work, their status in the system, and their effective performance.

We offer research, evaluation, program development and technical assistance to organizations and systems throughout the country. We organize teams of professional consultants to carry out both small- and large-scale projects and activities.

Many of our staff have served on numerous projects sponsored by various national, regional, and state-level agencies and organizations, including the U.S. Department of Education, the New Mexico Commission on Higher Education, the Texas Education Agency, and various philanthropic foundations.

Authors

The authors of this research report are Dr. Joseph P. Martinez, Dr. DeborahWatson-Acosta, and Ms. Laura L. Chandler.

Organizational Information

We are an association of full- and part-time consultants working within the vision and mission of the Center for Positive Practices. The Center serves as the administrator, coordinator, and fiscal agent for the project. Each consultant must individually agree to be bid on any project and accept his or her roles and responsibilities for each project. This allows us greater flexibility for selection of team members who fit well with a given project, and a deeper commitment by all team members to the overall success of each project.

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EXECUTIVE SUMMARY

With proper guidance and training, teachers now can use technology to improve their performance on almost all aspects of the teaching-learning process. Teachers can use various computer applications to more efficiently manage information related to their classroom tasks. They can also use computers to more effectively present instructional materials. And, they can use computers as "mindtools," in which they and their students apply computer skills to enhance the learning process. But the initial challenge in schools, with regards to technology, is the basic computer literacy of the facilitators — teachers guide how computers are routinely used in the classroom.

Futurekids, Inc. is a worldwide provider of technology solutions to education systems. Along with many other services, it provides professional development (training) services designed to improve the computer literacy of teachers. The program's content is based on national standards of technology literacy. Its proprietary methods are based on a combination of site-based, project-based, and thematic pedagogical strategies which address skill development in authentic contexts of the participants, and the personal attitudes or perceptions associated with learning new technology skills. The present study conducted by the Center for Positive Practices, an objective third-party research organization, assesses the effectiveness of Futurekids professional development program based on teachers' computer literacy, and computer self-efficacy.

Computer literacy, how well teachers understand and are able to use computers, is the primary indicator of program effectiveness for the Futurekids program. The Idaho Educational Technology Assessment served as the computer literacy measure. Computer self-efficacy was also examined in this study because one's self-perceptions of capabilities to successfully accomplish a task is often either an inhibitor or facilitator to learning and performing well, especially in science, mathematics, and technical domains (such as technology). The level of computer self-efficacy that participants initially bring to the training, as well as how it changes over the course of training, are both factors that may significantly affect performance. The Computer Self-Efficacy Scale served as the self-efficacy measure for this study. Both measures have credible reputations. Internal consistency reliability coefficients on all measures in this study were very high ($r > .90$).

Findings from this treatment-control groups study demonstrate that Futurekids professional development participants performed significantly better than a non-treatment control group on the dependent variable, posttest computer literacy ($p = .053$, $p < .10$), and were significantly ($p < .05$) more likely to pass the posttest at the 75 percent cutoff score. Treatment participants also reported greater levels of post-program computer self-efficacy ($p < .05$). When either pre-program self-efficacy or prior computer experience is controlled for (as a covariate), the results are even more dramatic in favor of the treatment groups on both post-program computer self-efficacy and posttest computer literacy ($p < .001$).

These findings provide strong evidence that Futurekids professional development training is effective for improving both the computer literacy and computer self-efficacy of participating teachers.

INTRODUCTION

Goal 2: All teachers will use technology effectively to help students achieve high academic standards.

Most teachers have been prepared for a model of teaching dramatically out of step with what is needed to prepare the nation's students for the challenges they will face in the future.

We should … increase the quantity, quality and coherence of technology-focused activities aimed at the professional development of teachers.

(U.S. Department of Education, 2001)

At the time of this writing, the U.S. Department of Education had recently restated the educational technology goals for America's schools. The five goals, as one might suspect, deal with access to resources, professional development for teachers, student learning, research and evaluation, and networking. Of specific relevance to this study, and as quoted in the three lines above within the context of Goal 2, is the idea that teachers are in real need of technology-related preparation and professional development. Reports from numerous organizations, such as National Council for Accreditation of Teacher Education, American Council on Education, the National Commission on Mathematics and Science Teaching for the 21st Century echo this need.

What is most interesting about the problems stated above, is that there is also widespread agreement on what are the potential solutions. In this era of standards and accountability (and massive information sharing), we have national organizations, associations, and commissions who do a remarkable job of assessing needs and establishing standards designed to address those needs.

In the field of educational technology and computer literacy, the standards are in place and ever changing (ISTE, 2001; NCATE, 2001); although not quite as rapidly as the capabilities of computers themselves. Standards for implementing professional development are also continually addressed by the U.S. Department of Education and other educational associations. Together, the computer literacy and professional development standards point the way to what content, skills and knowledge should be covered, and even how they should be covered.

For technical assistance providers to the education system, the goals for educational technology and professional development are clear. Address the content and performance standards, and deliver training according to the best and most promising practices as established by research conducted by the most respected organizations. If providers are able to do that much, then their service recipients (teachers and administrators) shall be exposed to the highest quality of technology-focused activities agreed upon within the profession.

The evidence that a technology-focused professional development program is effective therefore could be objectively based on the articulated standards of the field of educational technology and measured by an instrument aligned to those standards.

PURPOSE OF THE STUDY

The present study assesses the effectiveness of a program, developed by Futurekids, Inc., which is designed in alignment with national educational technology standards (ISTE, NCATE, & NETS). The study design was commissioned in Fall 2000, and was implemented in various public schools in a highly urban school district in Southern California.

The primary purpose of the program is to train in-service teachers and administrators in the fundamentals of computer literacy. This includes an array of skills and knowledge about hardware and software uses. In addition, the program developers believe that the techniques they use in professional development enable participants to perceive themselves as capable users of educational technology, thus enabling them to remove personal barriers that affect their ability to learn and perform with educational technology in the classroom.

Program participants learn how to use a variety of software while working on projects that include creating a database, using telecommunications as a research tool, creating student handouts, producing classroom newsletters, and generating electronic grade books and multimedia presentations for their classrooms.

The professional development training course is composed of several lesson topics, as depicted in Table 1.

Table 1. Lesson Topics of the Futurekids Professional Development Program

Computer Basics	Operating Systems	Telecommunications
Wordprocessing	Graphics	Spreadsheets
Advanced Spreadsheets	Integration Models	Software Evaluation
Desktop Publishing Databases Advanced	Databases	Multimedia
Integrated Unit Design Integrated	Unit Creation	Integrated Unit Presentation

Note. These lesson topics closely mirror the categorical standards put forth by the major professional associations, ISTE and NCATE.

These topics are consistent with many taxonomies of computer literacy, and are also aligned with various content standards of professional organizations (e.g. ISTE, NET), and with various state and local technology-focused content standards.

