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A study of professional development, research, practices, and policies to prepare inservice teachers in new technologies: implications for training standards in new technologies

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A study of professional development, research, practices, and policies
to prepare inservice teachers in new technologies: Implications for
training standards in new technologies

by

Joyce Ann Pittman

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Education (Curriculum and Instructional Technology)

Major Professors: Gary D. Phye and E. Ann Thompson

Iowa State University

Ames, Iowa

1999

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Graduate College
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has met the dissertation requirements of Iowa State University

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Co-Major Professor

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For the Major Program

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For the Graduate College

Dedication

To all who have supported me from Day 1 of my life and those who will do so for the rest of my life,

especially

Daddy, Mama

Endearing sons

(Dee and Kenn)

All the grandchildren

(Derrick Jr., Kortney, Karissa, Rebecca, and Eliza)

11 Sister Educators

Velma, Verlee, Rosie, Bobbie, Future, Ella, Brenda, Jackie, Dianne, Sharmin
who always believed in me so much

and

My best friend

and

Life partner, Brian

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PREFACE

This study focuses on the status of standards and professional development guidelines for educators (teachers), especially in the State of Maryland. A policy research, evaluation, and analysis strategy was used to examine the current standards for professional development that govern technology for educators (teachers). Multiple processes, which incorporate both qualitative and quantitative data collection and analysis methods, were combined to generate summative results in this study. Research shows that evaluation research and policy analysis is supported by Decision-Oriented Evaluation (DOE). DOE research and evaluation is the process of determining the kinds of policy or programmatic decisions needed based on the findings. This methodology is confirmed as an effective strategy that can contribute information for decision-making whenever the goal is to bring about change (Bogdan & Biklen, 1997; McMillan & Schumacher, 1997).

It is contemplated in this research that a clear vision of training for teachers may help conceptualize the capacity of current technology standards to support the professional development needs of inservice teachers in new technologies (including assistive technologies). This vision may drive training guidelines to increase the effectiveness of technology training, technical support, and access to technology. An examination of current standards unveiled the fact that technology priorities are not focused on professional development in new technologies for inservice teachers in American public schools. Consequently, policymakers and educators may need to reconsider current professional development standards for teachers in new technologies. Evidence examined indicated that training and support needs of preservice teachers, new teachers, and inservice teachers may be different when learning new technologies. These differences in needs may have an impact on teachers' capacities to learn, use, and integrate technology in the classroom.

The purpose of the study was to determine the efficacy of CTE-MSDE's standards-based technology and support partnership. The partnership was established in 1986 to provide

educators with the training and technical support to learn and use assistive and educational technologies to achieve national and state standards. Equal access to new technologies for its educators is a critical goal of Maryland's effort to create inclusive learning environments in Maryland's schools. Five major factors related to educators' perceptions of their priority needs for training and support services to integrate general and assistive technologies were measured and examined in the study: 1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination, and 5) availability of new technology.

The Center for Technology in Education (CTE) is a division of the Johns Hopkins School of Continuing Studies. CTE has a professional development and support staff of 20 professional personnel. Maryland, with a population of 4,983,900, ranks forty-second in size and nineteenth in population among the fifty states. The state department of education is housed in Baltimore. There are 24 local school systems and 1,309 public schools and centers.

This research was designed in two phases—quantitative and qualitative research designs—called the *integrated research design* to answer the following overriding question: Do existing national and state professional development and technology standards have the capacity to ensure that Maryland's inservice teaching force has access to programs for their continued improvement and opportunities to acquire the knowledge and skills needed to meet new high-quality teaching standards in the 21st century?

In summary, the results are statistically significant. The explanations and interpretations are plausible, based on the data collected from surveys and evidence examined from qualitative measures. Based on the richness of the emerging themes from qualitative data and strong reliability coefficients of the factors, the results may have practical significance for the CTE-MSDE partnership directions and theoretical implications for technology for educators overall. However, the size of the small purposive samples places a statistical and moral limitation on the extent to which these results can be generalized beyond the unique groups of Maryland educator-participants in this study.

While the results fully support the model for the study, the implementation into practice on a large scale must be done with some caution pending further investigation. However, many important relationships emerged in association with the four primary factors examined in this study. The results indicate that the relationships between and among these variables are sophisticated and interrelated or complex. Although the limitations of this research effort preclude further investigation into this complexity at this time, it is no less important to determine weight and further treatment of the factors in this study. Clearly missing from the literature and research is an examination of cognitive psychology and the affective domain in the psychological foundations that may be forming a new paradigm for how teachers' interests in technology-based learning environments compete with traditional cognitive learning theories (Molenda, 1997; Winn, 1997). These factors emerged as major gaps in existing technology training standards that are currently under recommendation. The recommended competency standards are focused intensely on the application level as foundation competencies. The concern is that the competencies appear to have emerged without a dominant model that includes new emerging cognitive paradigms, which may include more of the affective domain when correlated to teachers adoption of new technologies (Tennyson, Elmore, & Snyder, 1992).

Therefore, based on the limitations and conditions of this study, the researcher recommends extending the investigation and preliminary findings of the questions posed in this study. The recommendation is that future investigation includes more extensive experimental research and a more nationally focused sampling approach. However, the study reveals compelling evidence that the most critical weakness may not exist in ISTE-recommended technology competency standards or other preliminary standards enacted by the Maryland State Department of Education. It seems that the greatest contributor to the implementation into practice exists in the technical assistance and support following training. Teachers and administrators consistently reported a desire for more research-based information

about practices to assist in curriculum adaptation, informing policymakers, and funding for assistive technology and instructional technology (AT/IT) technical support.

The potential gravity of inadequate information about the type of support that is needed for teachers to achieve the competencies identified in the standards emerged as a critical contributor to articulation of the professional development needs of inservice educators. These findings are supported by the findings of six prior studies from 1989-1999 and are cited in this paper at appropriate junctures.

Other issues emerged, such as barriers related to the aging teacher population, minority representation in technology environments, and access to telecommunications in rural and metropolitan schools. These potential barriers must be addressed before the efficacy of the standards posited by ISTE and MSDE can be extensively negotiated.

It was interesting to find that educators completing the CTE technology programs reported very high levels of comfort with learning new technologies at the skills application level in the basic foundations that are specifically addressed in the ISTE and Maryland technology standards. The Maryland educators' responses to the questions that relate to issues of learning and integrating new technologies far exceeded national averages reported in the U.S. Department of Education's Teacher Quality Study of 1999.

CHAPTER 1. INTRODUCTION

Background

A 1995 Electronic Learning Survey by the Office of Technology Assessment reported that 50% of teachers (educators) have not had adequate training, professional development, or technical assistance in the use of new technologies (National Education Association, 1997).

Ultimately, the efficacy of standards for professional development and technical support for inservice teachers in new technologies is highly conditional: based on teachers' interest, competence in the subject matter, and the support they receive to acquire this preparation (Darling-Hammond & Ball, 1997). Within the context of appropriate preparation, the present investigation is focused on the efficacy of Johns Hopkins University Center for Technology in Education and Maryland State Department of Education's standards-based training and support partnership to ensure access to appropriate training for inservice teachers. In addition, there may be a need to adapt existing training standards, policies, and practices based on pedagogy and incorporate prevalent continuing education principles (Knowles, 1978). In this review, learning and practice refers to *training*.

The theories of teachers' adoption stages such as the Hall's Concerns-based Adoption and Apple Classrooms of Tomorrow models of technology will be considered. By relating the emerging concepts surrounding training and technology standards for educators, policymakers and educators will be educated, trained, and helped to understand the nature of current technology training standards when speaking to training needs of inservice teachers in new technologies (Hall & Loucks, 1979). These theories of adult learning could be used to restructure the current technology training standards to better meet the needs of inservice teachers.

The literature shows that training in new technology for teachers often resembles a shortsighted vision of technology (Moursund, 1997)—shortsighted because in some circumstances deciding teacher quality based on the recommendations are supported by

undeviating interpretation and application of ISTE technology standards. Undeviating refers to without taking into consideration the organizational context and other local conditions that may preclude the implementation in practice due to inadequate or inappropriate conditions. However, these standards do perform a valuable contribution as a guide in training and practice in new technologies for inservice teachers (Pittman, 1998b). In addition, these practices are incorporated into the enactment of reform policies at national and state levels. These enactment conditions contribute to the growing concern about high-quality professional development for inservice teachers to learn new technologies, especially in urban and rural areas. Recently at the National Educational Computing 20th Annual Conference (NECC, 1999), a national leadership forum of educators from around the country discussed the efficacy of existing technology standards to meet the needs of all teachers, especially minorities.

The moderator implied that The International Society for Technology in Education sponsored this discussion about teacher technology standards based, in part, on emerging questions in the literature about the efficacy of ISTE technology standards and the realities of implementation. As a result, educators and policymakers openly promoted the need for more research, collaboration, and support to reach a consensus about existing technology standards and implications for inservice teachers in general. As a result, the forum's consensus was there is a need to revisit the standards periodically (Schrum, 1999; 1993).

However, for this call to effect definitive change in training and support practices, more research about effective practices and technical assistance for educators to become proficient in new technologies is needed. According to a recent Education Reform Analysis and Overview report, professional development and preservice training for teachers account for one-third of the education reform subgrants to LEAs and other parties. The Department of Education acknowledges that national NCATE/ISTE standards perform a significant role by encouraging continuous improvement of teaching, school reform, and technology integration. However, there

“is no formal evaluation of the impact that the reform programs have had on professional development or student achievement” (Stedman & Riddle, 1998).

When national education goals originated, a group of policymakers propositioned the need for a national entity to coordinate and certify national education standards and state education standards, which included Goal Four: Teacher Quality. The group’s proposal was the National Education Standards and Assessment Council (NESAC). The proposal was not adopted. However, two years after a recommendation was signed into law, another group was established called National Education Standards and Improvement Council (NESIC) that was later entirely eliminated by the 104th Congress. The result was the elimination of any national entity to ensure the enactment of policies and practices to coordinate state efforts to achieve national standards (Stedman & Riddle, 1998).

Consequently, amended legislation resulted in empowering local school districts, in states not participating in national education goals, to apply for education department funding, if approved by their state educational agency. Although the amendments provided states with more flexibility and local control, it may have weakened the possibility of a national professional development infrastructure for teachers to ensure access to effective preparation in new technologies. Presently, there are 12 states participating in the ED-Flex authority: Colorado, Illinois, Iowa, Kansas, Maryland, Massachusetts, Michigan, New Mexico, Ohio, Oregon, Texas, and Vermont.

These states do participate in educational reform, but are not required to participate in the Educate America Initiatives as authorized by the “Educational Flexibility Partnership Act of 1999” (P.L. 106-25). However, the states may qualify for direct federal support or state support by having an approved reform plan along with other conditions (p. 9). During this review, technology practices prevalent in different states will be discussed. The study will focus on how the Maryland Technology Plan ensures access to technology and support for teachers in the State of Maryland under the Ed-Flex authority.

Organization

This study is presented in five chapters. The Review of the Literature, Chapter 2, helps establish the basis for this research. In this review, research and literature were examined and professional development models were investigated to:

1. identify groundwork about existing training practices in new technologies for inservice teachers, and
2. investigate existing standards, practices, and policies overseeing the quality of inservice teachers in public schools within the states and in Maryland schools.

Chapter 3, Methodology, defines the research design, selection of participants, instrumentation, data collection and analysis, and limitations. In Chapter 4, the results are reported to address the research questions raised in Chapter 1. Chapter 5 focuses on the implications and conclusions based on the findings. The discussion is then summarized with recommendations for future research.

Statement of the Problem

The United States does not have a professional development infrastructure or standards to retrain 2.8 million inservice public schools teachers in the use of new educational technologies. To meet 21st century education reform goals, teachers will need new skills to teach in new technologically-oriented and learner-centered environments (Riley, 1998). This growing concern about the adequacy of existing standards to support the adult learning and training needs of inservice teachers is unexplored. Although only 36 states require technology preparation and/or teacher competency tests for licensing and certification, this number is growing (Gitomer, Latham, & Ziomek, 1999; Riddle, Stedman, & Irwin, 1998). As a result, the pressures to meet reform goals and high quality teaching standards for inservice teachers states are adopting the International Society for Technology in Education Foundation standards (ISTE) for teacher competency in new technologies. These states are linking technology standards to other teacher certification and licensing standards (Lively, 1998; Vermont

Department of Education, 1998). Research shows there is insufficient evidence to support these standards efficacy to meet the training and technical support needs of inservice teachers to integrate new computer and educational technologies. As a result, the potential impact on teaching and learning suggests this relationship between these standards efficacy and teacher training and technical support is relatively uninvestigated (Moursund, 1997).

The research and evaluation problems addressed in this primary study are to determine:

1. how does the Center for Technology in Education-Maryland State Department of Education professional development partnership improves access to continuing professional development activities in new and assistive technologies for Maryland educators.
2. what is the relationship between or among the partnership training and support: variables for technology integration (components): professional development, technical support, knowledge and awareness, and dissemination support national and state standards for educators in need of training in new technologies.
3. how does the Center for Technology in Education-Maryland State Department of Education professional development and training model in new and assistive technologies decrease barriers to technology support programs for Maryland's Educators.
4. to what extend do current teach education and technology standards support access to *training in new technologies and instructional strategies* for inservice teachers to meet the needs of all learners in technological and diverse learning environments in selected Maryland school districts.
5. *Grand Tour: Do we need professional development and technology training policies to ensure inservice teachers have access to appropriate training in new technologies and instructional methods to prepare all learners for the 21st Century.*

Purpose of the Study

The study is focused on the efficacy of existing state and national technology standards to ensure access to appropriate training, support, and technology Maryland educators perceive they need to meet the requirements of these standards and integrate technology into their professional practice. As a result of a pilot study during summer 1998, five critical factors are theorized as contributors to educators' perceptions about training and technical support services they need to integrate general and assistive technologies. The factors are: 1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination, and 5) new technology.

A subsequent goal was to determine the relationships between and among the administrators' 1) knowledge and awareness, 2) beliefs about the value of access to technology and use by students with disabilities, 3) information and skills needed by key administrators to increase technology access, and 4) kinds of information and training resources they perceive as valuable to increase technology access and professional development for their educators. In addition, data were analyzed to determine if administrators' perceptions about technology training and support needs were influenced by other factors such as years of experience, location within the state, or satisfaction with site-based management, current processes, and outcomes were related to the educators' perceptions of their needs (Wylie, 1995-1996).

Assumptions

The study was guided by the following assumptions:

1. The educators and administrators were truthful and accurate in their responses.
2. The developed instruments were reliable and acceptable.
3. The CTE-MSDE training and support partnership has a direct bearing on educators' and administrators' perceptions of their needs and attitudes towards assistive and general technology integration.

4. Training and support services provided by CTE-MSDE are standards-based and driven.

It is hypothesized that policymakers need more research-based information to increase their knowledge and awareness of inservice teachers training and development needs in new technologies. This new research could be used to establish new policies that will increase inservice teachers' access to high quality training and development in new technologies.

New learning and training standards in new technologies conceptualized with the needs of inservice teachers and learners at the forefront may potentially support, prepare, and sustain teachers to integrate new educational technologies. By establishing transferable professional development and training models, policymakers could improve decision-making about the training and technical support teachers need. Effective preparation in new technologies could empower teachers to integrate and use new technologies more appropriately in the classroom (Darling-Hammond, 1998, 1997a, 1997b, 1996; Darling-Hammond & Ball, 1997; National Board for Professional Teaching Standards, 1993; Thompson, Bull, & Willis, 1998). This review will be guided by the research questions listed below.

Research Questions

This research is designed in two phases: quantitative and qualitative research designs, called the *integrated research design* in this study. To answer the primary question, ten sub-questions are posited to guide this study.

Grand tour question. Do existing technology standards have the capacity to ensure Maryland's educators have the access to programs for their continued improvement and opportunities to acquire the knowledge and skills needed to meet new high quality teaching standards in the 21st century?

This study evaluates the extent to which

1. circulating standards drive support and training that will ensure equal access to training and support in new technologies for all teachers?

2. best practices in research, policy, and practices are accounted for in technology preparation and professional development models, especially in Maryland?
3. national, state, and local guidelines for training and support in new technology address the training and support priorities perceived by inservice educators to meet their needs?
4. CTE professional partnership activities improve access to continuing training in general and assistive technologies?
5. CTE partnership decrease barriers to technology, training, and support?
6. CTE partnership for technology training activities influence educator's practice in the classroom?
7. educators and administrators perceive technology integration in the curriculum, and especially assistive technology for special needs students to be a priority?
8. are national and state standards driving support and training for Maryland educators in new technologies?
9. are there significant relationships among the training and support variables in the CTE-MSDE partnership model components of 1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination, and 5) access to new technologies (general and assistive).
10. are the best indicators of technology training and support for educators' professional development, knowledge and awareness, technical assistance, and information dissemination? See Figure 1.

Model Components and Definitions

The following represents the CTE-MSDE partnership model found in the action plan within the contract. Under this model four primary strategies were identified, three goals, and three objectives. Based on activities and strategies outlined in the proposed plan, training and support activities are correlated to achieve local, state, and national standards for technology

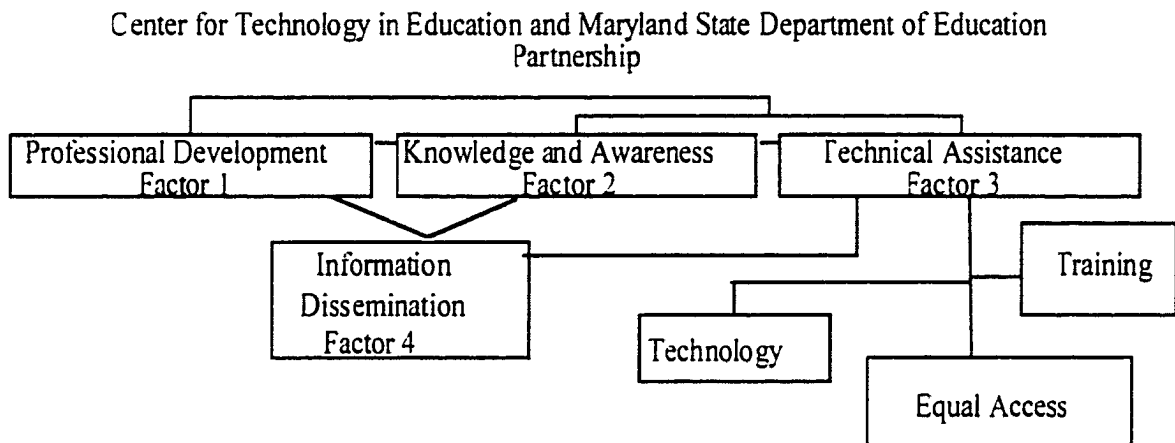


Figure 1. Professional Development Conceptual Model

integration and reform. In the case of CTE there is a special focus on access to technology to increase the inclusion of students with disabilities in the statewide assessment process and in general education.

Hypotheses

Two hypotheses were developed to answer the research questions posited in this study. Research questions one through eight did not require inferential statistics, since they were approached primarily from evaluation and interpretive research perspectives, which require no hypotheses be tested. However, the two prevailing hypotheses for questions nine and ten are presented in the null form.

H_0^1 . There are no significant correlations among the training and support variables of:

1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination, and 5) access to new technologies (general and assistive).

H_0^2 . Educators' perceptions about knowledge and awareness, professional development, technical assistance, and information dissemination needs are not the best predictors of educators' priorities for training and support needs from the CTE-MSDE partnership.

In Table 1, the critical factors that emerge in this study are broadly defined. The terms described are based on their interpretive use in the data collection, analysis, findings, conclusions, and recommendation.

Table 1. Definition of factors

| Factors and Related Variables | Defined as: |
|--|--|
| F-1. Knowledge and Awareness | <p>Increasingly information about the integration of computer and telecommunications in education surmounts. This condition increases the potential need for access to new information. Easier access to information will require policymakers, educators, parents, and other stakeholders to be apprised of how new technologies increasingly affect the way learning, teaching, and problem-solving emerge s in this new environment to accomplish goals and objectives of educational reform. Thus, educators and policymakers need research on policies and practices to assess the implications for instruction, assessment, and learning to improve student learning and teaching practice (Pittman, 1998b).</p> |
| F-2. Professional Development and Training | <p><i>Professional development</i> traditionally is used to represent a concept of learning and training for inservice teachers to acquire and develop expert skills in a specific content area (Snowden, 1993b).</p> <p><i>Training</i> comes from the word train, which may be conceptualized as a line of movements that are connected by a common thread to reach a goal. However, it is preparing one to become proficient through instruction and practice. (<i>American Heritage Dictionary</i>, 1991).</p> <p>The definition in this study supports research that says teachers who are immersed into the problems of using technology during training are more likely to transfer skills than those who are trained in an environment that limits experiences (Birman, Kirshtein, Levin, Matheson, & Stephens, 1997).</p> |

Table 1. (continued)

| Factors and Related Variables | Defined as: |
|-------------------------------|--|
| F-3. Equal Access | In this study equal access specifically refers to the number of educators who have the and support they need to ensure equal entry to technology and support services for individualizing instruction and adapting the curriculum to improve learning results of all children, but especially those with special needs. |
| F-4. Instructional Technology | Instructional uses of computers and other technologies have merged with computer science as tools to increase the <i>learning and teaching capabilities</i> in education for all stakeholders in the learning process. Instructional technology has emerged as a major discipline of study over the past 10 years (Moursund, 1997). |
| F-5. Assistive Technology | "Any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is <i>used to increase, maintain, or improve functional capabilities of individuals</i> with disabilities." National School Boards Association & Office of Special Programs, Office of Special Education and Rehabilitative Services, & U.S. Department of Education, (1997). |
| F-6. New Technologies | <i>New technologies</i> may be defined as methods of applying scientific applications as a primary communication mechanism; technology is a system of knowledge, information, or devices which often requires the use of some electronic instrumentality or computers to situate functionality. (<i>American Heritage Dictionary</i> , 1991). This broad and general description of new technologies include both general and assistive technologies. |

Significance of the Study

The call for accountability by the Department of Education for 21st Century Schools and the National Commission on Teaching and America's Future (1996) is the driving force supporting the President's reauthorization of the Elementary and Secondary Education Act proposal (ESEA). This proposal requires states, cities, and schools across the nation to take

responsibility for qualified teachers in their schools. This may indicate that states, cities, and schools will be required to:

1. Adopt performance examinations for all new teachers.
2. Phase out teachers with emergency certificates within five years.
3. Eliminate the practice of assigning teachers to teach who lack adequate preparation, especially in new technologies (Gitomer, Latham, & Ziomek, 1999).

Clearly the missions of National Commission for the Accreditation of Teacher Education [NCATE] and ISTE are focused on preservice teacher education and graduate programs in higher education (Wise, 1999). However, the literature shows that NCATE/ISTE standards have made significant progress in calling attention to the need for technology training and support for inservice teachers (p. 8).

Herein, the question being addressed is about the effectiveness of ISTE and the state of Maryland's standards to improve educators' access to training and technical support in technology needed to achieve integration. A recent report, "Falling through the Net II: New data on the digital divide," indicated a profound gap in access and distribution of technology in metropolitan and rural cities with large populations of special needs students (National Telecommunications and Information Administration, 1998). Research showed that despite existing efforts to increase access to technology in public schools, teachers in these environments remain the least likely to have access to the technologies or the training and development needs of their teachers (Coley, Cradler, & Engel, 1997).

These unidentified gaps in knowledge about what inservice educators in these environments need to know and be able to do may be a facilitating source for questions being raised about the ISTE technology standards. New information may be needed to increase the efficacy of existing standards to guide the training needs of inservice teachers in new technologies in these environments (National Center for Education Statistics–NCES, 1999). The national teacher quality study reports that the lack of information about teachers (educators)

and effective pedagogy for training teachers in new technologies is worthy of extended discussion (Riley, 1998; NCES, 1999).

Policy experts describe involvement as time and opportunity for teachers to engage in reflective thinking (Darling-Hammond & Ball, 1997). This reflective thinking may include self-related ideas such as self-efficacy, personal agency, and individual teaching practice as valuable distinctive parts of the support concept (Snow & Jackson, 1993). Moreover, experts tend to agree it is important to view teachers as individuals, not a profession when discussing professional development and learning (National Foundation for the Improvement of Education–NFIE, 1996).

Therefore, this study is focused on the prevailing professional teaching research, policies, and practices that are guiding the professional development of experienced teachers in new technologies. Clearly, the missions of current teacher licensing and certification standards were not designed to address teacher competence in new technologies. The literature shows critics of standards argue that setting higher standards and not enforcing them has added to the underqualified teachers in public schools (NCES, 1999). While there is disparate agreement on what constitutes teacher quality among the various standards, the literature suggests there is agreement on two critical elements. They are:

1. Teacher preparation and qualifications.
2. Teaching practices (NCES, 1999).

Summary

The broad objective of the literature review was to examine concerns about professional development standards and practices that guide training in new technologies for experienced K-12 public school teachers. The study met with the following delimitations.

1. The criteria for training standards in new technologies were defined in the literature review and field observations. The study may not contain all factors related to the

effectiveness of the ISTE foundation training standards in new technologies and their adequacy for experienced teachers.

2. All participants in the study were voluntary participants who allowed themselves to be interviewed, observed, surveyed, and/or have their work examined.
3. The findings of the study cannot be generalized for all Maryland educators, administrators, or others without extending the research to a wider audience.

The study begins by examining journals, national policy studies, research studies, technology plans, books, congressional records, and field experiences to acknowledge the policy, practices, and research works of others about these issues and questions. Figure 1 provides a descriptive conceptual map for the organization of the review.

CHAPTER 2. REVIEW OF THE LITERATURE

Introduction

A system of accountability for teacher quality would provide educators and policy-makers with a way to measure the performance of individual schools' efficacy to prepare teachers who can help students become independent and contributing citizens. Research clearly shows student achievement is highly dependent on teacher qualifications, especially in levels K-8 (NCES, 1999).

Figure 2 describes the conceptual framework for this review, which will investigate three interconnected technology training and technical support issues: 1) research (R), 2) policies (P), and 3) practices (P). There are five major sections and 13 subsections. These three areas (RPP) will be used to examine the efficacy of existing training and development standards and practices for inservice teachers with regard to:

1. Teacher quality standards.
2. Technology training and development practices.
3. Standards for teacher learning in new technologies.

In this study, the terms learning and practice are used to represent what is commonly known as *training*.

Status of Teaching Profession

In 1997, the National Center for Educational Statistics (NCES) released a report, *America's Teachers: A Profile of a Profession*. At that time, approximately 2.8 million teachers were in U.S. public schools. In a recent survey, the U.S. Department of Education reported a profile of 4,049 teachers in public schools. The study found that only 20% viewed themselves as well prepared to meet the challenges for rising standards in schools, teaching students from diverse backgrounds, helping students with special needs, and using technology in the classroom (National Center for Education Statistics, 1997a; 1997b; 1999).

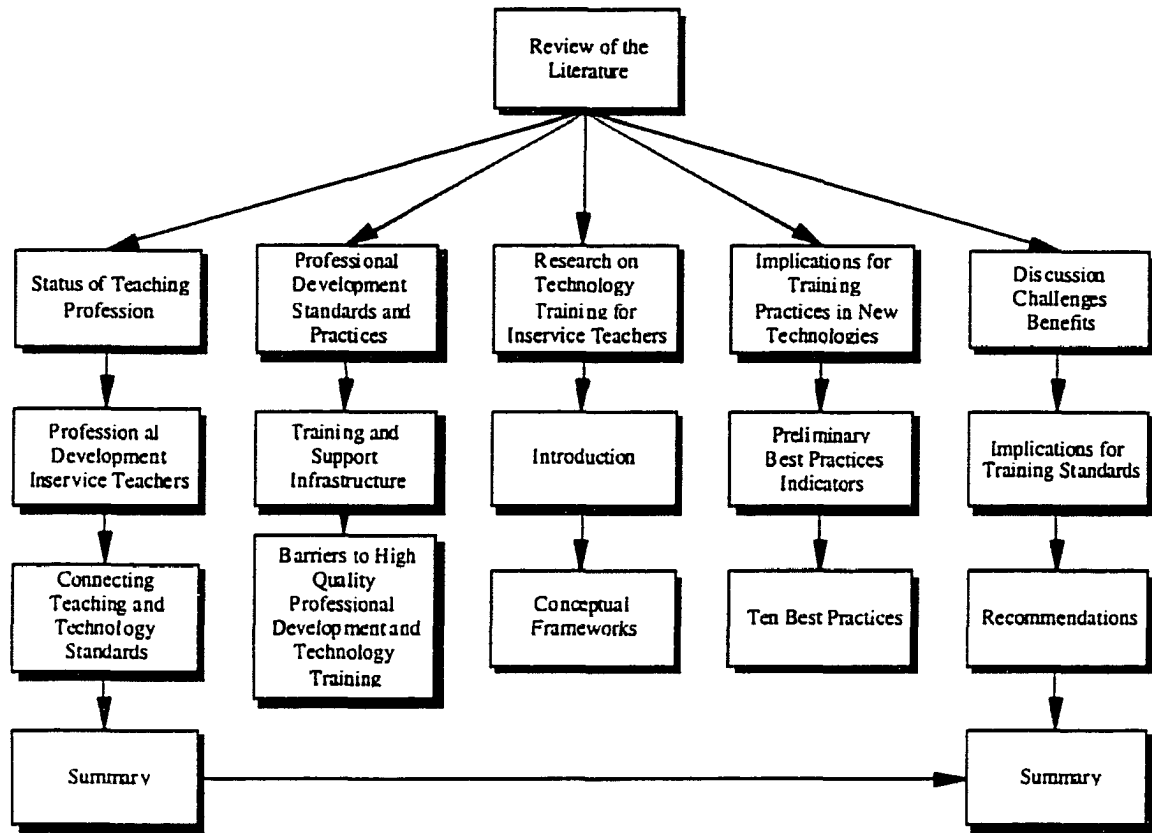


Figure 2. Conceptual Model for Organizational Schemata for Literature Review

Professional Development for Experienced Teachers

Because prevailing training efforts have fallen short in delivering strategies for teachers to adequately test the efficacy of technology, many teachers do not realize the benefits technology integration can offer in the classroom. Despite these facts, teachers continue to take on leadership positions and serve as role models for new teachers to learn and use technologies. Consequently, teachers need immediate learning opportunities in new technologies to meet new licensing and certification requirements.

Many schools have made significant progress in training teachers in basic computer literacy, word processing, and database skills through university and corporate partnerships. However, this access is often inadequate and too often does not increase use of new technologies in the classroom (Pittman, 1998b; Fulton, 1995). Considering the President's initiative to connect all schools by Year 2000, the E-rate program assisted schools to expand

professional development by including more telecommunications, Internet, and distance learning experiences. This has contributed to increasing training opportunities and making them more accessible to a small percentage of teachers (Lloyd, 1998). However, research shows that the majority of teachers continue to need training in their new roles as learners and facilitators to fully benefit from the increased access to technology. In this environment, the distinctions between knowledge and skills often appear unclear for teachers (Pittman, 1998b). The literature implies this may be an important distinction in identifying and designing training around what teachers need to know and be able to do to use new technologies (Darling-Hammond & Ball 1997; Hall & Loucks, 1979).

However, these questions seem to counter “What should policymakers know about what teachers need to know and be able to do.” More important, how do administrators ascertain this information? Considering adult learning principles, some experts advocate it may be more efficacious to ask, “How do we help teachers assess their training needs in new technologies” (Knowles, 1978).

For the last 10 years, Cuban (1986; 1997) has argued that providing teachers with wired classrooms, computers, and ongoing help is not sufficient to stimulate creative use of technology in instruction. He consistently bases a significant part of his argument on university faculty who have had computers for almost two decades and are just now getting help to infuse technology into instruction. He states explicitly in his argument that shaming or blaming teachers about their lack of technology use will not work, because value conflicts seldom succumb to technical fixes (p. 2). Research on teachers and attitudes about technology use has revealed that teachers differ widely in their perceptions about the value of technology in the classroom (p. 2). They also differ in their perceptions of abilities to integrate technology in the classroom (Association for Supervision and Curriculum Development:-ASCD, 1997a; National Center for Education Statistics, 1999). Considering this information, experts seem to agree that a major issue of technology integration is the quality of new technologies’ preparation for

teachers. This implies that to improve the quality of learning and practice, new criteria for training teachers in new technologies effectively are needed. This is especially important now that general educators must also be prepared in assistive and general technology (referred to in this study as new technologies) to include special needs students in the generalized classroom (Zorfass, Morocco, Tivnan, Persky, & Remz, 1991). The next discussion is focused on the nature of existing standards for technology professional development in technology and teacher education.

Connecting Professional Teaching and Technology Training Standards

Selected groups of policymakers have advocated linking inservice teacher technology preparation to preservice teacher education and practice. It was portrayed as central to establishing a shared vision of effective use of technology in the classroom (U.S. Department of Education and White House Outreach Meeting Report, 1998). However, the similarities and differences between the current technology teacher education standards and the proposed new technology learning and practice standards for inservice teachers are the least researched among teacher education standards.

The literature does not reveal the explicit nature of the research-based aspect of developing technology teacher education standards (National Education Technology Standards Project (NETS), 1998). Therefore, we will examine the standards to establish the rationale for policymakers' suggestion to link learning and practice for inservice teachers in new technologies and preservice teachers' technology education standards.

Three distinctive teacher groups emerged in the examination of standards: 1) preservice 2) new, and 3) inservice. The intent is to focus the discussion of standards for inservice teachers. However, it is important to explore other standards to establish a rationale to link new technology preparation standards for inservice teachers to standards designed for preservice and new teachers. Policymakers have expressed a position that standards for professional development of teachers to use new technologies should not be isolated from other standards.

These include licensure, certification, and teacher preparation (Sheingold, 1998; U.S. Department of Education and White House Outreach Meeting Report, 1998; Council for Basic Education, 1996).

While this logic may be true, it focuses attention to a different line of thinking. For example, one of the questions that emerged was, "Is the difference in the professional development and technology preparation needs of these three teacher groups analogous?" Therefore, the discussion continues by addressing standards designed for each group of teachers by summarizing the foundations of existing and related teacher education standards. This includes the organizational mission, structure, goals, objectives, and limitations.

Preservice teachers. Currently the National Council of Accreditation of Teacher Education (NCATE) is endorsed by the U.S. Department of Education as the official policymaking body to accredit preservice teacher education programs in new technologies. The targeted audiences are schools or colleges of education, state, and local agencies. The International Society for Technology Education (ISTE) works with NCATE to provide guidelines for technology standards called unit guidelines. Recently, the National Educational Technology Standards (NETS) Project was formed to foster collaboration between policymakers and teacher education institutions and organizations. The initiatives include various groups in this discussion, but are not focused on training standards for inservice teachers (ISTE, 1997; Moursund, 1997; NCATE, 1997; NETS, 1998).

Graduate programs provide continuing education in new technologies training that, in part, support the needs of teachers. Although many teachers will return to the halls of higher education for graduate programs, studies show the largest single group returning to school are teachers with less than ten years of service (with an average of 1-5) or those with 20 or more years of service (Gitomer, Latham, & Ziomek, 1999; Pittman, 1998b). The largest population of teachers averages 14.5 years of service. This data indicates graduate and continuing education

programs are not reaching the largest group of teachers believed to need training and development in new technologies.

Analysis of NCATE/ISTE Technology Standards for Teachers. For years, NCATE's mission has been licensure and certification of new teachers and teacher education accreditation. Presently, the new NCATE/ISTE guidelines and standards require all candidates seeking initial endorsements in teacher education to demonstrate competencies in one of three areas: 1) Basic Technology Operations, 2) Professional and Personal Use of Technology, and 3) Application of Technology in Instruction (ISTE, 1997). In Table 2 the details of these standards can be reviewed.

The CTE-Maryland partnership will be examined to develop an understanding of the link between technology standards (policies), training, and technical support, and the impact on: 1) Maryland's Technology Standards, 2) instructional practices and student learning assessment, 3) how teachers use hardware/software to achieve standards of learning, and 4) the social foundation for technology integration in Maryland schools.