The purpose of this study is simply to determine whether this particular professional development program effectively improves teachers' skills and knowledge on the specific topics identified above, and whether it also improves teachers' self-perceptions about using technology in schools.

Justification for the Study

Many education systems across the country are presently asking for evidence of effectiveness from technical assistance/professional development providers. A provider could easily be tempted to tell the stories of success that came about as a result of their intervention with a school. In many cases, they are probably justified in believing that their interventions are linked to any number of tremendous outcomes. Without question, teachers empowered with greater technology skills and knowledge have the potential to accomplish many great things too varied to measure. Providers, however, must not take credit for all outcomes beyond their specific purpose and contribution any more than they should take the blame. This requires that evidence of effectiveness studies be linked solely to the stated objectives, and actual inputs, activities, and outcomes of a given program.

We can and should, however, attempt to go beyond microanalytic studies of causality and associations when we study professional development training. We should strive for greater explanation and understanding of what takes place, how it takes place, and with what results. In a "real world" situation, there is often a lack of opportunity for clean, controlled laboratory studies. The methods we employ, therefore, should be based primarily on what gives us the best evidence of effectiveness given all of our opportunities and constraints. This study should serve as one component of the ongoing internal and external evaluation processes of the service provider.

The main objective of this treatment-control groups study was to investigate as simply and elegantly as possible the direct effects of Futurekids professional development program.

Evaluation Questions

The research questions for this study are as follows:

- To what extent do teachers acquire new computer literacy skills and knowledge as a result of participation in the program?
- Does incoming computer self-efficacy have a role in determining teacher performance on a computer literacy measure?
- Does incoming computer experience (background) have a role in determining teacher performance on a computer literacy measure?
- To what extent do teachers enhance their computer self-efficacy as a result of participation in the program?

Definitions

The major variables of this study are:

- **Program**: The Futurekids professional development program as conducted in Fall 2000/Spring 2001.
- **Computer literacy**: The extent to which participants are able to perform an array of computer-related hardware and software tasks, as specified in the program.
- **Background**: The level of computer literacy and attitudes toward computers that teachers have when they are enrolled in this study.
- **Computer self-efficacy**: The degree to which participants in the study believe that they will be successful in performing the various computer tasks provided in the program.

SUMMARY

Technology can be seen as a vast array of equipment, software, and processes. This complexity can affect the present study design in many ways. When we study technology-related performance, for example, should we look at hardware, software, or process skills? What about personal determinants? Are there perceptions that participants have about their own capabilities that confounds how well they perform after training? And, can faulty perceptions also be improved? These questions should be asked in any present-day study of technology training in education because of the following:

- the field is massive and rapidly changing so we need to narrow down our assessment focus to verify that it is aligned with the content and skills of the program intervention; and,
- while participants can "acquire" some basic skills directly from the intervention, they need also to attain a level of self-efficacy sufficient to pursue constant technology-focused learning on their own into the future.

The Center for Positive Practices (CPP) believes that the national content and performance standards represent the best of our collective thinking about technology-focused professional development skills and knowledge targeted for teachers. CPP also believes that proper standards are in place to guide how technology-focused professional development should be conducted in our schools.

This study investigates the effects of the Futurekids professional development program on the computer literacy and computer efficacy of in-service teachers. Computer background was also taken into consideration.

Computer literacy is measured by an instrument aligned to the national standards for educational technology. Computer self-efficacy is measured by a major reputable instrument for assessing the construct. Computer background is measured by the length of experience teachers have with technology.

RELATED STANDARDS AND RESEARCH

What exactly does it mean to be literate in the "post-modem" world? And what are educators talking about when they use the term "computer literacy" these days? ...If we ask five people to define "literacy," we're likely to hear 10 different answers.

R. W. Burniske (2001)

Definitions of computer literacy, and some would say technology, information, or media literacy, have abounded since 1972 (see for example, Kay, 1992 for a literature review of the previous 20 years). Despite multiple interpretations of these terms, they have all been revised over the years to coincide with new advancements of computer technologies. Because computer technologies and their functions change so rapidly, there will always be multiple definitions of this construct. This also explains why there have been multiple computer literacy assessments over the years (see Kay, 1993;). In addition, many computer attitude measurements have come and gone (see for example Massoud, 1990; Campbell and Williams, 1990).

The Rand Corporation (Glennan & Melmed, 1996), noting that the National Education Association had determined more than half of all teachers thought they had good computer skills, stated that "computer literacy is hard to pin down." The paradox continues today, because the issue is not whether teachers are computer literate, but whether they are reasonably proficient on a measure that actually measures computer literacy.

So, when we speak of such terms as professional development for computer literacy, or computer self-efficacy, it is important to define our terms.

Throughout the last decade, and particularly in response to requirements of the Improving America's Schools Act of 1994, the education system has focused on content and performance standards. To begin to understand what we are measuring when we purport to measure computer literacy in relation to professional development, we conducted a literature review of the computer literacy standards. We also surveyed the field for related measurement issues and instruments. In addition, we reviewed the related research on computer self-efficacy. The self-efficacy construct is widely known in social and experimental psychology, but rarely discussed in practical educational settings (Multon, Brown, & Lent, 1991; Schunk, 1991, 1994). The concept of self-efficacy with respect to computer literacy, however, has been studied for many years (Delcourt & Kinzie, 1993; Ertmer, Evenbeck, Cennamo, & Lehman, 1994; Murphy, Coover, & Owen, 1989). Its power to predict and explain phenomena in education, however, is becoming more and more evident (Schunk, 1994; Zimmerman, Bandura, & Martinez-Pons, 1992).

TECHNOLOGY AND PROFESSIONAL DEVELOPMENT

The major national and professional organizations concerned with technology use in education are the International Society for Technology (ISTE) and the National Council for Accreditation of Teacher Education (NCATE). These two organizations have for many years collaborated to adopt the same standards and benchmarks for teacher integration, student competencies, curriculum guidelines for educational technology, and teacher competencies (Ley, 1997; Taylor & Wiebe, 1994; Thomas, et al. 1994). Of particular relevance to this study, the ISTE has articulated very clear guidelines of what teachers should know and be able to do with regard to technology at various stages of professional development (Wiebe & Taylor, 1997; Peck, 1998; Dugger, 1997; Friske, et al. 1996). More recently, schools are beginning to realize that technology professional development is also appropriate for administrators (Heaton & Washington, 1999; Kajs, et al. 1999) and teacher assistants as well (Carney, 2000).

The National Educational Technology Standards Project (NETS) is also coordinated by the ISTE to continually develop national performance indicators for the educational technology. The NETS standards are aligned to the ISTE and NCATE frameworks. Content and performance standards developed by the NETS Project also serve to guide educational technology instructional and professional development content for both students and teachers. As of 1998, the standards established by NETS were divided into six broad categories for students and teachers: 1) basic operations and concepts; 2) social, ethical, and human issues; 3) technology productivity tools; 4) technology communications tools; 5) technology research tools; and 6) technology problem-solving and decision-making tools.

The definitions and specific content and performance standards for computer literacy are therefore reasonably defined. The Futurekids professional development program has for many years developed its curriculum to align to these standards given our review of the content, the skills addressed, and methods employed, CPP verifies that the Futurekids professional development program is aligned with these standards.

This study, therefore, in yielding significant results in favor of the Futurekids professional development program also provides evidence that the program is effective according to what we know regarding technology-focused professional development.

We know that the effectiveness of schooling is intricately tied to innumerable factors that extend beyond the technology-focused professional development of teachers. But it can help when it is specifically aimed at improving teacher's performance across the components of school reform and across the curricula. There is a great deal of research that suggests that technology professional development has in fact led to improved teaching and learning as well as the management and efficiency of school-related tasks. For example, the Council of Chief State School Officers (1990) found that exemplary schools serving disadvantaged populations almost always had established in-service professional development programs for their teachers.

When teachers are more adept at using technology, their students begin to perform better. For example, Wenglinsky (1998) found that fourth and eighth grade students whose teachers received more professional development on technology were more likely to do better on tests than their counterparts. Coley, Cradler, and Engel (1998) also found that teacher technology professional development was also positively correlated with their students high levels of academic performance. And, Yocam (1998) found that classrooms that used technology more were also more likely to establish collaborative learning environments, where students were more engaged and their written work improved.

CPP supports the many varied possibilities that can be addressed by technology; however, we realize that teachers must first acquire the essential skills, knowledge, and attitudes, for starting or improving using technology.

Teacher Technology Needs and Issues

Last year, the U.S. Department of Education's National Center for Educational Statistics completed a study using a 1999 fast-response survey to look at the status of technology integration in education (Smerdon & Cronin, 2000). Professional development and the present capabilities of public school teachers were assessed. A summary of relevant findings from that study include:

- Approximately half of the public school teachers who had computers or the Internet available in their schools used them for classroom instruction
- Teachers in high poverty or high minority schools used technology less often to support classroom instruction
- Teachers with fewer years of experience were more likely to use computers at home, and more likely to use the internet to access model lesson plans

- Most teachers (84 percent) had at least one computer in their classroom
- Only one-third of teachers felt that they were well prepared or very well prepared to use computers and the Internet for classroom instruction. Teachers who felt less-prepared were less likely to use computers for instructional purposes
- Veteran teachers (with more years experience) were less likely to have been formally prepared to use technology in the classroom
- Most teachers reported having access to technology-focused professional development.
- Teachers who participated in professional development activities lasting longer than four days felt better prepared to use computers for instruction

Essentially, the findings above indicate what many observers in the field already know, or felt they knew. The more teachers have access to computer technologies, or the more technology training they participate in, the more likely they will use technology for classroom purposes. Also, veteran teachers are in greater need of technology-focused professional development than their younger counterparts.

In another study, conducted by the CEO Forum, researchers found similar statistics, including that only 20 percent of teachers report feeling very well prepared to integrate education technology into classroom instruction (CEO Forum, 1999).

And yet in another study, the Milken Exchange and the ISTE collaborated to assess teacher pre-service preparation with regard to technology (The Milken Exchange and the International Society for Technology in Education, 1999). They found that preservice teacher preparation programs are "not providing the kind of training and exposure teachers need if they are to be proficient and comfortable integrating technology with their teaching." What is most interesting about the latter study, is that researchers are now asking about teachers' comfort levels with technology, alluding to the fact that teachers will use technology more if they are confident about technology. Also, supporting a finding made in that study, the Benton Foundation agrees that preservice training is not meeting the technology preparedness needs of today's teachers (Conte, 2000).

Computer Literacy Variables

There are innumerable variables available for study in the field of computer literacy, and many of these often go beyond the narrow definitions of computer literacy from the 1980s. Then, we focused a great deal on knowledge of simple hardware and software knowledge, like knowing what something is and what it does. Today, there is a greater focus on knowing how; how to perform functions, certainly, but also how to use the functions to manage, manipulate, transform, generate, and present information. The range of skills and knowledge, as reflected in the varying sets of technology standards in education, means that today being computer literate is not just a moving target, it is also a contextual one (Barron, 2000).

Confounding Variables

We learned a great deal about person-centered variables in the last quarter of the last century, particularly in the field of mathematics and other so-called technical domains — like computer technology (see Ramey-Gassert & Shoyer, 1992; Randhawa, 1993). People have a remarkable potential to learn in new domains, but how well they learn and perform is often affected by personal variables, such as self-confidence, self-concept, anxiety within a domain, value-expectancies, motivation, self-efficacy, and more.

Albaugh (1997) for example found that teacher *skepticism* for the usefulness and effectiveness of technology is a factor that indeed affects their perceptions of technology training, and whether they adopt the concepts of the training in their classrooms. Skepticism, however, is often grounded in anxiety and lack of confidence and manifested as resistence. George and Camarata (1996) for example found that resistence to technological change in an educational setting can be lessened or eliminated by focusing on enhanced self-efficacy.

Dusick and Yildirim (2000) also recommend that technology training takes into consideration participants' anxiety, liking, and confidence for using computers. The potential list of confounding variables is endless.

Many personal determinants interact to influence the motivation, cognition, and performance in a technology-focused professional development program. A seemingly endless array would include skepticism, resistence, self-concept, self-esteem, self-confidence, anxiety, background, socio-economic status, ability, gender, and self-efficacy. However, according to Bandura (1986), "any gigantic attempt to study all these reciprocal actions at once would produce investigatory paralysis. It is the subsystems and their various interrelations, rather than the entirety, that are analyzed" (p. 25). In the present study, we have chosen to focus on computer self-efficacy.

Self-efficacy for academic tasks is integral to the present study for several reasons. Self-efficacy is often shown to hold greater explanatory and predictive power for treatment outcomes than many other determinants (Pajares & Miller, 1994a, 1994b, 1994c; Zimmerman, Bandura, & Martinez-Pons, 1992).

Computer Literacy Measurement

The appropriate measurement for computer literacy should be aligned to the specific aspects and components of literacy that are addressed in a given treatment condition. Last year, the U.S. Department of Education (2000) released its final report "Evaluating the Technology Proficiency of Teacher Preparation Programs' Graduates: Assessment Instruments and Design Issues." The purpose of that report was to identify and evaluate instruments that assess teachers' technology proficiency. The researchers contacted the major assessment developers and conducted a large-scale scan of available instruments. They also conducted an evaluation of the strengths and limitations of instruments they identified. Of the 26 assessment instruments identified in the report, 19 dealt with portfolios and self-assessments, and only three deal with performance assessment.