In 1998, Maryland extended its adoption of the new national teachers' examination, PRAXIS, developed by Educational Testing Service (Educational Testing Service, (1990). In addition, plans are underway to connect technology standards to teacher licensure and certification standards. A recent study, *The Academic Quality of Prospective Teachers: The Impact of Admissions and Licensure Testing*, show those preservice teachers and experienced teachers who attend NCATE accredited institutions score higher on the Praxis I and II licensure tests, a national teachers' examination (Gitomer, Latham & Ziomek, 1999) (p. 12). However impressive the results of NCATE are, there is another model that may be as appropriate for guidelines for local agencies, the Teacher Education Accreditation Corporation (TEAC, 1999). This group is believed to extend more flexibility for accreditation guidelines to evolve based on local education needs within the existing institutional frameworks. The research indicates that an infrastructure similar to either may be needed to implement guidelines for technology for public

Table 2. Foundations technology standards for all teachers: instructional strategies, software/hardware applications, social foundations, and teacher training

ISTE Recommended Foundations in Technology

All teachers should be able to:

Basic Computer/Technology Operations/Concepts

1. operate a multimedia computer system with related peripheral devices to successfully install and use a variety of software packages
2. use terminology related to computers and technology appropriately in written and oral communications.
3. describe and implement basic troubleshooting techniques for multimedia computer systems with related peripheral devices.
4. use imaging devices such as scanners, digital cameras, and/or video camera with computer systems and software.
5. demonstrate knowledge of uses of computers and technology in business, industry, & society.

Personal and Professional Use of Technology

1. use productivity tools for words processing, database management, and spreadsheet applications.
2. apply productivity tools for creating multimedia presentations.
3. use computer-based technologies including telecommunications to access information and enhance personal and professional productivity.
4. use computers to support problem-solving, data collection, information management, communications, presentations, and decision-making.
5. demonstrate awareness of resources for adaptive assistive devices for students with special needs.
6. demonstrate knowledge of equity, ethics, legal, and human issues concerning use of computers and technology.
7. identify computer and related technology resources for facilitating lifelong learning and emerging roles of the learners and the educator.
8. observe demonstrations or use of broadcast instruction, audio/video conferencing, and other distance learning applications.

Application of Technology in Instruction

1. explore, evaluate, and use computer/technology resources including applications, tools, educational software and associated documentation.
 2. describe current instructional principles, research, and appropriate assessment practices as related to the use of computers and technology resources in the curriculum.
 3. design, deliver, and assess student learning activities that integrate computers/technology for a variety of student group strategies and for diverse student populations.
 4. design student learning activities that foster equitable, ethical, and legal use of technology by students.
 5. practice responsible, ethical and legal use of technology, information, and software resources.
-

school teachers. However, the information cautions that the impact on teachers, especially minority teachers, could severely reduce the pool of qualified teachers (Gitomer, Latham, & Ziomek, 1999). Despite this alert, institutions across the country have adopted or are in the process of adopting/adapting new quality standards for teachers. The basis for these new standards are local needs and state-wide licensing and certification requirements for technology as recommended by ISTE technology standards (p. 15).

New teachers. Two policy groups emerge in this arena: National Board for Professional Teacher Standards (NBPTS, 1993) and the new Intrastate New Teacher Assessment and Support Consortium (INTASC, 1997) standards. NBPTS's mission is primarily to provide a process for advanced certification of new and inservice teachers in subject matter content, general learning, and teaching practices (Educational Testing Service, 1990).

Inservice teachers. The policymaking environment found two groups that approach standards for inservice teachers. NBPTS (discussed earlier) and the National Staff Development Council (NSDC, 1996). However, neither group unequivocally is responsible for developing guidelines to train and support the needs of teachers.

A White House U.S. Department of Education outreach meeting in April 1998 brought together over 150 representatives from universities, schools of education, and education association representatives. During the meeting, a proposal was made to link new professional development standards for inservice teachers to the existing ISTE technology and NCATE teacher education standards. One question that emerged was whether standards designed for preservice and new teachers are appropriate for inservice teachers (U.S. Department of Education and White House Outreach Meeting Report, 1998).

The adoption training standards in new technologies for inservice teachers without substantial input from them seems inappropriate. This action could potentially result in a mismatch between adult learning and practice standards and the reality of what teachers really need to know and be able to do (Goodlad, 1991). Appropriate research about revising current

standards may reduce the potential for a mismatch between teachers' preparation needs and training for teachers in new technologies.

The review of current standards unveiled technology preparation priorities were not focused on professional development for inservice teachers in new technologies. Research shows that inservice teachers express training needs that extend beyond the basic applications (Means & Olson, 1995; Moursund, 1997). Teachers desire more indepth knowledge about why use technology and how to adapt existing curriculum and content to accommodate this new support system. In part, this clearly supports the rationale for this discussion about the need for new standards for technology preparation for teachers (ISTE, 1997; NETS, 1998). As a result, in the next section a review of effective practices is discussed. The discussion attempts to highlight outstanding features of selected models that may contribute to building future models, standards, or guidelines for teacher preparation in new technologies.

National Professional Development Standards and Policies

This review section provides information that serves as the foundation for this study on the status of professional development standards for training inservice teachers in new and assistive technologies. Occasionally, contrasted arguments present information to support the research and development of adult learning and practice standards for teachers to learn new technologies.

Training and Support Infrastructure

The first line of examination comes from the federal government's attention to professional development of teachers. Despite the government's attention to training teachers in technology, the pace of technology integration continues to move slowly into teaching practice. Current teacher education, licensing, and certification standards within the states may be inadequate to guide new technology learning for inservice teachers. This condition may exist because current standards do not provide an articulated vision for training inservice teachers in new technologies, except through graduate education.

The United States does not have a professional development system for approximately 3 million inservice teachers nor does it have standards for training teachers in new technologies (Darling-Hammond & Ball, 1997). Our system of professional development is portrayed in literature and research as inadequate to train teachers in new instructional technologies (Moursund, 1997; National Education Goals Panel, 1995). With only 20% of teachers reporting satisfactory comfort levels with technology, it is somewhat evident that prevailing training guidelines have produced little influence on effective training for teachers in new technologies (National Foundation for the Improvement of Education, NFIE 1996).

The consensus of the multiple interest groups supports the idea that if teachers are effectively trained to use technology, it does enhance opportunities to learn (OTL) for all students (NCES, 1999). This consensus only adds new and perplexing dimensions to content and pedagogy, at every level and in every teaching discipline (Moursund, 1997; National Education Association, 1997). Moursund's perspective encourages the need for improved professional development. In his study, *The Future of Information Technology in Education* (1997) Moursund states:

Our inservice teacher education system was not designed to deal with a rapid pace of change. It is proving inadequate in dealing with computer-based technology. Unless there is a major restructuring in our inservice education system, there will be a growing gap between the potential of information technology in education and actual implementation. (p. 81)

Moursund goes on to forecast additional training needs especially in multimedia, telecommunications, and new instructional methods. In Table 2, ISTE recommends that all teachers be required to operate and install multimedia equipment and software. Considering multimedia is not that accessible to most teachers, there is a need for dialogue about the need for technology training standards. The current foundation technology standards developed by ISTE and those being adopted and adapted by the states are focused on "how to" software and hardware applications skills.

During the review process, approximately 32 technology plans were collected through the Internet and the literature. These were used to select professional development school sites in different states. The selection of states to visit was, in part, based on the models that were unveiled in these plans (State of West Virginia, 1996). The highest priority was given to professional development plans aligned with national, state, or local technology plans or standards. Other states were selected because they connected to professional teacher education and learning events. However, visits were also made to states by invitation that met none of these criteria (Rhode Island Department of Education, 1998).

During the focusing process, field observations included visits to approximately 15 states, schools, and districts to investigate university partnerships within selected states. There were three underlying assumptions in this part of the review:

1. Educators, practitioners, and policymakers tend to agree technology professional development of teachers needs to be reconceptualized (Darling-Hammond, 1997a).
2. The most effective preparation in new technologies for inservice teachers is grounded in practice. The idea of practice must reach beyond traditional professional development to effectively bridge the gap between the *how to use, to why use* new technologies (Zorfass et al., 1991).
3. Despite the slow pace of technology integration, experts report pockets of exemplary models within over 140,000 business-school reform and educational technology partnerships (Solomon, 1992).

These are communities of teachers and learners using technology effectively in isolated classrooms in public and private schools (Becker & Sterling, 1987). Technology-minded educators and reformers refer to these niches as *rich learning communities* (Thompson, 1997). The Society for Information in Teacher Education founder, acknowledged these communities as islands of excellence. The literature further supports this observation in the discussion that follows (Willis, 1998).

Barriers to High-Quality Professional Development and Technology Training

In today's schools, knowledge and skills in new technologies have become a basic skill comparable to that of reading, writing, mathematics, and science (Yoder, 1991). It is speculated that teacher training in new technologies is a problem challenging public schools. It is problematic because many training programs for teachers are not guided by an infrastructure for professional development that ensures access to continuing opportunities to acquire additional knowledge and technology skills. The National Education Goal Four states inservice teachers will have continuing opportunities to acquire additional knowledge and skills needed to teach challenging subject matter and to use emerging new methods, forms of assessment, and technologies (National Education Goals Panel, 1995).

Five years ago, the National Education Goals Resource Group acknowledged data gaps in the published report, *The Status of Teaching and Teacher Development in the United States*. The most critical gaps included the subjects of:

1. measurement strategies for evidence connecting the quality of professional development activities to increased proficiency in teaching skills, and
2. equity regarding the number of teachers having access to high quality professional development activities in new technologies (National Education Goals Panel, 1995).

Five years later, many teachers still need learning and practice in new technologies. Without adequate preparation, teachers cannot teach new challenging subject matter, use emerging new instructional methods, or forms of assessment, as required by educational reform (Mackowiak, 1991; U.S. Department of Education, 1997; National Education Goals Panel, 1995). In 1991, Mackowiak identified technical assistance as a major obstacle to technology integration for educators. At that time five other studies were also cited that found computers must be accepted by educators like any other technological innovation before they can be utilized for productivity (Betza, 1986; Jacobson & Weller, 1987-88; Lewis, 1985; Moursund, 1979). Even more recently, a subsequent study of professional development in public schools

analyzed professional development defining features of 12 most widely implemented professional development and programs currently used to train practicing teachers (Wang, Haertl, & Walberg, 1998).

Providers of professional development services report that within the last five years professional development practices were redesigned to help educators respond in two ways:

1. new instructional methods, and
2. pull-out and school-based programs designed to increase student achievement in reading and mathematics.

However, based on a review of the findings from this study of 12 models for reform and associated technology plans for selected states, few states include technology learning and practice components for inservice teachers as a part of their models for reform.

The professional development practices in question are important because they represent a continuous stream of resources into traditional professional development for teachers during a time of demands for technology integration and high quality teaching. The survey did not explicitly report any technology-specific training and development initiatives within these programs (Wang et al., 1998).

Traditional training and development programs continue to represent a primary investment in professional development for inservice teachers, while overlooking research that indicates the need for more technical assistance. This study reported that during the last five years in over 600 schools that served at least 36,000 students, these types of programs existed in growing numbers. In addition, the analysis unveiled disparities in terms of results based on the research supporting these programs (Wang et al., 1998).

Furthermore, while investigating professional development technology learning and practice models, it was disclosed that substantial investments of dollars and time were inconsistent and in some cases could not be accounted for based on reporting and tracking practices. The argument is not that general professional development programs are not needed,

but a system of direction is needed. An accountability system is needed if teachers are being held accountable to achieve new high quality teaching standards. In addition, professional development must be focused within the context of the new technologically-oriented learning environments.

The practice of traditional training and development stimulates the question of impending barriers that could potentially be reduced if there were standards. Training standards alone will not address this issue (Wolf, 1998). To achieve this restructuring, more effective research-based policies and practices will be needed. Without this action, reform efforts may remain easier said than done, if current professional development efforts continue to undermine support, inservice teachers may need to learn new technologies (Little, 1993).

The continued implementation of traditional professional development practices have important implications for new learning and practice standards considering the USDE and National Foundation for the Improvement of Education (NFIE) have both constructed guidelines for high quality professional development practices (NFIE, 1996). An analysis of national professional development unveiled five critical areas as domains where policies and practices are not clear in the professional development guidelines and standards. The lack of clarity may contribute towards the misinterpretation and implementation of the standards. This would add to the potential growth of disparaging training and development practices for inservice teachers.

Therefore, this limited research about policies to gauge professional development for inservice teachers could be a contributing factor in part to the widening gaps in the access and efficacy of new technology training and development practices and standards. In an analysis of USDE and NFIE guidelines, a comparison of basic criteria resulted in what appears to be largely Pareto-improving policies. The literature shows that Pareto policies are most prevalent in international reform efforts. To explain, Pareto-improving policies provide improvements in the welfare of some without making anyone worse by sustaining practices that drain limited

resources (Liew, 1998). Such practices have been proven by international business and political experts to result in a negative impact on progressive reform efforts.

The definition used in policy studies for this type of policy revealed that conceptually it bears a likeness to current training standards, policies, and practices in public education for inservice teachers in new technologies. In other words, the guidelines for high-quality professional development do not effectively address the type of support clearly needed to provide adequate access to learning, practice, and development of teachers in new technologies. Yet, the standards meet the political requirement of establishing criteria for training teachers through existing policies. Some specific examples of where the guidelines may fall short in addressing the access to high quality teacher training in new technologies are:

1. Equity and access in schools that serve large multicultural ethnically culturally diverse student population. The USDE guidelines state that effective professional development *enables teachers to develop further expertise in subject content, teaching strategies, uses of technologies, and other essential elements in teaching to high standards*. The guidelines are not clear in the criteria for high quality professional development. The guidelines do not sufficiently address the issues of access to technology, diversity, and financial resources. Schools cannot provide support to teachers without a way of gauging the type of support teachers need. NFIE simply states that high quality training *makes the best use of new technologies*.
2. Infrastructure for inservice teacher preparation. USDE states professional development should be driven by a coherent long-term plan. During a time when technology is changing rapidly, it may be more feasible to construct a long-term, ongoing, and flexible plan. NFIE comes closer by seeking to promote professional development that is rigorous, sustained, and adequate by acknowledging inevitable long-term change of practice.

3. Support framework for technology preparation. Professional development, learning, and practice in new technologies require substantial time and other resources. While both acknowledge the need for such, few resources seem adequate, beyond school districts redistributing current budgets short-term and one-shot funding deals.
4. Research-based practices to improve professional development - the guidelines by both groups clearly reflect the importance of the best available research necessary to support effective practice in teaching, learning, and leadership. However, upon investigating practice, few seem guided by these criteria. The analysis of the research further highlighted the lack of a consistent way to measure progress of effective practices for training inservice teachers in new technologies. As a result, the fifth and probably the most critical area of inadequacy emerged.
5. Accountable system to measure student achievement and teacher change.

Knowledge of the relationship between these variables and technology integration by teachers may help teachers, educators, and policymakers design more effective standards for training teachers in new technologies.

Research on Technology Training Practices for Inservice Teachers

Evaluation experts report the greatest challenge incurred in selecting models to review was identifying universal criteria for evaluating and analyzing the different models (Cradler, 1998). The teacher preparation standards examined have clear missions and strategies (ISTE 1997). However, this was not the case with the professional development models for inservice teachers. Yet, promising behavioral theoretical frameworks of how teachers progress in technology training did emerge. An example of these includes the Concerns-based Adoption Model (Hall & Loucks, 1979) and the ACOT™ Professional Development Model (Yocam, 1996); the designs were widely dispersed and inconsistent with the exception of those model with extensive or valid research foundations. (See Table 3.)

Table 3: Principles of high quality professional development: A comparison of the U. S. Department of Education and NFIE

| USDE Model | NFIE Model |
|---|---|
| Professional Development: | |
| <ol style="list-style-type: none"> 1. Focuses on teachers as central to student learning, yet includes all other members of the school community; 2. Focuses on individual, collegial, and organizational improvement; 3. Respects and nurtures the intellectual and leadership efficacy of teachers, principals, and others in the school community; 4. Reflects best available research and practices in teaching, learning, and leadership; 5. Enables teachers to develop further expertise in subject content, teaching strategies, uses of technologies, and other essential elements in teaching to high standards; 6. Promotes continuous inquiry and improvement embedded in the daily life of schools; 7. Plans collaboratively by those who will participate in and facilitate that development; 8. Requires substantial time and other resources; 9. Follows a coherent long-term plan; 10. Evaluates ultimately on the basis of its impact on teacher effectiveness and student learning; and this assessment guides subsequent professional development efforts (USDE, 1999). | <ol style="list-style-type: none"> 1. Directs toward teachers' intellectual development and leadership. 2. Balances individual priorities with school and district needs and advances the profession as a whole. 3. Directs towards teacher's intellectual development and leadership. 4. Fosters a deepening of subject-matter knowledge, a greater understanding of learning, and a greater appreciation of student needs. 5. Makes best use of new technologies. 6. Provides adequate time for inquiry, reflection, and mentoring and is an important part of the normal working day of all public school educators. 7. Provides rigorous, sustained, and adequate long-term change of practice; 8. Designs and directs teachers to incorporate the best principles of adult learning, and involves shared decisions designed to improve the school; 9. Supports site-based training and technical support activities clearly with an articulated vision for students; 10. Helps teachers and other school staff meet the future needs of students who learn in different ways and who come from diverse cultural, linguistic, and socioeconomic backgrounds; 11. Improves student learning is at the heart of every school endeavor. |

Sources. U.S. Department of Education and National Foundation on the Improvement of Education (1996).

To establish some uniform criteria, the U.S. Department of Education and NFIE Guidelines for High-Quality Professional Development were used to gauge the general quality expected about training practices. This vast number of professional development formats increased the complexity of selecting a universal evaluation strategy as well. Consistent with the designs supporting the preparation models, classroom integration practices were discrepant and inconsistent in implementation in the models. Considering these discrepancies, more in-depth analysis of technology preparation practices was pursued in search of a unique pattern for the variations for this fragmentation in implementation.

A primary notability of policy and program analysis is the integration of fragmented ideologies, which increases exposure to different interpretations. A second consideration is that policies and program guidelines that support teacher training are consistently susceptible to multiple priorities of the schooling and political systems. These multiple and often conflicting priorities posit unique implementation issues for local school districts and the administrative decision-making infrastructure.