Of the three performance tests addressed by the U.S. Department of Education, only the Idaho Technology Competency Exam and the Teacher Universe Curriculum Integration Assessment System were considered "most appropriate for a national evaluation."

In the present study, the technical assistance provider, Futurekids Inc., designed and developed its professional development program according to the ISTE, NCATE, and NETS standards. A proper assessment of its effectiveness, then, is a measurement instrument that is also aligned to those same standards, such as the IETA.

To accommodate large-scale assessments, the program developer, Futurekids, Inc. has selected the Idaho Educational Technology Assessment (IETA). Of the 26 assessment instruments identified in the U.S. Department of Education report identified above, the IETA is one of three that deals with performance assessment, and the only one of those three to accommodate online testing.

The IETA has been administered to over 12,000 Idaho teachers over the last few years, and is often used in the Futurekids professional development program. It is used in the state to certify the mandated technology competency of its teachers, and is also aligned with the ISTE standards (Strickland, Salzman, and Harris, 2000;). It was developed by Boise State University according to the ISTE standards for technology literacy, which are also sanctioned by the NCATE.

The IETA is also used with permission by in the states of Pennsylvania, Illinois, Hawaii, California, and Michigan (U.S. Department of Education, 2000).

Other large-scale assessment instruments available include the Teacher Universe Curriculum Integration Assessment System, the North Carolina Essential Technology Skills Inventory, and Utah State University's Computer and Information Literacy Test. None of these other tests offer a full complement of secure online performance assessment proctored by the test developer, large-scale testing capabilities, and objective correct-answer scoring, making the IETA an appropriate choice for this study.

COMPUTER SELF-EFFICACY

Research indicates that even the best approaches to training and instruction are not the only factors that will determine the extent to which participants are engaged in learning, and the extent to which they are able to learn and demonstrate their learning. One of the most potentially powerful sources of influence on learning is self-efficacy.

Self-efficacy is one's judgments of personal capabilities to initiate and successfully perform specified tasks, expend greater effort, and persevere in the face of adversity. It emerged onto the psychological scene in 1977 with two seminal studies conducted by Albert Bandura (See Bandura, Adams, & Beyer, 1977; Bandura, 1977). About a decade later, it began to be studied more vigorously in academic contexts. A lineage of research has been unfolding ever since, particularly in mathematics and technical domains, such as with educational technology. Many of these studies, however, are only correlational and only describe how self-efficacy relates to academic outcomes.

Dale Schunk is one of the more prolific researchers applying self-efficacy as an academic construct. He and colleagues often use a research paradigm that goes beyond correlational analysis to include instructional interventions designed to raise learners efficacy and corresponding performance on criterial tasks.

Frank Pajares, another self-efficacy researcher, often uses advanced statistical procedures to account for the explanatory and predictive variance of self-efficacy in relation to other personal determinants, such as anxiety, academic background, self-confidence, and so on (Pajares & Kranzler, 1995; Pajares & Miller, 1994a; Pajares & Miller, 1994b; Pajares & Miller, 1994c; Pajares & Miller, 1995). Consistently, Pajares and colleagues find that self-efficacy maintains high explanatory and predictive power for mathematics performance.

In one study of 350 college students, Pajares and Miller (1994c) examined the hypothesized mediational role and predictive power of self-efficacy in mathematics problem solving. Using previously validated measures, the researchers ran several mathematics-related independent variables in relation to mathematical problem solving. Results show that self-efficacy held greater predictive power for problem solving success than did mathematics self-concept, background in mathematics, perceived usefulness of mathematics, and gender. The effects of background and gender, however, were significantly related to self-efficacy, supporting Bandura's assertion of the mediational role of self-efficacy on performance. Simply put, background and gender are not independently strong predictors of mathematics performance, but they are influential sources of mathematics self-efficacy which is highly predictive and plays a strong mediational role on performance.

Given so many similarities among research in mathematics and technical domains, such as computer literacy, we strongly feel that we should examine the associations and effects of self-efficacy in professional development programs.

What is most important to understand about self-efficacy is that it is domain specific. One can have high self-efficacy with regard to writing, and low self-efficacy with regard to computers. Secondly, it is important to understand that self-efficacy can strongly influence whether participants learn and/or perform well with regard to a given set of tasks, especially in technical domains. There is considerable research that shows that personal determinants such as computer confidence, computer anxiety, computer expectations, and computer efficacy are influential factors affecting computer-related performance. It is therefore critical that some level of personal determinants are investigated in the context of technology-focused professional development for teachers. We have chosen to focus on computer efficacy because it most often accounts for more of the variance when studied in combination with these other determinants.

Computer self-efficacy is one's judgments of personal capabilities to apply computer skills to initiate and successfully perform specified tasks, expend greater effort, and persevere in the face of adversity. It has been studied in recent years due to a widespread belief that the dimensions of applying technology, similar to the field of mathematics, are specialized fields in which some persons are more inclined than others to do well within the field (Olivier & Shapiro, 1993). Educators who have high computer self-efficacy, for example, are more likely to learn computers easily, and to apply computers to their professional roles. One's levels of self-efficacy are "fluid," and can also be changed as a result of an intervention.

Ertner and colleagues (1994) found that positive classroom experiences were related to participants' enhanced self-efficacy for computer technologies. Zhang and Espinoza (1997) found that computer self-efficacy is a significant predictor of the need for learning computer skills, suggesting that self-efficacy can also be measured to determine which educators may be the best candidates for technology-focused professional development.

In the present case, it is believed that participants who will perform best as a result of the training will either come into the program with high computer-efficacy, or that their efficacy will be raised as a result of participation in the study. The convergence of research on computer literacy and computer efficacy provides the rationale for theoretical framework for this approach. And, finally, there is also a strong lineage of research that shows that teachers who have high levels of efficacy for a given task are more effective in the classroom. The final link from teacher efficacy to student performance and achievement is therefore theoretically sound, but beyond the scope of this investigation.

Computer Self-Efficacy Measurement

Computer self-efficacy is measured either qualitatively (see, for example, Burroughs-Lange & Lange, 1993) or quantitatively. It is most often measured on a scale, in which questions are asked directly of respondents about one's confidence for successfully performing a specific set of tasks. The word confidence is often used in the question stem (as many persons are yet familiar with the term self-efficacy), however, the questions are designed more to determine how well respondents are able to picture themselves successfully completing a given task.