The literature indicates that opportunity for administrators and teachers to engage in collaborative decision-making about implementation procedures are highly desirable. However, in reality, collaborative decision-making can present yet another opportunity for policy modifications based on different interpretations. Nevertheless, despite these apparent weaknesses of policies and standards, they do perform an important role. Four areas emerged as critical within the context of professional development for inservice teachers in new technologies include:

1. Policy formulation about which education and technology problems to address.
2. Implementation practices to carry out policies to support standards.
3. Policy revision that involves preparation practices for teachers in new technologies.
4. Criteria for evaluating the effectiveness and efficiency of specific program

(McMillan & Schumacher, 1997).

Conceptual Frameworks

Concerns-based adoption model (C-BAM). This framework guided the analysis and synthesis of the research, policies, and practices in new technologies for much of this study. The questions posed in the review at the awareness level were effective in unveiling information that revealed outmoded practices (that is, one size fits all traditional training workshops). These findings were employed to further support the argument that current training standards for inservice teachers may not be adequate.

C-BAM is a theoretical framework developed for professional development activity planning. Developed by Gene Hall (1979) is a validated model to explain orientations and expectations of teachers concerning innovative technology practices in the classroom. It incorporates six, research-based, and documented principles of change. The model is based on the belief that people are generally well disposed towards change, but that valid concerns do emerge in the process. The six levels of concern in the model includes 4-5 sub-themes): Level 0 - Awareness, Level 1 - Informational, Level 2 - Personal, 3 - Management, Level 4 - Consequence, Level 5 - Collaboration, and Level 6 – Refocusing.

Apple Classrooms of Tomorrow Stages of Development (ACOT)TM. ACOTTM is a research and development collaboration established in 1985 among public school to facilitate and integrate technology into the classroom. It is the most comprehensive and long-term model ever initiated in public schools. The partnerships connect public schools, universities, research agencies, and Apple ComputerTM. The research-based project began in seven classrooms selected to represent a cross section of America's elementary and secondary schools.

The goal was to determine how the standard use of technology by teachers and students would affect learning and teaching. For over 10 years, ACOTTM has studied learning, assessment, teaching, teacher development, school design, the social aspects of education, and the use of new technologies in over 100 classrooms. During the process one of the most

outstanding programs to emerge was the professional development for teachers to use technology.

This nationally recognized project is reported to have created a supportive environment that encourages reflective discussions among teachers as adult learners. These discussions resulted in a five-tiered learning and practice model for representing teachers' experience in learning to integrate technology:

1. Entry
2. Adoption
3. Adaptation
4. Appropriation
5. Invention

The professional development model viewed teachers as individuals, which helped them to become learners again; thereby establishing what is now referred to as *communities of learners*. Six features emerged that can be replicated by other schools in developing standards for professional development in technology. The ACOT™ Professional Development Center Model suggests that all staff development activities should be:

1. Situated in practice.
2. Attended in teams of 2-4.
3. Conducted as a constructivist learning environment.
4. Designed to engage teachers individually and collectively in reflective conversation about technology.
5. Developed to support teacher learning, which employs the use of technology in different ways.
6. Provided on an ongoing basis.

The best practice features were many, but attention will focus on those most relevant to teacher technology learning and practice, and student achievement gains. ACOT™ admits

beginning their professional development efforts with traditional staff development approaches held after school, whole school days, and summer institute for weeklong learning and practice sessions, what they call the "spray and pray approach." They found it was not working, so they moved from didactic to constructivist learning strategies to transition ACOT™ teachers in the project from computer saturated (25-30 computers in classrooms) to routine access (computer clusters with 3-4 students per computer with teacher workstations). Along with this new approach, more collaborative learning, teaching, and technical ongoing training and support was incorporated.

However, the most outstanding feature of this model is the ACOT™ research and access to technology. Reports revealed that across sites and classrooms a considerable variation in instructional uses of technology was identified. These differences varied based on implementation across curricular areas, uses for traditional (skill practice). There was considerable difference in nontraditional (constructive projects) student work. This information is valuable and could potentially influence the development of future technology training standards (Baker, Gearhart, & Herman, 1993; Yocam, 1996).

The project has provided opportunity for development of intellectual and leadership efficacy of teachers, principals, and others in the school community through project-based learning that brings the teacher and student together as learners. The routine access to new technologies provides excellent collaborative learning, and teaching engaging modeling and mentoring practices.

A University of California Evaluation study (Baker et al., 1993) recounted significant impact on participants. ACOT™ research provides ongoing assessment and evaluation by outside experts. Reports revealed that teachers have changed their teaching practices, redesigned their classroom, increased levels of technology use by teachers and learners, took on leadership roles, resulting in a student achievement increase. However, the researchers revealed it was difficult to determine how much of this improvement could directly be attributed to technology.

Before productive dialogue can guide technology training and integration, there must be an awareness of the potential problem to determine the appropriate typology of an intervention. The ACOT™ research report in over a 12-year period that teachers learn technologies in stages in the classrooms. In this case, it needs to be determined if teachers are participating in ongoing staff development to promote their personal and professional growth, and concern about new technologies. The preliminary scan of the teaching profession and the literature indicates that very little information exists about who our teachers are as individuals or professionals. Without a profile of our teachers, technology training for teachers will continue to bear and meet many limitations that create barriers to technology integration in the classroom.

Neglecting to address teachers' concerns about the poor preparation at the awareness level may continue to result in learning and practice that do not sufficiently lead to transforming learning and teaching in the classroom for all learners (Cuban, 1986).

During this examination, four potential goals for a professional development infrastructure in new technologies emerged:

1. Build an awareness of why current teacher education and technology standards may be inadequate to guide preparation for inservice teachers in new technologies.
2. Establish rationale to support the theory that standards for inservice teacher preparation in new technologies may be necessary to support and expand best technology training practices.
3. Inform with examples of effective practices that represent best practices and thereby enact new guidelines for learning and practice standards for inservice teachers in new technologies.
4. Incite dialogue among local, state, and national policymaking bodies to establish a national research agenda for assessing the effects of teaching with technology on achievement for all learners as a national priority (McMillan & Schumacher, 1997).

Current Standards Emerge Inadequate

Despite National Goal Four, the High-Quality Professional Development Guidelines, teachers' use of technology to teach remain widely dispersed in public education environments, especially urban and rural schools. Educational Testing Service reported only 15% of the teachers received an average of nine hours of preparation in educational technology (Rigdon, 1996) In the same study, less than 25% reported receiving any type of support for professional development during the school year (Fulton, 1995). Focus on five areas consistently emerged as plausible rationale for inadequate preparation standards in the discussion: Access and equity, technology learning and practice infrastructure, supportive framework, use of research-based practices, and a system of accountability.

Equity and Access. A study of computer coordinators reported that access to computer technology was available an average of only two hours a week across all subject lines and unequally distributed. This contributed to widening gaps in opportunities for teachers and learners. A study, *Computers in the Classroom*, reports students and teachers in high poverty and rural schools were least likely to have access and use of new technologies and computers in the classroom (Coley et al., 1997).

Yet technology reformers advocate technology as the one educational change that can make a difference for teachers and learners in these isolated schools to increase achievement levels and connect to the world (Coley, Cradler, & Engel, 1997). A U.S. Department of Education professional development study indicates teachers in these schools were the most isolated. As a result of the isolation teachers in inner city and rural schools were least likely to receive support and access to technology learning and practice on-site during the school day or any other time (U.S. Congress Office of Technology Assessment, 1995).

Technology Learning and Practice Infrastructure. Licensing and certification standards for teachers license renewals and endorsements vary significantly across the states. The literature shows there are eighteen states that do not require teachers to have any technology

preparation for licensure or certification (Coley et al., 1997). A two-year study conducted by NFIE and another by ASCD indicates that when technology is present in schools it often follows the one-size-fits-all learning and practice format. This format was adequate before educational reform and technological innovations in education called for new teaching standards and technology integration. Consequently, this format was suddenly rendered obsolete (ASCD, 1997b; National Foundation for the Improvement of Education, 1996; Wang 1997).

A major consideration in this argument for new infrastructure is traditional professional development models have produced only a moderate cadre of teachers and administrators receiving adequate preparation relevant to their content areas or professional development needs in new teaching strategies (Fulton, 1995; Wang, 1997). Repeatedly, expert practitioners, and technology educators continue to portray the one-size preparation models as failing to maximize teachers' potential, new technology, and resources (Yocam, 1997; Rigdon, 1996).

Supportive framework for implementation. In this paper, support is defined as time, money, and opportunity to learn, practice, and reflect (Darling-Hammond, 1998). The USDE and ETS studies both recommend 30% of technology budgets are allocated for professional development in new technologies. However, data reported in studies revealed average expenditure is about 10%; and even then in most cases, it is not a line item in the school budget or in technology plans.

A report prepared for the U.S. Department of Education, *Investing in School Technology: Strategies to Meet the Funding Challenge*, focuses on planning and investment strategies necessary to manage variable costs. These costs vary widely, based on many factors. The most important of these factors are differences in school size, learning and practice needs, substitute teachers, technology technical support, compatible software, new related curriculum materials, equipment upgrades, and the list gets longer.

These costs can escalate to substantial variable costs for training teachers in new technologies (Pelavin Research Institute, 1997). Despite this elaborate framework and the

recommended 30% of technology budgets for teacher preparation, many technology plans only budget an average 10-15%. The learning and practice allocation guidelines were prepared to assist state and local policymakers, state legislatures, state superintendents, departments of education, and school administrators plan for teachers learning and practice. The goal was to encourage planners to include technology budgets for teacher learning and practice in new technologies in technology plans. However, but few models seem to follow the recommendations for learning and practice support (p. 5). Many plans include professional development lines. However, when examining technology plans, it was discovered that this line often includes a wide variety of training with little allocated specifically for technology training. The result is a technology plan can create an illusion of the 30% allocation based on the defining of variables within this line item.

Currently, USDE and NFIE guidelines are two of the most prevalent national principles forming a broad support framework for establishing new technologies professional development. However, neither organization provides a system for developing neither specific guidelines nor standards for new technologies' integration as a part of learning and practice support. The focus is now directed to USDE programs such as Challenge Grant (U.S. Department of Education, 1998) and Star Schools (U.S. Department of Education, 1997a) because they were two of the first and continue to be the largest funded support initiatives targeting educational technology and reform in education.

Intervening funding guidelines now require service providers to focus on professional development and inservice teachers to use and integrate technology into learning and teaching (U.S. Department of Education Challenge Grant, 1998; Garnett, 1998). Nevertheless, in 1998, over \$30 million was awarded for professional development for inservice teachers to support the evolution of a national professional development model to prepare inservice teachers in new technologies. However, there are no shared standards for these funded initiatives for training inservice teachers in new technologies (U.S. Department of Education, 1998).

It is important to note that under federal initiatives, effective partnerships were formed over the last five years. Fortunately, this support has contributed to a small cadre of exemplary professional development technology models (Solomon, 1992). Three selected school-university-industry partnership models for inservice teacher learning and practice in new technologies are discussed in "Best Practices" section of this report. The analysis of exemplary models reflects remarkable support largely based on site-based management (SBM) and local control policies and practices that have emerged in local school districts within the states. Through partnerships of business, educators, administrators, and teachers have taken responsibility to develop guidelines and standards for technology learning and practice to support their unique needs (Sharp & Thompson, 1997). An example of a practical and effective model is the Iowa Mathco program.

An examination of evaluation reports from 1997 and 1998 revealed this program as one that increases access to distance learning and school-based inservice training for inservice teachers through a school-university-industry partnership, Iowa State University's Center for Technology in Learning & Teaching (CTLT). The project conceptualized and implemented the preliminary phases of a model professional development school for training teachers to use and integrate new technologies in mathematics curriculum to meet National Council for Teachers of Mathematics (NCTM) standards. This model may potentially provide impetus for other content areas. This model is an example of planning and implementing an evolving and ongoing process of training teachers to use new technologies to increase achievement levels of learners.

The impact on teacher and student technology use and achievement was the most outstanding practice in this model. This appeared to be achieved through the empowerment of teachers, faculty, and learners to develop further expertise in subject content, teaching strategies, learning strategies, uses of technologies, and other essential elements of high standards. The professional development school focuses on teachers as central to student learning. It achieved

this based on practices designed to respect and nurture intellectual and leadership efficacy of teachers, principals and others in the school community.

The research driven approach is both teacher- and learner-centered. The supportive framework provided by a university-corporate partnership enables access and equity to new technologies in Des Moines, Iowa schools to create a collaborative professional development school within the school. The program is based in schools with high minority percentages in comparison to other schools in Iowa. Through collaborative planning and decision-making, these partners created a community of learners and diverse experiences for the learners.

Iowa Communications Network (ICN) was the first fiber optics network in the U.S. The network is now used to implement the Mathco professional development model for teacher preparation and staff development, which has significantly enhanced mathematics education of preservice and inservice teachers. It is a partnership funded by Iowa State University and Exxon Corporation that connects ISU and two elementary schools with notable percentages of minority and disadvantaged learners in Des Moines, Iowa.

In 1997, the Mathco program was designed and implemented to integrate the NCTM standards in the math curriculum. At the forefront, was training teachers in new instructional strategies and technology to improve student achievement in mathematics to realize the goals of the NCTM standards. The program's evaluation showed that it achieved initial goals after the first year. During the second year the program expanded by creating and integrating more innovative learning and practice approaches. Innovative practices included expansion of preservice teachers and inservice teacher's use of portfolios to monitor their learning experiences in the project. Best practice management expanded technology learning and practice options by developing specialized courses that focused on technology integration and mathematics content (e.g., *Using Technology to Implement NCTM* and *Implementing the NCTM Standards in Mathematics Teaching*).

The program is connected to another College of Education program, a five-year preservice teacher learning and practice cohort, Project Opportunity. This program matches preservice teachers with inservice teachers to learn new technologies and new instructional strategies. The school and university project participants planned a collaborative research-based agenda. The agenda included a rich community and parent outreach program. The assessment of the project goes beyond portfolio assessment. It also includes pre/posttest assessment components, workshops, and meetings designed for teachers, students, and administrators. This provided an opportunity to the groups to engage in reflective thinking and planning.

The National Council of Mathematics has recognized the program as a comprehensive professional development model designed to achieve mathematics standards. To extend the best practice results beyond Iowa, Dr. Ann Thompson, Project Director, is writing a book to disseminate the experiences of this project on a national level.

In addition, the Center is in the early stages of developing and incorporating more distance learning and video-based case studies of models for technology integration. Reportedly, this will involve faculty in higher education and K-12 teachers modeling the use of technology that may be used to train inservice and preservice teachers (Thompson et al., 1998).

It is clear from this project that planning and development perspectives (local or site-based decision-making) may potentially provide a framework to determine the ground floor level for technology standards development. Experts and teachers argue that despite budget cuts the annexation of decentralization or site-base management in schools has created new opportunities for growth and development.

Although some growth in technology integration has occurred in school systems, without adult learning and practice standards in new technologies, it will remain that some teachers will not reach desired or even minimum levels of performance in using new technologies. Being able to determine which practices work is central to improving technology

preparation for teachers. Without such measurements, the whole process of technology integration and school improvement may be at risk (Asayesh, 1994).

We will look closer at this issue in Best Practices. There are two more critical factors to consider in the discussion of why we need standards: research-based practices and accountability.

Research-based practices. This discussion is approached cautiously, due to the infancy of new technologies in education. At this time the existing knowledge base of empirical data or qualified evidence to connect technology preparation practices to effective teaching practices is very limited; even weaker is the research that connects learning outcomes to instructional practices and technology. In any event, it does not appear that the current body of research is strong enough to suddenly influence widespread decision-making or generalizations beyond their unique environments.

During this review, only a small selection of studies emerged that provided evidence of the connection between general professional development and technology learning and practice to student achievement (Yocam, 1997). Seemingly, policymakers agree that neither educators nor policymakers have enough information on technology preparation, use, practice, and the connection to achievement (Pittman, 1998b). As a result, these groups have joined hands in calling for more action research to address the issue of what best practices look like and where to find them.

Accountability. Currently standards are focused more on teacher education accreditation and teacher certification or licensure. So far, no one group appears responsible for new technology adult learning and practice standards for inservice teachers. However, the best and most effective models reviewed were systems supported by site, local, or state professional development and support infrastructures.

A case in point is Montana's Improving Schools Through Accreditation (MISTA) has developed as a pilot program to empower schools to attain accreditation. (1998) enacted their

plan apparently through their own visions of technology's role learning and teaching. Other states including Iowa; and Tennessee are also undergoing a similar process (Montana Department of Education, 1998; Oregon Department of Education, 1998).

The National Study of School Evaluations estimated that nearly 1,000 schools were engaged in collaborative school improvement and technology planning partnerships. Approximately 36 states have reported technology plans with teacher preparation in technology as a part of their visions (Anderson, 1997). In view of the many successful collaborative initiatives, it appears unquestionable that stakeholders are both capable and willing to accept responsibility at grassroots levels about standards for training teachers in new technologies.

It appears stakeholders understand the need for guidelines but require criteria suitable to their unique learning environments. Because of the flexibility of local and state education localities guidelines from these levels may be more effective and necessary to achieve technology integration and reform aimed at achieving national goals. However, to accomplish local or national goals educators, teachers, and policymakers will need national support to build on current efforts to train inservice teachers. Without establishing measures to gauge teachers progress, the Idaho state superintendent described the current professional development process as a system equivalent to "shooting in the dark" (Idaho Department of Education, 1998).

Summary of Practices

In summarizing why existing teaching standards may be inadequate to drive technology integration, it is clear that USDE and NFIE guidelines were designed to support teacher professional development needs. However, studies continue to show a slow pace of technology integration into the curriculum (Fulton, 1995). This may indicate that current guidelines are not working effectively to sufficiently guide and support preparation inservice teachers need to learn and use new technologies (Electronic Learning, 1995; Darling-Hammond, 1996).

The intent of this review was to examine teacher education and technology standards and technology-preparation practices for inservice teachers in the next part of this paper. It is

important to identify effective practices in technology preparation for inservice teachers before we can begin conclusively to frame recommendations for guidelines that support new adult learning and practice standards for inservice teachers in new technologies. If we do not take action to establish new learning and competency standards for teachers in new technologies, without a doubt, administrators will continue to enact standards without a system of accountability. These new requirements are necessary, but will undoubtedly have profound effects on new licensing and certification standards that hold teachers responsible for new knowledge and skills. More important, is that in reality there is inadequate evidence that these new teaching practices and technology uses result in increased student achievement. One thing is for sure: the new standards will have a grave effect on teachers' personal and professional lives and on this nation's students.

Implications for Practices in New Technologies

Fundamentals of Effective Practices. In this review, approximately 25 professional development and technology-preparation models were examined. The models were reviewed to identify potentially demonstrable examples of effectiveness in improving teaching, using new technology to attain higher student achievement levels. The examination of the practices in these models was conducted through a review U.S. Department of Education reports, technical evaluation reports, interviews, and professional observations (Jackson & Guerin, 1996). Some models are intended to serve only as an example of what exemplary practice might look like. The purpose of this short review was limited to a small sample to identify three examples that would emphasize the need for more in-depth research of potential best practices that exist to guide effective technology standards development for teachers.

Criteria and methodology for evaluating and selecting the models. Several evaluation models for reviewing programs to determine best practice when evaluating professional development and preparation programs in technology emerged in the search for best practice models. The criteria from three program evaluation strategies served as the foundation for a

three-stage analysis. The analysis used a five nonlinear evaluation conceptual framework illustrated in Figure 3 (EGATE—evaluating preparation context, gathering input, selecting a learning and practice design, analyzing/assessing learning and practice appropriateness, and evaluating desired outcomes). The process is a conceptual framework for evaluating technology-based learning and practice programs. It was useful in both selecting and analyzing the training and development practices to assess the efficacy of standards in implementation because it offers a flexible and ongoing progression through the stages.

For example, a researcher or an organization may want to start at analyzing information to determine what is known, not known, and what the organization wants to learn. This strategy is not entirely new but does offer a systematic way to follow a system pattern for implementing an integrated research design, which requires a large amount of data when evaluating technology integration and professional development within a complex organizational and matrix a management structure. Other strategies were used at three different stages of the review standards, impact on teacher practices and student learning, and the context of the organization. It was used extensively in evaluating distance learning models (Fortune & Keith, 1992; Sorensen, 1995; Sweeney, 1995).

In Stage 2, a six-stage methodology created by Gene Hall, the Concerns-based Adoption Model (CBAM) helped to formulate the qualitative framework to interpret research, policy, and practice relating to teachers' training and development during the learning process.

In Stage 3, the Council of Basic Education guidelines for developing and evaluating content standards were employed to support the researcher's interpretation of the data. In general, a qualitative approach to information analysis (interpretation) identified categorical descriptions for data that emerged during the research using this framework.

These features were annotated using a coding system to identify themes that related back to the questions in this literature review. Then these were compared to guidelines for high-quality teaching based on frequency counts for each criteria detected in the models that emerged

more than one time. This data was combined with other information gathered during the review. Prior to making the final judgments about the models, a final analysis included applying the U.S. Department of Education High-Quality Professional Development Guidelines and evaluation criteria. The evaluation criteria were adapted from standards used to evaluate professional development components of federal grant programs (U.S. Department of Education Challenge Grant, 1998; U.S. Department of Education Star Schools, 1999). This intensive process helped limit the number of models this review would accommodate in this paper as examples. Together, these three strategies were used to review and evaluate features of models to identify a small sample of 25 selected models that represented best practices in technology professional development for K-12 teachers.

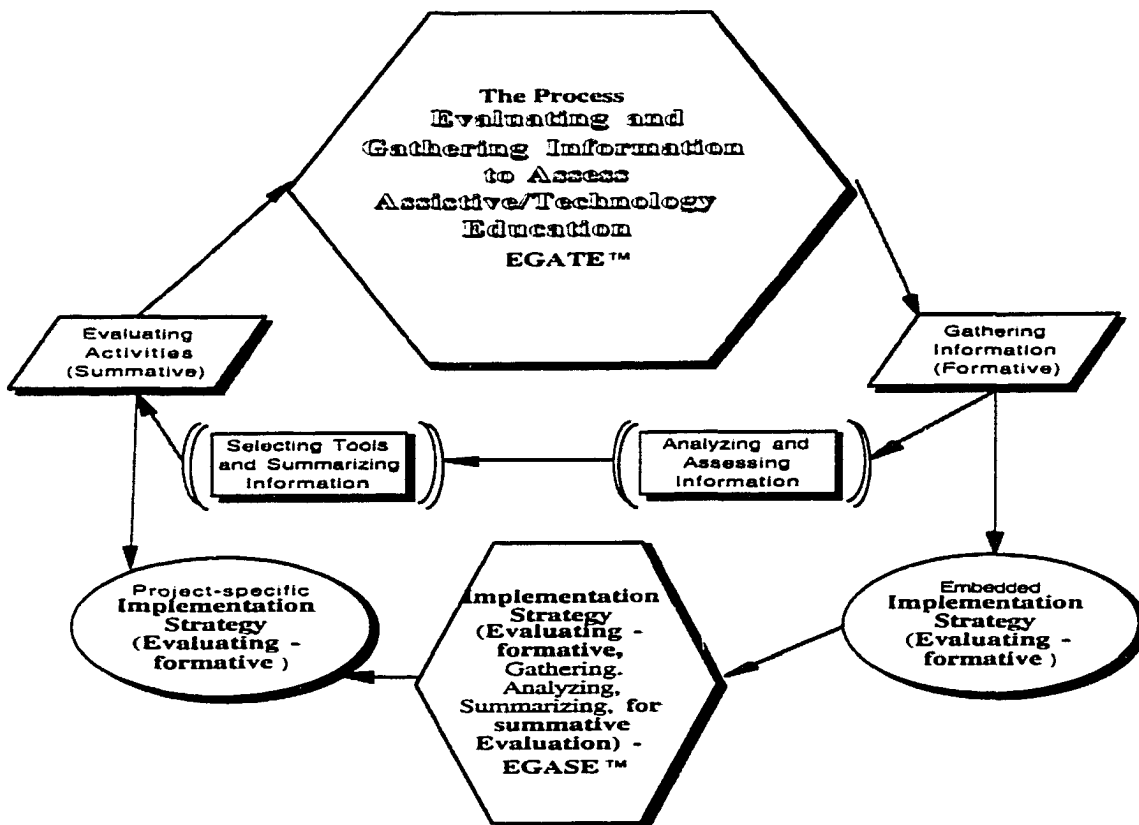


Figure 3. EGATE Data Gathering Process Framework

Preliminary Best Practices Indicators

As a result of the methodologies applied to evaluating the models, the following features emerged as practices that appeared prevalent in models. These models reported results in the form of evidence that related back to student learning and technology integration in both the classroom and in the curriculum:

1. Centered on learning and practice needs of each teacher as an individual.
2. Linked to organizational context and subject matter content.
3. Connected to new technologies (telecommunications, Internet, distance learning).
4. Supported by time, funding, and opportunity for teachers to learn, practice, and reflect on their new learning and how to best use it to improve their teaching.
5. Embedded assessment and evaluation system to measure impact on student and teacher learning.
6. Focused on meeting the needs of a more diverse student-teacher learning environment by incorporating special strategies and assistive technologies (e.g., mathematics manipulatives, enlarged screens and print for visually impaired, etc.)
7. Planned collaboratively in partnerships with business, industry, and higher education-colleges of education.
8. Integrated research to plan future professional development.
9. Developed and managed locally within framework of national goals.
10. Formatted in flexible, on-going, and evolving format.

Discussion

Challenges and Benefits

The challenges were many and so were the benefits. The failure to establish clear standards based on research-based practices or expert practice may raise more questions about our educational system's potential to reach national goals. At the moment, public education faces global competition for its talents and resources as the nation's schools struggle to achieve national educational reform goals by (National Education Goals Panel, 1995). The response to the question of standards for training inservice teachers may potentially strengthen or weaken the overall quality of support for technology integration to improve student achievement in

classrooms and achieve educational reform. For this reason, communication between teachers, researchers, policymakers, and the public is needed to form a sound, well-conceptualized agenda to promote technology-adult learning standards for inservice teachers.

One can argue convincingly that standards do not guarantee effective teaching practices or increased student achievement. Yet, studies continue to promote the best predictive criteria for improving student learning reflects back to competencies of teaching professionals (Peak, 1997). If standards were developed based on assumptions about teachers' knowledge, skills, and abilities the potential of a mismatch between standards and preparation could be profound. Another challenge is that teachers will need support to become learners again to develop new skills and habits, and to assume new responsibilities for their own professional development and preparation in new technologies.

However, accomplishing effective standards-based professional development may rest ultimately on the teacher's commitment to the profession and acceptance of new technology in the learning and teaching process (NFIE, 1996). Unfortunately, if we are not careful, a cadre of displaced teachers could emerge similar to the displaced workers of the eighties that resulted from technology integration in business and industry (Secretary's Commission on Achieving Necessary Skills, SCANS, 1989). In the past, reform such as SCANS and Goals 2000 promulgated by technology has required policymakers, educators, and communities to make some pointed social and economic decisions to achieve necessary change.

Participants in technology learning and practice models who experienced organizational change attributed to new technology indicate that tough decisions about resource allocation and priorities become easy to make when the quality of learning and teaching is at the forefront. (Grasmick, 1999). The implications derived from practices in technology models are that teachers' performance should no longer be a check-off list, but must incorporate standards of demonstrable professional performance, subject matter competence, and student achievement. This level of professional development and new knowledge can only be developed through

ongoing, extensive, reflective, and connected professional development, and learning and practice to use new technologies (NFIE, 1996).

If the community, parents, policymakers, educators, and students are accountable for achieving high standards, classroom teachers must also be responsible. Establishing and agreeing on guidelines and standards are necessary to develop a solid foundation from the ground floor up for technology integration and a new approach to restructure the teaching profession (Goodlad, 1991).

In summarizing challenges and benefits of developing new technology adult learning standards to facilitate the pace of technology use by teachers, five categories emerged that should be considered when planning technology for teachers: 1) people, 2) process, 3) policy, 4) products and practice (P-5).

The challenges and benefits of developing standards to train inservice teachers in new technologies are summarized as follows:

Challenges. Challenges include the following:

1. Developing a support system to immediately implement an action research agenda; agreeing on priorities; deciding who will be responsible.
2. Creating a system that will provide equity and access to new technologies to all schools that include high proportions of families living in poverty and rural schools is consistent with national reform goals to improve achievement for diverse and disadvantaged learners.
3. Developing local infrastructure to address technology preparation for teachers.
4. Deciding how the system will be monitored and evaluated.
5. Developing systems of accountability.

Benefits. Benefits include the following:

1. Developing a cadre of prepared teachers to model effective teaching using technology to improve student learning.

2. Supporting infrastructures that contributes to increased levels of professionalism in the teaching practice for teachers, thereby providing for more personal and professional career satisfaction.
3. Collaborating to build and enhance existing public school-higher education-business/industry partnerships.
4. Embarking on new research bases of knowledge to improve education and professional development of the future.
5. Increasing achievement of students to improve our global positioning in technology and education; thereby maintaining and improving our competitive social, economic, and democratic position in comparison to other countries and nations.

Implications for Standards in New Technologies for Inservice Teachers

Standards will assist stakeholders by:

1. defining the territory for standards used to identify the competencies and skills teachers need to effectively use new technologies and perform in their new roles as facilitators of learning;
2. promoting coherence in technology preparation for inservice teachers necessary to make connections between ideas and linkages to student achievement;
3. providing a foundation for teacher preparation, continued professional development in new technologies, or career transition planning;
4. guiding efforts to improve achievement for all learners; and
5. providing foundations for technology learning, practice, and assessment criteria to effectively evaluate individual and organizational performance based on clear evidence.

Recommendations

In response to posited questions in this paper, dynamic practices found in best practice models underscore the need for more research. The recommendation is that the agenda be

established to develop new technology learning standards for teachers to increase teachers' use of technology, thereby student achievement.

Professional development should no longer bring us the narrow image of teacher preparation of the past (Wise, 1999). Instead, it should be associated with the infusion of technology, new ideas, development of new skills in more diverse learning communities, and not a professional development program. Technology learning and practice must be conceptualized as an ethos, ongoing and forever changing, and an intricate part of everyday learning and practice in the classroom (Renyi, 1998).

A two-year study of professional development conducted by NFIE, which represents 2.2 million education employees analyzed professional development after studying over 1,000 teachers and teacher leaders. In 1996 they published those results and concluded professional development must be grounded in what is best done in schools by the end-users and supporters (p. 71). Without a framework for guidelines that support for implementation and training teachers may not be permeate into practice in classrooms. Teachers need to learn new instructional strategies to facilitate the construction of new knowledge. Traditional lesson plans presented in isolated classrooms that continue to reproduce the same knowledge no longer meet achievement standards (NFIE, 1996). For teacher learning and practice standards to be effective, they must incorporate the use of language that more clearly and accurately describe the expected learning environments and outcomes.

The predominant model of one-size-fits-all workshops offered to inservice teachers at the same time described in ASCD reports and others are increasingly recognized in the research as inefficient and ineffective, in general. The model is particularly inappropriate for professional development and preparation for inservice teachers in new technologies. If American students are to achieve reform education, this means one-size training for teachers and learners is no longer acceptable (Fulton, 1996). To address the changing roles of teachers, concepts, and practices in teaching that emerges in a technology -rich learning environment, calls for a new

standards framework designed specifically to train inservice teachers in new instructional methodologies and technologies.

Suggestions for Conceptualizing Training Inservice Teachers

In this review, six fundamental concepts emerged as important in planning training standards to guide teachers in new technologies:

1. extended access to telecommunications and new technologies;
2. integrated research-based practices to link subject matter, social context, and teacher preparation;
3. embedded learning and practice in the daily activities of learning and teaching;
4. connected directly to teachers learning and practice needs;
5. engaged in collaborative planning and support within the local learning community and from a national level; and
6. supported by a funded preparation and development policy structure.

Priorities for Meeting Training and Support Needs in Technology

The education and policymaking communities must first agree on priorities. For example, consider expanding the defining qualities of research in relation to technology professional development and preparation system. This might include expanding the definition of scholarly research to include “best practices,” which are grounded in research, theory, and practice to develop a new preparation infrastructure (Darling-Hammond, 1997b).

However, more important, the following elements are examined in this discussion as a useful model for thinking about the quality of professional development and training in technology for teachers. An ongoing education department (ED) evaluation of the Eisenhower program discovered that some elements of high quality professional development activities, as identified in the literature are not so prevalent in Eisenhower activities. The missing or weak elements included: developing a vision for learning and teaching that focused on high achievement of all learners, giving teachers opportunity to build on their professional

experiences, and create accountability for outcomes from professional development (The Eisenhower Professional Development Program Emerging Themes from Six Districts, American Institute for Research, 1998).

A vision of professional development is necessary to connect the planning, research, and development process that must incorporate:

1. *Knowledge and Awareness.* The system must be one of franchise, that provides information on how to connect inservice teacher preparation through pedagogy based on appropriate research-based methods. It must contribute to the lifelong career development process for teachers in increasingly technological learning environments (Sheingold, 1998; U.S. Department of Education and White House Outreach Meeting Report, 1998).
2. *Training and Support Infrastructure.* A technology-based, expert accountability system is needed to track and maintain records of teacher training, technical support, funding allocations and expenditures (as a planning tool for future professional development activities). It must be designed to view and assess teachers growth as individuals in the use of new technologies, which should be based in part on student achievement (Maryland State Department of Education, 1999; Yocam, 1997).
3. *Technical Assistance.* It must create, incorporate, and maintain an integrated career development, assessment, guidance, and incentive system for all stakeholders, especially educators (Hall & Loucks, 1979). A system is needed to reward and recognize teachers for human performance and leadership, especially those who make personal investments to update their knowledge, skills, and abilities. The system may incorporate a mentoring and peer review process to identify on-going training needs.
4. *Information Dissemination.* The sharing of information and practices is critical to continued growth and improvement of models as they emerge. This is an evolving and revolving process, characteristic of a system transitioning to technology-based operations (Hall et al., 1979).

5. *Access to Telecommunications, Computer, and Assistive Technologies.* If policymakers continue to mandate teachers be able to teach all students using new and assistive technologies, it seems reasonable that new technologies and technical support must likewise be considered priorities (e.g., telecommunications and video technologies are identified in the literature as viable technologies for all learners). However, research shows new technologies appear underutilized and inaccessible in both professional development and in the classroom, especially in rural and inner-city schools (Pittman, 1998b).

John Cradler (1999), former Chair of the Chief States Schools Officers, argues in a white paper to the 106th Congress that evaluation is critical to determining the progress of education reform and technology initiatives such as the Technology Literacy Challenge. He argues that reform efforts are dependent on teachers. The learning and practice system for teachers must be linked clearly to relevant technology, and subject-matter content. Performance-based assessment must be embedded in daily teaching practices and supported by access to sharing and reflecting time for teachers during practice.

Teachers can learn to reflect and assess the contributions that new methods and technology produce in the classroom. This type of assessment can produce evidence that can be supported by valid measures of student achievement. An example of this can be found in the planning stages within the Iowa Consortium for Assessment of Learning and Technology (ICALT), which is currently exploring innovative assessment practices (Schmidt & Thompson, 1999; Iowa Consortium for Assessment of Learning and Teaching, 1999).

While there were many ingredients for successful preparation of inservice teachers, there remain many questions. We know that it would not be practical to attempt standardizing all that is necessary to become an effective teacher. However, practices and policies for training inservice teachers in new technologies can be. Therefore, during the change process we must reflect on the human elements involving different ways of thinking about pedagogy, philosophy, social context, and personal efficacy of teaching (Snow et al., 1993).

While it was stated that ultimately the success of technology integration is dependent on the classroom teacher, it is obvious that classroom teachers cannot implement change without support (Darling-Hammond & Ball, 1997; Means, 1996). The ACOT™ research provides an example of learning in stages over a period of time.

The research on C-BAM and ACOT™ models consistently recounted that higher achievement for teachers in the use and integration of technology comes through collaboration, shared decision-making, and practice in continuous and evolving stages throughout their careers (Baker et al., 1993; Yocam, 1996). However, technical assistance is a primary variable in the movement through these stages (Maushak, Manternach-Wigans, & Bender, 1998).