Several instruments for measuring computer self-efficacy include the Attitude toward Computer Technologies (ACT), the Self-efficacy for Computer Technology (SCT), and the Computer Confidence/Self-Efficacy Scale (Kinzie & Delcourt, 1991; Delcourt & Kinzie, 1993), which is simply a combination of the previous two. Keeping up with the times, other researchers are presently validating other instruments to focus on internet self-efficacy (Miltiadou & Chong, 2000; Nahl & Meer, 1997) and computer programming self-efficacy (Ramalingam & Wiedenbeck, 1998). There are also a variety of *home-grown* instruments, which also in some cases report to measure self-efficacy but do not. The largest mistake made, is when self-efficacy is measured as a global construct, either for a given domain, or in place of other personal determinants such as global self-confidence, self-concept, or expectancy-values orientations.

The instrument selected for measuring both pre-program and post-program self-efficacy in the present study is the Computer Self-Efficacy Scale (CSE) originally developed by Murphy, Coover, and Owen (1989). Although it is one of the older instruments to measure the construct, it has also received a strong lineage of positive assessment as a valid and reliable instrument (Moroz & Nash, 1997). Moroz and Nash (1997) report that the CSE differentiates between participants' incoming and outgoing levels of computer experience, as reflected by their previous computer experience. The CSE, therefore, can serve as an effective covariate for when applied for the purpose of removing confounding personal determinants, such as prior experience and computer self-efficacy.

SUMMARY

Together, the studies discussed above provide background research and documentation about the need for ongoing technology-focused professional development, and for addressing at least some personal determinants (e.g. skepticism, comfort, anxiety, confidence, etc.).

The standards for technology-focused professional development outcomes are well-defined by the national educational technology associations. Appropriate instruments for assessing computer literacy and computer self-efficacy are identified and reviewed for use in this study.

The hypotheses for significant results will be that:

- The program group receiving training will demonstrate greater computer literacy than the control group on the posttest
- The program group will report greater computer efficacy than the control group on the post-program measure
- When the effects of pre-existing computer background and pre-program self-efficacy are removed from the design (i,e. entered as covariates), then the program group will demonstrate greater computer literacy on the posttest

METHODS

The Center for Positive Practices (CPP) designed this treatment-control groups study as part of a larger evaluation design presented previously in two parts to Futurekids, Inc. CPP also contracted with Futurekids as an independent third party to conduct the analyses for this treatment-control groups study. Boise State University (BSU) also contracted with Futurekids to proctor the computer-literacy assessment. Futurekids was objectively removed from that assessment, and these analyses, to 1) protect the confidentiality of individual testing results, and 2) to ensure the security of the data and assessment instruments.

Guidance for this study follows methods put forth by Stevens (1999), Keppel and Zedeck (1989), and Wilkinson and the Task Force on Statistical Inference, APA Board of Scientific Affairs (1999). Faculty from the Research and Evaluation Methods department of a southwestern university were also consulted on appropriate design and analyses issues. For some aspects of this design, there were some healthy disagreements among these sources, however CPP assumes responsibility for the selection of data reduction procedures and analyses.

The present study is designed to assess the effectiveness of a professional development (training) for teachers, specifically in the domain of computer literacy. The study is conducted with actual training and trainees. As with all applied research, there are several limitations and opportunities afforded in the assessment process. Practical limitations, for example, include the lack of a laboratory-controlled environment and the ability to randomly select and assign participants. CPP also felt that there were practical limitations on the number of participants available for the study. Ideally, randomization of participants and a much greater population sample would enable more sensitive analyses of subgroups, such as with a linear hierarchical modeling design. Nonetheless, we are studying the effectiveness of a training program and not a potentially life-threatening drug or otherwise dangerous intervention. The balance therefore between practical limitations and investigatory control can only therefore be reasonable.

Generally, this study assesses whether participants in the treatment (program) condition will have benefited from participation in the professional development program, as demonstrated by their superior outcomes over participants in a control (non-treatment) condition. The potential outcomes are 1) enhanced computer literacy, 2) enhanced computer self-efficacy, and 3) enhanced combination of computer literacy and self-efficacy. In the primary analyses, simple posttest scores were assessed using analysis of variance. In secondary analyses, posttest scores were assessed while controlling for participants incoming levels of computer self-efficacy. The secondary analyses are important in order to determine whether participants' incoming and outgoing levels of computer self-efficacy are having a confounding effect on computer literacy. Tables III-A and III-B illustrate the overall research design in research notation.

Table III-A. Primary Research Design in Research Notation

GROUPS	TREATMENT	POSTTEST
A=N	X	O_2O_3
B=N		O_2O_3

Note. Group "A" represents participants who are assigned to the treatment (program) intervention. Group "B" represents participants who are assigned to the control condition. N = Number of participants in each group. O = Observation/assessment (O_2= computer self-efficacy, O_3= computer literacy "X" = Program.)

Table III-B. Secondary Research Design in Research Notation

GROUPS	PRE-PROGRAM	TREATMENT	POSTTEST
A=N	O_1	X	O_2O_3
B=N	O_1		O_2O_3

Note. Using the same notation as in Table III-A, secondary analyses will focus on the whether participants' incoming levels of computer self-efficacy and prior computer experience (O_1) are having a confounding effect on either or both of the outcome variables.

PARTICIPANTS

By necessity, this study was implemented using intact groups; those receiving professional development training using the same program. Participation in the program is limited to small groups participating at their school site. This is the real-world manner in which the professional development program is delivered. Although this is not as ideal as a randomized controlled laboratory setting, it is a real, and therefore completely accurate, replication of how the program is administered in schools. Eight schools participated in the study. Seven schools received the program and one served as a control group. Schools were nested in group (N=112), by treatment (N=70) or control (N=42). The unit of analysis, therefore, is group.

The study is therefore limited to intact groups, and the possibility that the participating groups are nonequivalent. All of the schools, however, have numerous similarities, reside in the same school district, and serve similar populations. The practical realities of real training, using real schools and teachers, therefore precludes the luxury of a sterile, laboratory-controlled environment. The only ascertainable difference between schools and participants, therefore, is that those serving in the controlled condition are slated to receive the training at a later date but agreed to measurement components of this study.

Most of the participants are teachers, although some other staff such as counselors and administrators are also included in the study. They are employed in highly urban, public schools residing in lower-income neighborhoods. Ethnically, they are very diverse. The population that they most closely represent are staff in public schools in large American cities.

VARIABLES

The variables under investigation in this study are detailed below.

Independent Variable

There is one independent variable in this study. It is the professional development training (program), and will be treated at a nominal level. The program is based on a comprehensive 45-hour training program designed by Futurekids, Inc. to meet the national standards of the International Society for Technology in Education (ISTE). The training is available for both Macintosh or Windows formats and is based on standard software packages, such as Microsoft Office or ClarisWorks. Although Futurekids, Inc. also offers more advanced professional development services as well, the present program was based on technology training in wordprocessing, desktop publishing, graphics, databases, spreadsheets, operating systems, the Internet, multimedia, programming, and applied technology.