Summary of Literature

Based on the interpretations of practices described or recognized as exemplary in technology professional development models reports, it is suggested that guidelines for standards for training inservice teachers in new technologies be further studied. One of the greatest challenges in developing training standards in new technologies is the process of identifying and meeting the needs of teachers.

This is a challenge because information about teachers' technology knowledge, skills, and abilities is not easily accessible or comparable in buildings or across school districts. Even less is known about how they will respond to training. For this reason and those associated with adult learning principles, it is theorized that guideline discussions for training standards should be organized beginning at local levels.

This research was initiated based on two theoretical assumptions:

1. There is a need for a system of accountability to ensure all Maryland teachers have access to professional development and technology training to learn and integrate technology effectively in the classroom.

2. A system of accountability may help to identify and bridge potential gaps between teachers' training needs, professional development practices, and policies for training experienced Maryland educators in new and assistive technologies.

CHAPTER 3. METHODOLOGY

The focus of the study was to determine the efficacy of the CTE-MSDE partnership to provide educators with the training and technical support educators perceive they need to use new assistive and educational technologies to achieve national and state standards, and to create inclusive learning environments in Maryland schools. Seven factors are studied related to educators' perceptions of their priority needs for training and support services to integrate general and assistive technologies were measured and examined in the study: 1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination and other related variables, 5) equal access, 6) assistive and instructional technology, and 7) new technology. These are defined in Table 1.

This chapter describes the procedures and methods that were used to gather and analyze the data required for the study. It has been divided into five major sections: Background; Sample Selection; Instrumentation; Data Collection; and Data Analysis. The Human Subjects Approval Form authorized the pilot study for data collection for this study. The Iowa State University and Johns Hopkins University Committees on the use of Human Subjects in Research concluded that the *rights and welfare of the human subjects* were adequately protected and the confidentiality of the participants was assured. The Human Subjects form is found in Appendix A.

Background of the Study

The focus of the pilot study was to determine the perceptions of educators about training and support in technology, their ability to use new and assistive technologies, and access to technology in Maryland schools and/or districts. Another purpose was to learn more about how the CTE-MSDE partnership proposed to facilitate access to educational technology training to enable educators in Maryland to teach an increasingly diverse student population with a special emphasis on helping special needs students. A dozen years ago, CTE/MSDE entered a partnership to provide professional development in new technologies to support

Maryland administrators and educators in 24 Local Education Agencies (LEAs). CTE has a professional development and support staff of 20 professional personnel. Maryland, with a population of 4,983,900, ranks forty-second in size and nineteenth in population among the fifty states. The state department of education is housed in Baltimore. There are 24 local school systems and 1,309 public schools and centers. Figure 4 and Table 4 describe Maryland School Demographics.

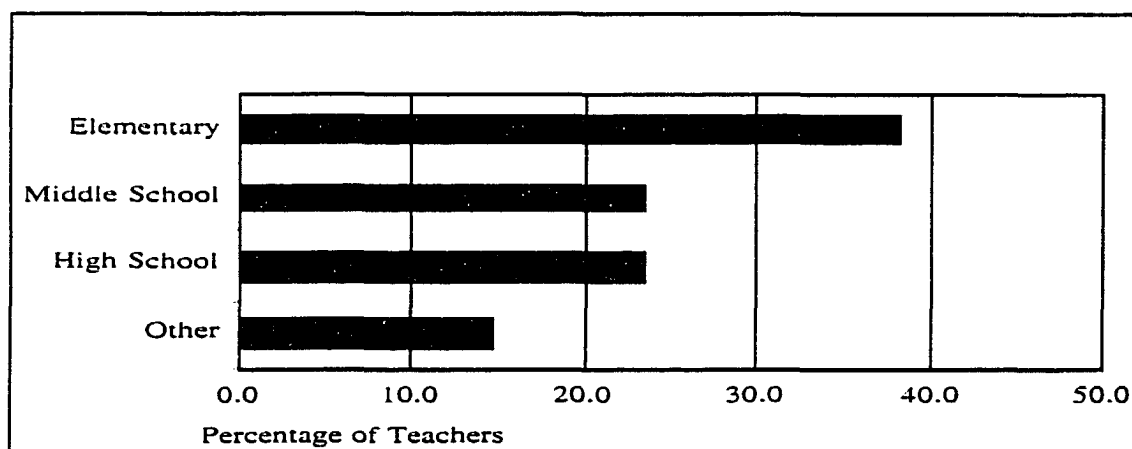


Figure 4. Profile of Educators in Pilot Study

Table 4. Maryland State Department of Education statistics, 1999

| Teachers | 1995-96 | 1996-97 | 1997-98 |
|--|----------|----------|----------|
| Total number of full-time staff in Maryland public schools | 86,477 | 88,466 | 91,986 |
| Total number of instructional staff | 61,387 | 62,499 | 62,538 |
| Total number of teachers | 46,492 | 47,963 | 48,212 |
| Total number of non-instructional staff | 20,008 | 20,851 | 29,358 |
| Years of experience among teachers | | | |
| Five years or less | 24.6% | 27.0% | 26.5% |
| 6-10 years | 13.5% | 14.0% | 13.8% |
| 11-20 years | 28.1% | 24.6% | 24.1% |
| More than 20 years | 33.8% | 34.3% | 35.6% |
| Average teacher's salary | \$41,186 | \$41,257 | \$41,404 |

Instrument Development

As discussed earlier, the researcher collected and reviewed a selection of instruments for the study. The first instrument identified was for the pilot study. It was an instrument adapted from one used by the University of Virginia -The Curry School to evaluate a technology-training program and workshops for inservice teachers (Curry School of Education, 1997). The original instrument was in a pre/post test model, which was not appropriate for our needs. As a result, the researcher made changes which were reviewed and agreed upon by the CTE-JHU research and development support teams.

A major change included adding a section on assistive technology at the request of CTE administration. The assistive technology questions were adapted from an instrument validated and used in a national survey of service providers for students with disabilities (Lance, 1996). The results of this pilot survey provided a general direction for the development of a strategy to study and evaluate the standards-based training and support services provided overall by the CTE-MSDE partnership study. Thus, the need for other instruments began to emerge.

During the researchers' observation of the CTE-MSDE 1998 summer technology training institutes for educators and administrators, the second and third instruments were identified during the pilot. These emerged from evaluation instruments embedded in CTE's assessment of the summer technology training. The instruments included a telephone survey of administrators from the educators local school districts or local education agencies and a performance-based assessment instrument designed to monitor the teachers' use of technology and new teaching skills once they returned to their schools.

The fourth instrument developed or was the needs assessment designed to survey the 187 Maryland assistive technology members (general and special educators trained as technology training facilitators to support their local systems). These instruments were developed and adapted to gather data to answer the existing and emerging questions under study. The process took place over the months August, September, October, and November.

During these months four primary instruments were developed, adapted, and pilot tested by university professors (including special education), graduate students, and CTE-MSDE administrators. A number of approaches were used to select the instrument and the items. These included field-testing of instruments and items for validity and reliability, clarity, and readability, administration time, and the appropriateness of questions.

Approximately 10-12 revisions of the Impact Needs Assessment occurred, three revisions for the teacher projects follow-up and reporting form, none for the administrators telephone interview survey, and two for the pilot instrument adapted from University of Virginia. In addition there was one adaptation and minor revisions of the focus group questions, and five revisions for an Individualized Education Program Checklist (IEP) developed to examine. However, due to time restraints this checklist was not included in this study.

A number of approaches were used to field test the needs assessment (IMPACT survey of the four primary variables). After development by the researcher, the ISU technology, research, and evaluation team and the CTE administrative and Equal Access administrative teams evaluated the instrument. Graduate students (special and general educators in a class at Iowa State University) were asked to complete the instrument as a field test for the instrument. This also provided information on time to complete the instrument and to heighten readability, clarity, and validity. Additionally, eleven Maryland educators at a training session on integrating technology in early childhood had an opportunity to review and/or make suggestions about the instrument. These responses were reported to CTE staff support and administrations and changes were made accordingly.

Cronbach's coefficient alpha was used to examine the internal consistency of item sets of three instruments: 1) the pilot survey, 2) the needs assessment (IMPACT, see Table 5), and 3) the administrators' interview form. The values of the standardized alphas for all instruments were .70 and higher, with the exception of the administrator surveys. Due to the format of the questions and the different scales, it was determined that this test was not valid for this

instruments. Therefore, member checks from data analysts' reviews and the significance levels of the related items served as the checkpoint. The Cronbach alpha values for all instruments can be found within contextual references.

Summary Descriptions of Instruments

1. A survey of teachers participating in the technology for educator's program was used to develop a model for profiling teachers' perceptions about technology training, support, and uses in the classroom, among other matters. During the summer of 1998, twelve variables and 125 items, plus open-ended questions, comprised an instrument used in a pilot study. The instrument was adapted from a formerly validated instrument (Curry School of Education, 1997).
2. Needs assessments were developed collaboratively by ISU and JHU team members under the direction of the researcher. These were designed for administration in general and special educators to assess perceptions of their expertise in new and assistive technologies. There were five variables—Demographics, Knowledge and Awareness, Information Dissemination, Professional Development, and Technical Assistance—and 28 objective items on Likert scales of 1-4 that ranked responses from not important to extremely important. In addition, there were two open-ended questions.
3. Teachers' performance-based projects were developed by JHU to evaluate teacher transition of skills from summer technology training institutes into the classroom. Projects were examined that represented a two-year period were collected and analyzed. The sample included thirty-six questionnaires with eight sets of variables: Demographics, Goals and Objectives, Classroom Activities, Technology Applications, Description of Targeted Students, Correlation to Maryland School Performance and Learning Outcomes, Funding Sources, and Access to Technology. Six months after attending a summer institute, educators were required to return a

monitoring instrument that documented their pattern of technology use in practice by responding to these variables in an open-ended format.

4. Interviews with local and state administrators were used to determine knowledge and awareness levels about the benefits of general and assistive technology, and the training and support a teacher may need. Formal 30-minute interviews with administrators were conducted. There were five variables and 33 items, with open-ended comments.
5. Observations were made of four professional development and training sessions in new and assistive technologies. The researcher was the tool. These included ATLAS training, Early Childhood, Infant/Toddler Programs, and the 1998 Teacher Training Summer Institute.
6. Other reports and studies involved the professional development partnership activities and evaluations from training sessions for a two-year period. These included self-reports, formal evaluations, and studies conducted over the last five years.
7. The focus group on technology training needs for teachers included 30 educators, who invited by the CTE administrator to participate in a focus group to discuss the technology training and accountability needs to further facilitate CTE/MSDE's support and training services. Data were captured via computer entry using a laptop computer and from a web-based discussion board. Three facilitators used these multiple methods. Each mini-focus group within the group of 30 was summarized through group reports, which used PowerPoint software and computer technology to capture and display each group's consensus about issues that emerged in their groups as important to support professional development in new technologies. The primary researcher, using a cassette tape and recorder, recorded the session.

Because the research assistants were not familiar with the project, it was necessary to prepare them adequately by planning, organizing, and facilitating various levels of training. This process is discussed in the next section.

Training for Researcher Assistants

There were eight assistant researchers involved at various stages of project development. The primary support included two data entry assistants and one part-time administrative support person. A research assistant accompanied the researcher on one site visit to serve as a member check to confirm interpretations of the environmental training conditions at CTE. All researcher assistants attended at least one of the weekly project team's planning and/or training meetings to: 1) discuss the goals of the data gathering visits [EGATE], 2) review the development and use of instruments, 3) discuss coding for teacher performance-based projects, and 4) discuss administrator interviews. Communication with the CTE team was conducted by U.S. mail, e-mail, telephone, and face-to-face contact.

The training session focused on journaling and notetaking; typology of data collection; connection of the evaluation process to research questions and goals; the coding process for data gathered from observational data during site visits; and the Internet. One research assistant served as a recorder for the last observation and data collection visit to the main site, the Center for Technology at Johns Hopkins University. This required very detailed listening, observation, and hand-written notes as back-up for taped sessions. This researcher was provided with a written transcript of the observations. The research assistant was trained in this process by the association with another similar project for the state of Iowa.

The Study

Following up the implications from the literature review and the pilot study (discussed in Chapter 4), this study examined the professional development and training support provided by the Johns Hopkins University, Center for Technology in Education (CTE), and the

Maryland State Department of Education (MSDE) partnership. The goal of this study was twofold. In summary, the study attempted to determine:

1. How Maryland's efforts were guided by existing standards, and
2. How their efforts impacted access and effectiveness of training and new technologies support for selected Maryland administrators and educators.

The CTE technology-training programs for educators in this partnership have been modified over the last five years, based in part on the ISTE and the state of Maryland technology-training standards to prepare educators in the use of educational technologies.

Selection of Participants for the Study

Two hundred and eighty participants made up the small purposeful samples for the entire study. These groups included general and special educators, local education agency administrators, and other instructional support staff who received services through the professional development partnership's services and the CTE technology for educators programs during 1997-1999. There were 150 teachers, which made up 53% of the sample within these groups. However, the number of participants was different for each micro-sample.

There were four distinct groups represented within the population of educators: general and special education teachers, administrators, special education directors, and education specialists. These different groups embodied what might be referred to as quasi-experimental groups in the study. The targeted groups were identified by the researcher and negotiated with the JHU-CTE research and development management team based on the questions to be answered. Due to political, financial, and time restraints, it was not possible to employ a large random sample for this study. However, within these small purposeful samples, 80% of the educators and/or administrators were represented from all 24 local education agencies.

The administrative research and support team at Johns Hopkins Center for Technology in Education highly recommended using an integrated approach that included multiple methods. The rationale was no single method existed that could capture the multiple-dimensions of the

questions posited in this study. As a result, the following participants emerged in the research and data collection process:

1. Forty-two general and special educators enrolled in a technology for educators program.
2. Thirty-six general and special educators participated in a summer institute for technology training in general and assistive technologies.
3. Approximately 125 special and general educators are members of the Maryland Assistive Technology Network.
4. Seven LEA senior-level administrators, who included assistant superintendents, superintendents, and directors of curriculum and instruction. This group represented three of four local education LEA cohorts or 75%.

Other auxiliary or supporting information was gathered from:

1. Observation of twenty-four Special Education Directors in Training (Excent™ Users—an electronic database for collecting, reporting, and developing individual education plans (IEPs) for students, distributed by CTE and supported by Global software publishers).
2. Thirty educators in a focus group (6 groups with 5 to 6 per group).
3. Fourteen CTE and MSDE administrators (Unstructured Formal Interviews).

This is an integrated study, which produced both formative and summative data using qualitative and quantitative research strategies to gather information.

Data Collection

The evaluation strategy described earlier in Figure 3, EGASE (data gathering, a conceptual framework) was developed by the researcher. The strategy was field tested during the pilot and determined suitable for the data collection required in this project. The framework was applicable because it employed a strategy to recycle information. This strategy was critical for interpretation based on the complexity of the organizational contexts and questions

addressed in both formative and summative research. This cyclical process increased opportunities to view the data from multiple perspectives to assess the effectiveness of training and standards in relation to their impact on professional development and support for educators in practice.

The use of multiple instruments allowed gathering data sets from the different levels that ultimately may affect the development of technology training for teachers. The data gathered in this study were analyzed using SPSS™, NUDIST™ (qualitative analysis software), and a systematic coding system developed by this researcher.

Research and Evaluation Design

Multiple processes, which incorporate both qualitative and quantitative data collection and analysis methods were combined to generate summative results in this study. The research shows evaluation research and policy analysis is supported by Decision-Oriented Evaluation (DOE). In DOE the research and evaluation is the process of determining the kinds of policy or programmatic decisions needed, based on the findings. This is an effective strategy that often leads to action or decision-making whenever the goal is to bring about change (Bogdan & Biklen, 1997; McMillan & Schumacher, 1997).

Therefore, Decision-Oriented Evaluation, which supports multiple methods, was selected because it emerged as the most suitable strategy for this research. Multiple methods were needed because the researcher needed to answer the multidimensional questions posited in this study by looking at the problem from many different perspectives. Multidimensional questions are found most extensively in evaluation research (McMillan & Schumacher, 1997) (p. 551). The decision-oriented design in this study incorporates three types of evaluation and research: 1) needs assessment, 2) implementation, and 3) process evaluation. These strategies are believed to be most effective when evaluating the impact of multi-faceted professional development and training practices for educators in technology (McMillan & Schumacher, 1997) (p. 552).

The role of the literature review. The use of multiple methods in the literature review was an attempt to identify and establish evidence that suggests best training practices for educators to learn and use new technologies. Consequently, new questions or problems emerged in the formative research stages. The data analysis process recycled data in this study through the formative stages to the summative analyses and synthesis stages. This process was instrumental in shaping connections between emergent and sometimes potentially confounding variables. Because there were no controls for these variables, it was important to acknowledge and treat them as variables instead of overlooking them. More importantly, in qualitative research an important phase is repackaging and aggregating the data (Carney, 1990). This aspect of the research process helps establish themes and trends in the data overall and an understanding of new and emerging problems that might be an influence during the examination of each research question independently.

An example of emerging or confounding variables was when the issue of assistive technology emerged during the review of the literature and again in the planning stages for the applied research data collection design. Consequently, in this unique environment of inclusive education and training, assistive technology training naturally emerged within the context of new technology and general technology in K-12 educational environments. The review provided an accepted body of research-based knowledge about current teacher education standards, practices, and policies driving professional development for experienced teachers. The review highlighted how training was designed to prepare teachers for new licensing, and certification requirements in K-12 education.

Applied research. The applied strategies were employed to examine and explain information gathered in the literature review and the questions that emerged about professional development and training practices and policies for training teachers in new technologies. An examination goal was to unveil any potential barriers that may exist and impede teachers' access to appropriate training.

These conditions and variables included teachers' behavioral, social, and perceived beliefs about technology training and support received that may affect their decisions and abilities to use new technologies. This researcher will also attempt to determine if there is a relationship between the variables that emerge as barriers and teachers' perceptions of technology integration in practice.

While examining the JHU Model for Professional Development through the applied research design planning and data collection, the issue of assistive technologies invariably emerged as a critical part of new technology training in the Maryland professional development programs for teachers. The environment is somewhat unique. There is a policy of inclusive education in Maryland, which mandates students with special needs be educated along with general students in selected Maryland schools within all local education agencies. Consequently, after revisiting the issue of assistive technology in an extended review of the literature, it was discovered this policy is not unique to Maryland, but is mandated by legislation for all states. This discovery was significant because it could provide some implications for how other states might address this new and emerging problem in K-12 schools.

The significance of this problem was realized recently when the Secretary of Education, Richard Riley declared teachers must be prepared to use technology to ensure opportunities to learn for all students (NCES, 1999). In response to this report, a white paper, *Role of Expert-authorization of Federal Educational Technology Programs in the 106th Congress* reported Secretary Riley as stating,

Only about 20% of both new and veteran teachers in the report classified themselves as "very well prepared" to integrated educational technology into the grade or subjects they taught and to help students with disabilities and those with limited English proficiency or from diverse ethnic backgrounds. (Cradler & Cradler, 1999, p. 6)

Evaluation research. Research attempts to use the criteria of accountability, effectiveness, and impact as a framework to establish evidence of effective technology training practices and policies (Sweeney, 1995). The goal is to use evaluation research to verify the effectiveness and impact of the CTE/MSDE professional development model and its efficacy to

improve access to appropriate training to prepare educators in general and assistive technologies. The results may produce evidence of effective practices and policies for technology training and professional development programs for inservice educators. Evaluation seeks evidence represented by educators' perceptions of their ability to integrate technology into the instructional and curriculum planning process for general and special education students.

To achieve this goal, the EGASE strategy guided the development process of gathering formative and summative data to assess the merit and worth of specific practices and policies at selected sites for this study. As discussed previously, assistive technology emerged as a critical technology in this study. Therefore, from this point on it is included in the research as a new technology in this environment (U.S. Department of Education, 1999).

Data Analysis

The data analysis includes descriptive statistics along with t-tests, Pearson correlation, and Cronbach coefficient alpha analyses. Exact procedures for each question are detailed in the finding section (Agresti & Finlay, 1997).

Data Analysis Goals

1. Develop a solid knowledge base through a synthesis of theoretical, practical, and political frameworks that research shows govern selecting, training, and sustaining new and career teachers in general education to use new and assistive technologies in education (see literature review).
2. Explore both cognitive and affective domains of knowledge surrounding the epistemology of education and training practices for educators in general and assistive technologies to develop a model for profiling teachers professional development needs. This new knowledge ultimately may help policymakers understand the support teachers need to learn and effectively integrate technology into their classrooms. The profile model incorporates strategies from two models.

The Concerns-based Adoption Model (Hall & Loucks, 1979) and the ACOT™ stages of teacher development when learning new technologies (Yocam, 1996).

3. Define and analyze the four variables of the CTE/JHU technology-training model for teachers to determine evidence of effective practices. The four primary variables were: knowledge and awareness, professional development, technical support, and information dissemination.
4. Validate an accountability and evaluation data collection framework (EGASE) which is intended to provide a systematized way of conducting an integrated data collection strategy to meet formative and summative evaluation data needs. Data are needed to measure the impact of technology training practices and policies on the teaching practices, the attainment of educational reform goals, and standards of learning in schools (SOLs).

The methodology used in this study was a part of the evaluation strategy employed for the CTE-MSDE training and support activities partnerships. The study employed multiple methods to conduct quasiexperimental microstudies within the framework of evaluation activities for the CTE-MSDE professional development partnership, Goal 1: Equal Access.

My role as the primary participant researcher was to work in a team-based environment and accept full responsibility for the research design, which included the specifics of the methodology needed to design, implement, and manage the project. The CTE provided limited administrative and data collection support for on-site during planning, observation, and data collection visits. The process is described in the next ten sections. The uses of these methods for each quasi-experimental question are described below.

Data collection strategies included:

1. researcher's observations and interviews,
2. surveys and questionnaires,
3. teacher performance-based projects, and

4. *focus group.*

Data analysis techniques included the following.

1. Demographics and sample statistics were reported in appropriate groupings by type of information (categorical, nominal, or continuous variables). These factors included grade levels, subjects taught by educators, access to technology, local education agency, years of service, positions held, area of specialty in education (general or special education).
2. Means, standard deviations, frequencies or percentages were calculated for each scaled item from the survey instruments (teachers' profile, administrator structured interview, and the needs assessment). Factor means and standard deviations were calculated for all participating and inclusive factors for each instrument.
3. Pearson product moment correlations were configured to determine the relationships between and among the factor for the needs assessment, which was the primary instrument used to measure the efficacy of the CTE partnership model: professional development, knowledge and awareness, technical assistance, and information dissemination.
4. Stepwise multiple regression was employed to determine if the four factors in the CTE model predict Maryland educators perceptions about the efficacy of the CTE-MSDE partnership to support their training and technical support needs in new technologies.

Data Preparation

Because the integrated research design included both qualitative and quantitative designs, the analysis of data involved the use of several methods to capture descriptive data of this non-experimental research. The most appropriate method was selected to achieve one of three goals and contributes the most to understanding the question. These are:

1. make inferences to a population,

2. describe existing conditions,
3. predict one phenomenon from another, and/or
4. determine potential causes or trends based on historical data.

Specific strategies include:

1. SPSS™ (electronic statistical analysis software),
2. NUDIST™ (nonnumerical data statistical analysis), and
3. researcher's analysis and interpretation.

Based on the complexity of multiple methods and groups, each driving research question was treated as a micro-study or quasi-experiment. When appropriate, the finding from each study was used to triangulate, verify, or explain the relationships that emerged between the variables. This process assisted in correcting any biases on the part of the researcher by unveiling any inconsistencies based on the beliefs of the researcher (Creswell, 1998; Manternach-Wigans, 1999).

Qualitative Data

Interviews with the educators and participants through formal and informal channels provided information that supported interpretive findings. After the initial interviews and analysis of open-ended comments from surveys, the data was documents using MSWord. The information was restructured for a computer software package for qualitative research called Non-numerical Unstructured Data Indexing Searching and Theorizing (NUDIST™). The process was used successfully in Star Schools Teacher Evaluation Project in the study by Manternach-Wigans (1999). The technology-based analysis allows for timesaving management, detailed exploration, and pattern examination of large amounts of data.

Four sets of data were processed by these electronic methods (teachers' survey, administrator interviews, needs assessment, and teacher performance-based projects). The format of the open-ended data provided an opportunity for quantitative analysis of supplementary data using SPSS™. The categories were predetermined by the instrument

designs. Therefore, it was only necessary to set up the categories and enter the data. Each researcher was allowed to negotiate and set up new categories when warranted by participants' responses. The categories were centered on relevant demographics and themes based on the Center for Technology in Education professional development training and support services. Another source of reference for categories was the four critical success factors or barriers that emerged in the Literature Review (see Chapter One). The factors directly related to the research questions are discussed in the conceptual model.

The Conceptual Model

Figure 1, Chapter 1, represents the conceptual model designed to enhance understanding the research questions in this study. As discussed earlier in this chapter, the pilot's focus was to determine the perceptions of educators about training and support in technology and the relationships between their ability to use new and assistive technologies and access technology in Maryland schools and/or districts. As a result, the study that emerged focused on developing an understanding of how the CTE-MSDE partnership facilitates access to educational technology training and support for educators. The researcher theorized that professional development and technical support in technology (general and assistive) are both necessary to enable educators in Maryland to teach an increasingly diverse student population with a growing emphasis on helping special needs students.

As discussed in Chapter 1, the major component of the CTE model is professional development. In recent years a plethora of promotional descriptions of the purpose and goals of professional development and standards have emerged. It was helpful to begin this study by reviewing the defining characteristics of professional development, standards, support, training, and new technologies. These terms are characteristic of dialogue between drivers, decision-makers, and stakeholders in the professional development infrastructure about what teachers should know and be able to do in general practice and in the use of new technologies.

Professional development traditionally is used to represent a concept for learning and training inservice teachers to acquire and develop expert skills in a specific content area (Snowden, 1993b). Researchers discovered that professional development in a technological age needs to be redefined, but there is no consensus towards defining the standard. The 1995 Office of Technology Assessment reported that when we speak of professional development, it has often brought us to a narrow image of inservice teacher training, a term associated with the infusion of new ideas and development of skills. But the predominant model of one-size fits all workshops offered to teachers without follow up is recognized increasingly as inefficient and ineffective in general. More importantly, it may be particularly inappropriate and discourage versus encourage teachers to adopt technology teachers (Fulton, 1995).

Standards are commonly used and accepted as an authority; they are a degree or level of requirements, excellence, or attainment. In 1993 (Snowden, 1993a) The National Board for Professional Teaching Standards issued a position statement that encouraged discarding the old guidelines and professional development mold and replaced it with a model that represents new standards for training which are student-centered and teacher-driven. Their position was, and remains, that special relationships which provide hands-on, on-the-scene involvement need to be developed with university faculty in professional education schools to develop new guidelines (Snowden, 1993a).

Support often has been interpreted as delivering the teacher a laundry list of options for training topics with a message to “select one or two,” whirl the teachers all in a crowded library, and proceed to train them using didactic presentation styles while teachers watch the clock or grade papers. At the end, everyone is relieved and thinks about just how thankful they are to have survived; now we can all get back to work. We have fulfilled our responsibility for professional development this year. Fulton’s (1995) research shows that this practice is no longer acceptable (National Education Association, 1997).

Support has taken on a new meaning and is defined more broadly in this study. When thinking about technology, support is more than providing a technical troubleshooter to unlock the computer or figure out a new version of an application. A more challenging definition of support is viewed as ongoing training and development in pedagogy, curriculum, and humanistic concerns (Fulton, 1996). This researcher theorizes this type of support is inclusive, collaborative, action-oriented, relevant, and ultimately results in higher achievement in student and teacher learning. In clearer terms, support is woven into the fabric of research, policy, and practice to develop and sustain opportunities for teachers to learn and practice new skills (Darling-Hammond, 1996).

Training comes from the word train, which may be conceptualized as a line of movements connected by a common thread to reach a goal. However, it is most common to think of training as making one proficient through instruction and practice (*American Heritage Dictionary*, 1991). Experts report that teachers who are immersed into the problems of using technology during training are more likely to transfer skills than those who are trained in an environment that limits experiences (Association of Technology Education, 1970). This paper agrees with this conceptualization of teacher training in new technologies.

New technologies may be defined as methods of applying scientific applications as a primary communication mechanism; technology is a system of knowledge and information which often requires the use of some electronic instrument or computers to make something happen (*American Heritage Dictionary*, 1991). This broad and general description of new technologies is used because there were too many arguments and not enough consensus in the research to determine which is more appropriate at this time in this research.

Professional is described by virtue of having mastered a prescribed body of knowledge and acquired the requisite skills, is given responsibility in a prestigious field and a level of authority to determine how best to fulfill that responsibility (NBPTS, 1993; Snowden, 1993a). This implies that with increased knowledge and practice, the professional is qualified to assume

more responsibility, authority, and control over standards of the profession and the conditions under which professionals practice that profession. In Chapter 4, the results of the pilot and the primary study are discussed in reference to these ideas.

CHAPTER 4. RESULTS

Introduction

Over the last five years, Maryland, like the rest of the country, has experienced a dramatic increase in the number of administrators and teachers who need training in new technologies. Maryland has adopted a statewide technology plan and school improvement plans that supports inclusive education. This mandate requires teachers be skilled in general and assistive technologies, which, in this paper, is all-encompassing in the term *new technologies*. Concern for these educators and learners are a focal point for policymakers in Maryland. While local school districts provide various levels of support and training in new technologies for their inservice educators, the number of educators who remain unprepared to use and integrate new technologies continues to increase. To decrease the gaps in training and support for these educators, more will need to be done to increase Maryland's educators access to appropriate training and new technologies.

Because Maryland operates an educational system based on local control and site-based management (SBM), administrators are key players in the effort to meet training needs of Maryland educators in new technologies; they must provide leadership for the new infrastructures. While much research has focused on the teacher (educator), less is known about the relationship of administrators' knowledge, awareness of technology training, needs of their educators, and the levels of support they give. There is a need to learn more about administrators perceptions, their self-efficacy, and how it relates to their leadership and policymaking in relation to technology in schools and support for teacher training.

The purpose for this study was to examine standards, practices, and policies that direct the access to appropriate training and support for inservice teachers to achieve the goals of inclusive learning and technology environments in selected Maryland schools /districts (general and special needs students). The research and evaluation problem addressed in this study was multidimensional, to determine:

1. how does the Center for Technology in Education-Maryland State Department of Education (CTE-MSDE) professional development partnership improves access to continuing professional development activities in new and assistive technologies for Maryland educators,
2. what is the relationship between or among the variables of professional development, technical support, knowledge and awareness, and dissemination to CTE-MSDE's ability to meet the needs of Maryland's educators in need of training in new technologies,
3. how does the CTE-MSDE professional development and training model in new and assistive technologies decrease barriers to technology support programs for Maryland's Educators,
4. to what extent do current teacher education and technology standards support access to training in new technologies and instructional strategies for inservice teachers to meet the needs of all learners in technological and diverse learning environments in selected Maryland school districts, and
5. Grand Tour: Do we need professional development and technology training policies to ensure inservice teachers have access to appropriate training in new technologies and instructional methods to prepare all learners for the 21st Century.

This section summarizes the data collected and their statistical treatment. It begins by stating the main findings, which will be followed by implications in the discussion section.

Tables and figures will be used to illustrate data using these effects.

The Pilot Study

Educator Profile Survey: A profile of Maryland educators

In summer 1998, 42 educators enrolled in one of three classes were randomly selected for the pilot survey to develop the profile of Maryland's educators that ordinarily participate in the CTE's Summer Technology for Educators' programs. This includes gender, subject matter

taught, years of teaching experience, and a discussion of specific findings that are relevant to this present study.

In preparation for the pilot study, three groups of 10-15 participants were identified in negotiation with the CTE's professional development and technology training management and instructional teams. These groups were selected because the participants represented educators from a significant portion of Local Education Agencies (educators in the general population) throughout the State of Maryland. The Center administrators and instructional staff set aside approximately one hour for the survey activities.

Forty-two participants completed a survey, representing 70% of the participants enrolled in the three classes and approximately 28% of participants in the CTE summer program. The Center for Technology in Education issued no specific guidelines for the survey. In the 1998 summer program, there were 13 technology for educators courses offered. CTE management and the researcher randomly selected three courses. The result was three classes at two different sites: one class at the Center's main site—Baltimore—and two classes at the JHU Columbia location—for a total of three (3) sites (McPherson, 1998).

Qualified and professional instructional teams taught all three classes. A team consisted of a program director, instructor, and technical support person. All learners were required to participate in collaborative team and project-based learning. The focus areas in the pilot study were:

1. integration of technology into instruction,
2. collaborative research and inquiry using technology,
3. integrating technology into project-based learning, and
4. knowledge and awareness levels of assistive technology.

A primary goal of the summer training was to help teachers and administrators learn to use a variety of software, Internet browsers, on-line communications systems, e-mail programs, and Internet tools. Similar to technology training academies, teachers were required to prepare

instructional units and lesson plans that could reasonably be implemented upon return to their classrooms. The goal was to provide teachers with an opportunity to get hands-on practice in a supportive learning environment.

Description of the Sites

Site 1 (Group 1). The Baltimore site is the Center for Technology in Education (CTE), the headquarters for the technology and professional development activities and programs. It shares the Dr. Samuel L. Banks Professional Development Center with Baltimore City schools. The center has two large computer laboratories, administrative offices for Center management and program directors, professional development schools, offices, and many educational partnership programs that offer educational and social services throughout the Baltimore area and Maryland.

Site 2 (Groups 2 and 3). The Columbia Center occupies the second floor of a three-story building and features 14 classrooms, one PC lab, one Macintosh lab, the Career and Life Planning Center, as well as an electronic library, large student lounge, bookstore, faculty lounge, executive conference room, a seminar room, and administrative offices.

Site 3. The Homewood Campus is the location for the School of Continuing Studies administrative offices (Schaffer Hall). In addition, the Schools of Arts and Sciences, and Engineering, as well as the university's administration are located on this campus.

In this pilot study, a small sample was selected to examine the demographics of the relative incidence and frequency distributions of sociological and psychological variables that are frequently associated with professional development and technology training for teachers.

The goals were to:

1. Identify characteristics of Maryland teachers enrolled in three instructional technology courses,

2. use the results in these preliminary reports to draw inferences about educators who typically participate in CTE-MSDE professional development and training programs, and
3. determine educators' perceptions about the efficacy of the CTE courses and/or other technology training that may have been sponsored by Maryland through their local schools. (See Table 5.)

Methods

An integrative data collection model was used, which combined quantitative and qualitative methods. The survey research was the primary method, but also included open-ended questions. A secondary method was photography and observation of teachers as learners in the CTE learning environment. The use of visual media enabled the researcher to extend analysis by capturing the richness of the learning environment, especially the classroom management process and collaborative teamwork among the teachers.

Implementation. A 125-item survey with eight categories was used to gather information to develop a profile of Maryland's educators in the CTE summer technology training for educators. This was the primary method in this study and served as one of the decision-making tools and as the pilot for determining the direction of future surveys and the

Table 5. Cronbach coefficient alphas for current usage, standards of usage, support, skills and applications, and attitudes and support

| Concepts | N | Number of Items | Cronbach Alpha (Internal Consistency) |
|-------------------------|----|-----------------|---------------------------------------|
| Current Usage | 30 | 12 | .8487 |
| Standards of Learning | 32 | 9 | .8883 |
| Technical Support | 34 | 7 | .8537 |
| Skills and Applications | 32 | 15 | .9635 |
| Attitudes and Support | 34 | 12 | .6389 |

organizational context and conditions for the larger study. An integrative data collection model was used, which combined quantitative and qualitative methods by including open-ended questions within the survey.

Descriptive Statistics

Summary Pilot Findings

This section reports and summarizes the findings from the pilot. These results are represented in Tables 6-9 and summarized in the subsections below.