Covariate

The covariates used in the present study include the Computer Self-Efficacy Scale and the teachers' prior computer experience. The covariates were used to remove pre-existing differences between the participating groups. A test of homogeneity of slopes was run with both covariates to verify no significance.

Dependent Variables

There are two outcome variables, computer self-efficacy and computer literacy, that were assessed in this study. Computer literacy is defined as the computer-related skills and knowledge deemed appropriate for teachers by the major, national technology professional associations (e.g. ISTE and NCATE). Computer self-efficacy is defined as one's perceptions of personal capabilities for using computers in the teaching-learning process.

MATERIALS

The variables listed above are measured by two instruments: The Idaho Educational Technology Assessment (IETA) which is produced and proctored by Boise State University, and the Computer Self-Efficacy Scale (CSE) which was developed by Murphy, Coover, & Owen (1989).

The Idaho Educational Technology Assessment

The IETA is used as a posttest measure of several educational technology competencies. It remains in continuous development and review, and has a strong, positive reputation as a good measure of technology literacy in education. The test consists of 77 questions that cover approximately 180 competencies. It is administered online and takes about one hour to complete. It is continually maintained and rigorously assessed for content, construct, and concurrent validity and internal consistency and discrimination item reliability. The IETA's reliability ranges from .82 to .95 on the present set of questions. This has been identified as a strength of the exam (U.S. Department of Education, 2000).

The IETA is protected by high levels of security, requiring that test-takers submit photo identification and sign a non-disclosure agreement. Neither CPP nor Futurekids were privy to individual test results.

CPP collaborated with the IETA developer and proctor, Boise State University, to compile the results of the posttest computer literacy exam and to recode participants by group to assure individual confidentiality. The resulting database of participant test results, without individual names, is securely maintained by CPP and only aggregrated results are available to Futurekids and the public.

The IETA is aligned with the ISTE standards and includes basic technology, software, ethics, and basic integration competencies.

The Computer Self-Efficacy Scale

The Computer Self-Efficacy Scale (CSE) is designed to measure one's perceptions of personal capabilities with regard to specific computer skills and knowledge (see Murphy, Coover, & Owen, 1989). There are 32 items on a Likert scale in which the question stem asks respondents to rate their level of confidence for successfully completing a designated computer task. Items are grouped by beginning, moderate, and advanced computer skills.

The CSE has been used extensively in research conducted on computer self-efficacy. It has also received several positive reviews when assessed for validity and reliability (see, for example, Harrison & Rainer, 1992; Murphy, Coover, & Owen, 1989; Torkzadeh & Koufteros, 1994).

Harrison & Rainer (1992) assessed the CSE and reported an overall reliability coefficient of .95. Torkzadeh & Koufteros (1994) conducted a factorial validity assessment of the CSE and produced a four-factor solution, with each factor producing an alpha greater than .90.

Although the CSE is getting along in years, we determined that it still represents a solid assessment of computer self-efficacy. Its present-day weakness is that it does not include items representing the functions of the internet. Its strength is in its consistency and dependability across numerous studies.

The CSE is used in this study with written permission from Dr. Stephen Owen, one of the original developers.

Program Materials

The program materials for this study are the proprietary training materials of Futurekids, Inc. These include lesson plans and materials for the following:

- Computer Basics and Operating Systems
- Telecommunications
- Wordprocessing
- Graphics
- Spreadsheets
- Desktop Publishing
- Databases
- Multimedia

The program, also called a "course," is recognized and accredited by 20 universities, including the University of Southern California and California State University, Sacramento. Participants may receive up to three graduate level credits for completing the program. It also satisfies requirements for the California Clear Teaching Credential. Locally, the accrediting institutions are the University of Southern California and California State University, Sacramento.

The program is designed to train educators in the basic fundamentals and advanced skills of computer literacy. Participants learn how to use some major software programs while working on projects. Skills are learned while working on projects to simulate real-world applications. The methods employed in the program therefore enable teachers to conduct ongoing self-assessments and to experience incremental successes along the way. Teachers, for example, conduct their own instructional units using computer technologies.

The course is under continuous development and refinement to remain aligned with the standards set by the major national professional associations, ISTE and NCATE. It totals 45 hours in length, with teachers meeting for three-hour sessions each week for 15 weeks.

The methods used in the treatment are proprietary; however, the overall format is designed to be project-based and thematic, and to address the affective needs and dispositions of participants. It is also designed to follow close alignment with the national standards for teachers and students with regard to educational technology.

PROCEDURES

Teachers in both groups were asked to sign consent forms. Participants were then administered the pre-program measure. The program group received the 45-hour treatment, and then both groups were administered the post-program self-efficacy measure, and the IETA posttest.

Setting

The setting(s) for the study will include high schools in a large California school district. The program group included teachers already scheduled to receive the professional development services. The control group was selected based on an available group of teachers in a school with similar characteristics to the program group.

Data Formatting and Reduction

Data analysis procedures will follow guidelines set forth by Keppel and Zedeck (1989) and Stevens (1999). Analysis of Variance is the selected statistical procedure for the primary analyses. Analysis of covariance is the selected statistical procedure for secondary analyses. Although there are cautions to be taken with nonequivalent groups, the ANCOVA procedure is often recommended (Stevens, 1999, p. 321).

Although analysis of covariance is often not recommended for non-randomized designs, we felt that the potential explanatory and predictive power of the study would be muted if we did not adjust for the potential strong influence of computer self-efficacy and prior background. Justification for these analyses in this case is warranted. Consider this recommendation from the American Psychological Association's Task Force on Statistical Inference:

> *For some research questions, random assignment is not feasible. In such cases, we need to minimize effects of variables that affect the observed relationship between a causal variable and an outcome. Such variables are commonly called confounds or covariates. The researcher needs to attempt to determine the relevant covariates, measure them adequately, and adjust for their effects either by design or by analysis. If the effects of covariates are adjusted by analysis, the strong assumptions that are made must be explicitly stated and, to the extent possible, tested and justified.*
>
> Wilkinson and the Task Force on Statistical Inference, APA Board of Scientific Affairs (1999).

In this case, we had determined apriori in two research design documents (CPP, 2000 & CPP, 2001) that there is always a reasonable possibility when assessing effects in a technical domain that results may be confounded by participants' affective filters and prior relevant background. Affective filters may include attitudes, motivations, and one's own perceptions of personal capabilities (self-efficacy). Because research on computer self-efficacy demonstrates that it can inhibit or facilitate performance in technical domains, we determined that we should attempt to control for it in secondary analyses. Because prior computer experience is a strong mediator of computer performance, we also felt a strong need to control for that as well.

Both groups were pre-assessed to be sure that they were homogeneous enough for the purpose of the study (i,e. that their score differences will be not because of their group characteristics). Tests for homogeneity of slopes were run for both dependent variables. Results were expected to show that we can be confident that there were no interactions between the covariates and the independent variable ($p > .05$).

The hypotheses in this study were based on data from nonequivalent groups, so we can only assess the probability that the treatment would be generalizable to a similar population. Alpha levels for computer literacy results were relaxed to .10 to increase power because of the small sample size. This would permit us to analyze results beyond the omnibus p-values (if $p < .10$) in the primary model, thus increasing the chances for Type I error (rejecting the null hypotheses if they are in fact true) and reducing the chances for Type II error (accepting the null hypotheses if they are false).

The criticality level of the intervention is low. The intervention is not an analysis of a potentially harmful drug; it is an investigation of the usefulness of a professional development service. There are no known adverse affects associated with this type of instructional treatment and so the severity of making a Type I error is unlikely to cause adverse consequences. The benefit of making a correct decision on the hypotheses, of course, is that this study will fairly assess the effectiveness of the program.

The independent variable for this analysis, group/program, was run separately with the covariate, pre-program, on both dependent variables computer literacy and computer efficacy.

Internal consistency reliability (Chronbach's Alpha) was computed on all measurement instruments.

Analyses consisted of a univariate ANOVA on each dependent variable, and one-factor ANCOVAs on "group" results, with "pre-program self-efficacy" and "computer experience" as covariates. ANCOVA was used to analyze whether there was significant variance in the adjusted group means with regard to the independent and dependent variables.

RESULTS

This study investigated whether the Futurekids professional development program significantly increased the computer literacy and computer efficacy of in-service teachers. The Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) results are presented below.

ANALYTICAL SUMMARY

Overall results of the analyses indicate that the program treatment was significantly more effective than the control condition for raising participants' computer literacy and computer self-efficacy. As stated in the research design along with apriori hypotheses, alpha was relaxed to .10 for some analyses in order to increase power due to the limited number of participants available.

Of the many possible indicators in this study, the most important is certainly whether the treatment program was more effective than the control condition, particularly at some meaningful level. We determined that the most meaningful level or cutoff point for receiving professional development was whether participants passed or failed on a respected computer literacy measure. Performance on this measure would also be informative to the school system about the effectiveness of the program, and also about whether participants have successfully participated in the program based on their incoming levels of technology experience.

Table IV-A. How participants scored on the IETA posttest.

Group	Number Passing	Number Failing	Not Tested	Total
Treatment	34	35	1	70
Control	12	28	2	42
Totals	46	63	3	112

Note. Table shows that 49 percent of treatment participants are likely to pass the IETA, compared with 29 percent of participants in the control condition.

The table above demonstrates that the IETA is not an easy test to pass, with passing rates of 49 to 29 percent for the treatment and control groups, respectively. This could also serve as an indication that some participants in the control condition already had some confounding technology-related experience. A univariate ANOVA was run for both groups on the dependent variable, passing the IETA. Results indicate that treatment groups are significantly more likely than the control group to pass the IETA ($p. < .05$).

The greatest threat to the internal validity of these analyses is the potential non-equivalence between groups, particularly through prior technology-related experience or expertise. For example, if some schools had more technology experience than the others, either through prior preservice or in-service experiences, than they would no doubt confound the potential outcomes. To verify that schools were reasonably equivalent for nesting, ANCOVA was run between treatment schools, controlling for technology experience, to show no significance ($p = .019$). But to determine whether there was a potentially confounding variable between treatment and control groups, another ANCOVA would need to be run to adjust for incoming technology-related experience.

The following analyses now include ANOVA and ANCOVA comparisons between groups. On all analyses, where relevant, the homogeneity of variance/homogeneity of slopes were run to verify that the error variance of the dependent variable was equal across groups ($p > .05$).

COMPUTER LITERACY

In addition to passing rates on the computer literacy test, results were computed for raw score by group on computer literacy. The means and standard deviations, and ANOVA omnibus test for this analysis are presented in the following tables.

Table IV-B. Means and Standard Deviations for Group on IETA Score

GROUP	Mean	Std. Deviation	N
Treatment	73.44	12.645	70
Control	68.48	13.576	42
Total	71.58	13.164	112

Table IV-C. Tests of Between-Subjects Effects on IETA Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	645.406(b)	1	645.406	3.819	.053
Intercept	528704.912	1	528704.912	3128.626	.000
Group	645.406	1	645.406	3.819	.053
Error	18588.842	110	168.989		
Total	593081.123	112			
Corrected Total	19234.248	111			

Note. Levene's Test of Equality of Error Variances(a) was run to test the null hypothesis that the error variance of the dependent variable is equal across groups (p. = .587).

Results show that the treatment group significantly outscored the control group on the computer literacy posttest ($p = .053$) at the set alpha level of .10.

The Effects of Pre-Efficacy on Performance

The research design also called for Analysis of Covariance (ANCOVA) using two different covariates, independently. The first ANCOVA considered pre-test self-efficacy as a covariate and was run by group on the dependent variable, computer literacy. The means and standard deviations, and ANCOVA omnibus test for this analysis are presented in the following tables.

Table IV-D. Means and Standard Deviations for Group on IETA Score

Group	Mean	Std. Deviation	N
Treatment	73.44	12.645	70
Control	68.48	13.576	42
Total	71.58	13.164	112

Table IV-E. Test of Between-Subjects Effects on IETA Score with Pre-program Computer Self-Efficacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Paramete r	Observed Power(a)
Corrected Model	7346.533(b)	2	3673.267	33.681	.00 0	.382	67.361	1.000
Intercept	29793.002	1	29793.002	273.176	.00 0	.715	273.176	1.000
Pre-Program Efficacy	6701.127	1	6701.127	61.444	.00 0	.360	61.444	1.000
Group	1300.187	1	1300.187	11.922	.00 1*	.099	11.922	.928
Error	11887.714	109	109.062					
Total	593081.123	112						
Corrected Total	19234.248	111						

*Statistically significant at the .05 level.

ANCOVA results of groups on the dependent variable IETA score, taking into consideration pre-program computer self-efficacy, show considerable statistical significance in favor of the treatment group ($p < .001$).

The Effects of Prior Technology Experience on Performance

The second ANCOVA considered computer background experience in years as a covariate and was run by group on the dependent variable, computer literacy. The means and standard deviations, and ANCOVA omnibus test for this analysis are presented in the following tables.

Table IV-F. Means and Standard Deviations for Group on IETA Score

GROUP	Mean	Std. Deviation	N
Treatment	73.72	12.719	68
Control	68.38	13.729	41
Total	71.71	13.301	109

Note. The N (109) on this analysis reflects the fact that three cases were missing on the covariate and therefore excluded from these analyses.

Table IV-G. Test of Between-Subjects Effects on IETA Score with Pre-Program Computer Background Experience in Years

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power(a)
Corrected Model	2335.602 (b)	2	1167.801	7.381	.001	.122	14.761	.934
Intercept	419510.289	1	419510.289	2651.369	.000	.962	2651.369	1.000
Prior Technology Experience	1607.425	1	1607.425	10.159	.002	.087	10.159	.885
Group	901.218	1	901.218	5.696	.019*	.051	5.696	.657
Error	16771.748	106	158.224					
Total	579641.013	109						
Corrected Total	19107.351	108						

*Statistically significant at the .05 level.

ANCOVA results of groups on the dependent variable IETA score, taking into consideration pre-program computer background experience in years, show statistical significance in favor of the treatment group ($p < .05$).

COMPUTER SELF-EFFICACY

In addition to results on the computer literacy test, results were computed for raw score by group on the dependent variable post-program computer self-efficacy. The means and standard deviations, and ANOVA omnibus test for this analysis are presented in the following tables.

Table IV-H. Means and Standard Deviations for Group on IETA Score

Group	Mean	Std. Deviation	N
Treatment	4.0243	.72486	69
Control	3.4472	1.22094	36
Total	3.8264	.95967	105

Note. Not all participants qualified for this analysis because some (four for the control group, and one for the treatment group) did not take the post-program self-efficacy assessment.

Table IV-I. Tests of Between-Subjects Effects on Post-Program Efficacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.879(b)	1	7.879	9.232	.003
Intercept	1320.603	1	1320.603	1547.423	.000
Group	7.879	1	7.879	9.232	.003*
Error	87.902	103	.853		
Total	1633.131	105			
Corrected Total	95.781	104			

*Statistically significant at the .05 level.

ANOVA results of groups on the dependent variable post-program self-efficacy show statistical significance in favor of the treatment group ($p < .05$).

ANCOVA results using pre-program self-efficacy and prior computer background as independent covariates were also run on the dependent variable post-program self-efficacy, but only serve to further emphasize the same outcome in favor of the treatment group ($p < .01$).

RELIABILITY ANALYSES

Both measures of dependent variables used in these analyses came into this study with a history of strong internal consistency reliability. Reliability coefficients using the Chronbach's Alpha test of internal consistency reliability supported previous findings. The IETA results show $r = .9124$. The pre-program computer self-efficacy measure showed $r = .9873$. The post-program computer self-efficacy measure showed $r = .9863$.

RESULTS SUMMARY

Results of the ANOVA analysis of computer literacy were significantly in favor of the treatment group ($p = .053$, $p < .10$). Results of two ANCOVAs, using pre-program computer self-efficacy and pre-program computer background in years as covariates also demonstrated significant results in favor of the treatment program ($p < .05$).

Results of the ANOVA analysis of post-program computer self-efficacy showed results strongly in favor of the treatment group ($p < .01$).

Chronbach's Alpha analyses of all three instruments support previous results that demonstrate high internal consistency reliability for all measures.

The results presented here provide strong evidence that the Futurekids professional development program is effective in enabling participants to pass the IETA computer literacy posttest and in raising participants' levels of computer self-efficacy.

Discussion

Perhaps the greatest barrier to technology integration in America's schools is the lack of teacher training (Jones, 1998). Meanwhile, there is considerable evidence in recent years that schools that have a commitment to technology-focused professional development are making gains in student achievement (see for example, Archer, 1998; Armstrong, et. al. 1996). To get there, however, is a multi-stage process. Before teachers can adequately and appropriately apply technology to improve their classroom performance, and subsequently that of their students, they need to meet a minimum level of computer competence.

In the present study, it was determined that the professional development program was significantly more effective than a control group in helping participants to do better on a credible measure of computer literacy, the Idaho Educational Technology Assessment (IETA). Participants were also significantly more likely to pass the IETA. When computer self-efficacy and prior computer background were considered, the effects in favor of the program group were even more pronounced.

This study also examined whether the professional development program was effective in enhancing participants levels of computer self-efficacy, presently the most reviewed and credible instrument available for measuring this construct. Results also significantly favored the program group on this measure.

It is therefore reasonable to assert that the Futurekids, Inc. professional development program is significantly effective for improving both the computer literacy and computer self-efficacy of school staff.

The Need for Future Research

The scope of the present study is based on what could reasonably be considered to be the most straightforward assessment of effectiveness given the variables in question. Future studies could build upon this one by looking at additional factors that may also affect the outcomes. One variable that was presently not studied is the relationship of gender to computer self-efficacy with regard to the professional development program. Busch (1995, 1996) for example found gender differences in computer self-efficacy for college students. Chou (2000), however, found that females had higher self-efficacy outcomes from an instruction-based computer training program than males. The gender gap in computer education today is no doubt closing, but may still be an issue in some contexts.

Future Trends

The present need for technology-focused professional development for teachers cannot be underestimated. Teachers need to prepare students for using technology in all subject matter domains. We are moving from technology integration in schools to technology infusion into all matters and subjects of schooling. We are also beginning to move from the need for being computer literate to the need for being computer fluent; that is, being able to use technology effectively to improve our practices and to be able to adapt to rapid technology advancements over time (Committee on Information Technology Literacy, National Research Council, 1999). Programs such as Futurekids Professional Development are able to change with the times because they are products of discussion of the changing standards, and are adaptable to meet new needs and opportunities.

Another trend that is growing is based on teachers taking the initiative to work collaboratively to learn and to improve their professional practices (Becker & Riel, 2000). Due to the tremendous possibilities and rapidly changing nature of technology, this notion of professional engagement is a prime candidate for ongoing technology-focused professional development. The field will still, however, always need technical assistance providers and facilitators, as well as standards, to guide teachers and maintain learning about technology.

SUMMARY

This study provides strong evidence that the Futurekids Professional Development program is effective in helping educators to develop educational technology competencies aligned to relevant standards. The content and methods employed in the professional development program are on track for providing this service to schools; however, it is highly recommended to the program developer, Futurekids, Inc., continue along its present course of adjusting the program to meet changing standards and evidence of best practices.

The study also provides evidence that the professional development program is effective in enhancing the computer self-efficacy of participants. When results are compared on both dependent variables, they support a continuing lineage of research (e.g. Johnson, Ferguson, and Lester, 1999; Harrison, Rainer, and Hochwarter, 1997) which demonstrates that self-efficacy is directly related to performance on a given set of tasks. Addressing computer self-efficacy, therefore, can be an important component of technology-focused professional development. It also appears to be a strong indicator of performance.

Participants in the present study participated in the Futurekids 45-hour, technology-focused professional development program. The content and methods of the program are aligned with major national content and performance standards. Given the results of this study, it appears that both the alignment, and the various proprietary methods of program implementation, are effective in significantly raising both the computer self-efficacy and computer literacy of program participants.

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