1. The educators represented in this survey were 48% (.48) new teachers with 0-5 years of professional teaching experience. Twenty-two percent (.22) have greater than 20 years experience and about 20% (.20) have 6-10 years teaching experience. The teachers report dramatic confidence levels in their overall expertise in the use of new technologies. Seventy-nine percent are female and 21% are male teachers.
2. The CTE educators teach a wide range of subjects at the elementary school levels. Special education, technology, social studies, and math were subjects most frequently taught by the teachers. Reading, English, history, and science were the least likely found in this group.
3. Educators reported a wide range of levels of access to computers in their schools. The classrooms were more likely to have Macintosh computers other than PC platforms. However, educators reported that the majority of the computers are located in the library and/or in computer laboratories. (There is a mix of computer platforms within the schools. However, classrooms and schools are wired above the 60% level for the most part in these Maryland schools.)
4. The highest use of computers was word processing and the Internet, which are used to prepare students for the process of writing and research skills. On a five-point range, the means average over 4.0. The two least desirable uses were webpage development and drill and practice. Tables 6, 7, and 8 provide descriptive

Table 6. Current usage summary of means, standard deviations, means, and rank by participant responses to each subset of primary variables

| PV = Current usage | N | Std. Dev. | Mean | Rank |
|---------------------------------------|----|-----------|------|------|
| Drill and practice/ reviewing content | 33 | 1.24 | 2.88 | 11 |
| Educational games and simulations | 34 | 1.35 | 2.91 | 10 |
| Presentation tool (slide shows) | 34 | 1.39 | 3.06 | 8 |
| Multimedia development | 33 | 1.35 | 3.15 | 7 |
| Research tool | 34 | 1.26 | 3.91 | 5 |
| Word processing | 34 | .75 | 4.47 | 1 |
| Desktop publishing | 33 | 1.24 | 4.03 | 4 |
| Whole class instruction | 32 | 1.28 | 3.03 | 9 |
| E-mail/communication | 33 | 1.55 | 3.67 | 6 |
| World Wide Web access | 33 | 1.13 | 4.12 | 2 |
| Web page development | 32 | 1.17 | 2.03 | 12 |
| Productivity tools | 34 | 1.17 | 4.11 | 3 |
| Total N = 38 | 34 | .73 | 3.46 | |

Range: 1 = Never; 2 = Infrequently; 3 = Sometimes; 4 = Often; 5 = Very Often

data on the educators' perceptions and use of new technologies. This includes their attitudes toward technical and professional development support in their schools.

- Data in Tables 7 and 9 indicate that CTE educators feel highly supported in the effort to learn and use new technologies. Teachers reported extremely high comfort levels with computers and also indicated they enjoyed learning new technologies. One of the highest-rated items was confidence in technology to transform instruction and technology being an essential skill for students to learn. Educators felt least prepared to address the use of assistive technology to improve student learning. Eighty-three percent indicated their training in assistive technologies was

Table 7. Teacher perceptions and attitudes toward support in their schools: Summary of standard deviations, means, and rank by primary variable

| PV = Attitudes and Support | N | Std. Dev | Mean | Rank |
|---|----|----------|------|------|
| I feel at ease learning about technology | 36 | .91 | 4.56 | 2 |
| Anything the computer can be used for, I can do just as well some other way | 36 | .81 | 2.14 | 9 |
| Using a computer is an essential skill for my students to learn | 35 | .82 | 4.54 | 3 |
| I'm anxious about using technology because I won't know what to do if something's wrong | 35 | 1.08 | 1.83 | 10 |
| Computers are confusing to me | 36 | .87 | 1.58 | 11 |
| I feel comfortable about my ability to learn new technologies | 36 | .87 | 4.44 | 4 |
| I do not think computers will be useful to me in my profession | 36 | .59 | 1.22 | 12 |
| I enjoy learning about new technologies | 36 | .71 | 4.69 | 1 |
| Using technology at my school will mean more work for me | 36 | 1.36 | 2.71 | 8 |
| Technology will change the way I teach my curriculum | 36 | .91 | 4.34 | 5 |
| I can find technical support if I encounter any problems with technology | 36 | 1.15 | 3.64 | 7 |
| I have opportunities to take classes and learn about technology | 36 | 1.00 | 4.31 | 6 |
| Total N = 38 | 36 | .40 | 3.72 | |

Range: 1 = Strongly Disagree; 2 = Somewhat Disagree; 3 = Neither Disagree nor Agree; 4 = Somewhat Agree; 5 = Strongly Agree

Table 8. Teachers' perceptions about their technology applications skills: summary of means, standard deviations, means, and rank by primary variable

| PV = Skills and Applications | N | Std Dev. | Mean | Rank |
|--|----|----------|------|------|
| I feel confident I can: | | | | |
| Operate a computer system | 36 | .76 | 4.67 | 1 |
| Operate various software programs | 36 | 1.02 | 4.50 | 4 |
| Use terms associated with educational technology | 36 | .65 | 4.50 | 4 |
| Apply productivity tools (i.e., spreadsheets, databases) for professional use | 36 | .94 | 4.28 | 10 |
| Use electronic technologies to access and exchange information | 34 | .93 | 4.36 | 8 |
| Identify, locate, evaluate, and use appropriate technology resources to support the SOLs | 36 | 1.11 | 4.03 | 13 |
| Use educational technologies for: Data collection | 36 | .93 | 4.36 | 8 |
| Information management | 36 | .89 | 4.19 | 11 |
| Problem-solving | 36 | 1.04 | 3.94 | 14 |
| Decision-making | 36 | .92 | 3.94 | 14 |
| Communications | 36 | .77 | 4.53 | 2 |
| Presentations | 36 | .91 | 4.44 | 6 |
| Finding information | 36 | .77 | 4.53 | 2 |
| Planning and implementing lessons and strategies that integrate technology into the curriculum | 35 | .95 | 4.39 | 7 |
| Understanding the legal and ethical issues relating to the use of technology | 35 | 1.02 | 4.06 | 12 |
| Total N = 38 | | | 4.31 | |

Range: 1 = Very Uncomfortable; 2 = Somewhat Uncomfortable; 3 = Neither Uncomfortable nor Comfortable; 4 = Somewhat Comfortable; 5 = Strongly Comfortable

very limited and they desired more. Educators seem to believe that more knowledge about assistive technologies will enable them to help students achieve a higher academic performance (see Appendix CTE Study).

Access to Technology

Level of access to technology reported by the Maryland educators. In this pilot study, educators reported divergent access levels to computers and telecommunications in their classrooms, schools, and libraries outside school. Access to technology is a primary factor when it comes to technology integration, because you cannot use what you do not have. Aggregate data show that 70% of the respondents reported some level of access to technology. This research shows that the single highest number (633) of 1,076, computers, were located in computer labs, with only 107 in classrooms. The second highest were located in the libraries, which represented approximately 78% of the reported access to computers. Others accounted for 126, which are assumed to include home, community centers, places of employment, etc.

The numbers and kinds of computers reported show the primary platform was Macintosh computers. The Macs primarily are found evenly distributed with PCs in the classrooms and in the laboratories. However, in the library there was a three-way distribution with other, and most libraries and labs have both Macs and PCs.

The schools apparently are getting wired up. Participants reported access to the Internet, which averaged about 60% across the various grade levels and locations. The next question is: "How do they use the technology as a result of training and development?"

Present Study Findings

In the following section, data collected from the present study is presented. The specific implications based on these results is discussed in Chapter 4, in more detail.

Administrators' Interviews

During the summer of 1998, JHU-CTE administrators identified a small purposeful sample of administrators in 24 LEAS in Maryland as interview candidates about technology

Table 9. Teacher levels of agreement and perceptions about standards of learning for students:
Summary of standard deviations, means, and rank by primary variable (PV)

| PV = Standards of Learning | N | Std Dev. | Mean | Rank |
|--|----|----------|------|------|
| Use basic technology vocabulary | 34 | .90 | 3.71 | 3 |
| Compose/edit documents using word processing skills/writing process steps | 34 | .97 | 4.03 | 1 |
| Integrate graphics into word processed documents | 34 | 1.23 | 3.38 | 6 |
| Apply technology to strategies for problem-solving and critical thinking | 34 | 1.03 | 2.71 | 7 |
| Create databases and spreadsheets to manage information and create reports | 33 | 1.13 | 2.70 | 8 |
| Use electronic encyclopedias to retrieve and select relevant information | 32 | .82 | 3.91 | 2 |
| Use search strategies to retrieve electronic information | 33 | 1.25 | 3.55 | 4 |
| Use local/worldwide network communication systems to access information | 33 | 1.19 | 3.39 | 5 |
| Develop hypermedia "home pages" that can be accessed worldwide | 33 | 1.22 | 1.94 | 9 |
| Total N = 38 | 34 | .77 | 3.26 | |

Range: 1 = Strongly Disagree; 2 = Somewhat Disagree; 3 = Neither Disagree nor Agree; 4 = Somewhat Agree; 5 = Strongly Agree

integration. These LEAs represent a teacher population of 48,212 teachers and 838,500 students. In aggregate data, this is an approximate student teacher ratio of 17:1, which is about the national average. Sixty percent of Maryland's teachers have 11-20 years of service, 27% have less than five years, and 14% have 6-10 years. The years of service in U.S. public schools is estimated at 14.5 years. Consequently, Maryland has a very large inservice teacher population in need of training in new and assistive technologies. However, with 36% of the teachers having more than 20 years of service, it is likely that many of these teachers could be replaced with new teachers who are skilled in new technologies.

Table 10 shows the respondents' years of service in this sample ranged from 2 to 8 years. Seventy-one percent had held other positions within the school system. Approximately 30% of the group had 18 years of service. Others were distributed evenly within the range. Eighty-five percent of the respondents were in LEAs that practiced site-based management. The level of satisfaction on a 10-point range ranged from 5 to 9 in satisfaction with this practice.

Table 10. Maryland local education agency demographics and site-based management statistics

| | Number | Percent |
|---|--------|---------|
| <i>Administrators' Years of Service</i> | | |
| 2-8 Years | 4 | 57.1 |
| 9-28 Years | 3 | 42.9 |
| <i>Administrators Holding Other Positions</i> | 5.0 | 71.4 |

The idea of the interviews was to gather information about administrator's training needs that could be used to develop a monograph that would serve as a training resource for administrators in the future. The structured interview was designed to answer three research questions:

1. What are the beliefs of key administrators about the value of technology access and use by students with disabilities?
2. What information/skills are needed by key administrators to increase technology access and use by students with disabilities in inclusive learning environments?
3. What kinds of information and training resources would be of value in increasing technology access and use by students with disabilities?

The rationale was that responses to these questions would provide an indication of administrators' views about the training needs of educators. The administrators' interviews were structured for 30-minute telephone sessions. The scripted interviews were designed for

administration over the telephone. There were four primary variables and 33 items. The guidelines included a provision that not more than two individuals from any one district (LEA) would be interviewed.

The goal was to get a representative view of training and support needs throughout the state. Table 11 identifies the twenty-four (24) interviews for LEAs targeted for the interviews. The seven participant counties represent 30% of the 24 LEAs in Maryland. Thirty-six percent of all rural counties were represented, as well as 20% of metropolitan/suburban, and 66% of Eastern Shore counties. Central Maryland (5 counties) is the only area not represented in this group. Eastern Shore and rural counties were the largest groups represented. In summary, 19 LEAs, or 80% of the LEA population, was represented in this sample.

However, as the project progressed and data needs were identified, the administrator interviews provided essential data to answer other emerging questions about standards, practices, and policies that were related to MSDE/CTE support and training services to these LEAs. As a result, the interview (survey) became a part of the data collection for the research and evaluation study.

The results are detailed for emergent research questions in the findings. What follows is a presentation of key findings from the participants' responses for the three questions posited earlier. The open-ended responses will be included in the discussion of these findings.

What are the beliefs of key administrators about the value of technology access and use by students with disabilities?

Fifty-seven percent of the administrators responded that students with disabilities are almost always included in regular classroom activities; 27% reported often, and 14% reported sometimes, but none of the responses were negative. Eighty-five percent of the administrators reported that assistive and general technology acquisition and integration were either a very high

Table 11. Distribution of Administrators Interviews conducted with Maryland cohorts and counties represented in this small purposeful sample survey

| Cohorts | Distribution of Responding by Percentage x = counties where administrators were interviewed by county |
|---|--|
| Rural | |
| 1. Washington | |
| 2. Allegeny | x |
| 3. Garrett | x |
| 4. Charles | |
| 5. Calvert | |
| 6. St. Mary's | |
| 7. Queen Anne's | |
| 8. Kent | |
| 9. Dorchester | x |
| 10. Talbot | x |
| | N= 4 or 16% 24 counties |
| Metropolitan/Suburban Counties | |
| 1. Baltimore City | x |
| 2. Anne Arundel | |
| 3. Prince George's | |
| 4. Montgomery | |
| 5. Howard | N= 1 = 4% |
| Eastern Shore | |
| 1. Worcester | |
| 2. Wicomico | |
| 3. Somerset | x |
| | N= 1 = 4% |
| Summary Statistics | Total 24% of Maryland Counties represented 3/4 Cohorts = 75% of counties represented by Cohort Responses. |

Note: Counties responding represented their cohort in the study. The Western Maryland cohort counties were not represented in this selected sample, but did participate in other samples in the study. Maryland counties are divided into four cohorts. CTE provides services by cohort, LEA, or school districts.

or fairly high priority in their schools. The largest percentage was fairly high, at 57%. Seventy percent reported that instructional needs of students with disabilities are always taken into account. However, 30% did not respond to this question. Fifty-seven percent of the administrators reported providing technology training and support to help instructional team and teachers use and adapt technology; 43% reported providing training, technical support, and other resources.

The question about the adequacy of support and training that is provided was less promising and widely dispersed, yet equally distributed among the respondents. Only 57% responded to the question of the adequacy of the support to teachers in using and adapting technology. On a 10-point gradation, the responses ranged from 3 to 8.5; 43% of the respondents did not respond to this question. However, when asked if they were satisfied with the current processes and outcomes on a Likert range of 1-4 for satisfaction, all administrators were either very satisfied, satisfied, or somewhat satisfied; none were dissatisfied.

2. What information and skills are needed by key administrators to increase technology access and use by students with disabilities in inclusive learning environments?

In response to the question of whether they were satisfied with their level of knowledge, skills, and attitudes about technology integration and inclusion, 71% of the administrators reported a need for more information and 29% were unsure. However, 71% of the respondents reported that principals and school improvement teams are the most appropriate target audiences for technology training and support for teachers, while 29% reported being unsure.

3. What kinds of information and training resources would be of value in increasing technology access and especially use by students with disabilities?

When asked about training materials that would be most suitable for the targeted audience of principals and school improvement teams, participants were given a choice of four formats for print materials and a video. Seventy-one percent reported that a printed resource

guide would be most appropriate, 57% indicated case studies that were authentic and motivational, 43% preferred factual materials, and 43% supported a step-by-step process guide. In summary, the majority preferred more traditional formats characteristic of one-shot workshop formats.

Educators' Needs Assessment Survey

Project Goals and Objectives. The purpose of the needs survey was to gather information to identify the priorities of educators for training and support services provided by the Maryland Assistive Technology Network (technology training teams lead by educators trained by CTE professional development and technology specialists).

In Table 12, the strategies proposed by CTE are described as those that seek to increase the number of teachers who have the training and support they need to ensure equal access to technology and services that improve learning results for all children. The equal access goal includes six indicators that CTE-MSDE seeks answers to as evidence of technology's impact on student learning opportunities and teacher practice.

This proposes a special focus on special needs students because Maryland's technology and school improvement plans mandate special needs students must be educated along with general education students. Maryland's educators and policymakers make a valid assumption in their long-term technology and school reform plans about technology integration's capacity to help increase the number of these students who can function in the general classroom (Grasmick, 1999). This is especially plausible when given the consideration for appropriate accommodations, which is mostly envisioned as assistive, and computer technologies.

The partnership research and evaluation has three goals. They are to determine:

1. CTE's capacity to meet the professional development and technical assistance needs of MATN members,

Table 12. CTE-Maryland State Department of Education partnership preliminary evaluation indicators

| CTE-MSDE Partnership Evaluation Sample Questions (Indicators) |
|---|
| To what extent does CTE-MSDE |
| <ol style="list-style-type: none"> 1. Increase the consideration for the integration of assistive technology as part of the Individual Education Program (IEP) Process in Annual Review and Dismissal (ARD) Meetings? 2. Increase the knowledge base and awareness levels of educators, administrators, and policy makers of how technology can improve learning results for children with disabilities? 3. Increase the reworking of curriculum and instruction through the use of technology to accommodate individual learning needs? 4. Increase the use of technology (hardware, software, and assistive technology) to meet individual student needs? 5. Increase the number of accommodations for students with disabilities that support their participation on the Maryland School Performance Program (MSPP)? 6. Increase the awareness level of policy-makers and administrators of the training and support needed to build the capacity to use technology in instructional practice? |

2. if there is an associated increase in the number of educators who have the training and support they need to ensure equal access to technology and services that improve the learning results for all children, especially youth with disabilities, an
3. the existing systems for evaluating if technology standards, policies, and practices guiding the Maryland partnership ensure methods exist for evaluating the impact of CTE's work with MATN members, educators, parents, and students.

IMPACT: Needs Assessment (Integrating Multiple Processes to Assess Comprehensive Technology Training)

The focus of the needs assessment survey was to determine:

1. how the CTE-MSDE partnership is meeting the professional development and technical assistance needs of selected Maryland educators,
2. the nature of existing accountability and implementation guidelines for policies and practices,

3. partnership services that result in an associated influence on the number of educators who have the training and support they need to ensure equal access to technology and services that improve learning results for all children especially youth with disabilities, and
4. methods for evaluating the impact of the partnership to determine if they meet proposed local, state, and national standards for professional development and technology integration. See Appendices A for instrument and administrative correspondence.

Four variables linked the research questions to target indicators in the CTE-MSDE partnership agreement:

1. Knowledge Base and Awareness
2. Information Dissemination
3. Professional Development
4. Technical Assistance

There are six indicators designed to measure CTE's progress in these areas. A subsequent goal was to assess teachers and students' access to computer hardware, software, and communications systems. To accomplish these multi-dimensional purposes, the analysis included both the project's implementation and the impact. The ACOT™ and Concerns-Based Adoption Models (Hall & Loucks, 1979) will feature prominently in the discussion of these findings.

The sample. The Maryland Assistive Technology Network (125 members representing 24 local education agencies) held an annual congress on December 3, 1998. Eighty-seven surveys were distributed to participants and collected at the congress. This represents an estimated 75% of the current membership. The participants were asked to respond to 28 items that focused on their perceptions of the adequacy and priorities of technology training and support service provided by the CTE-MSDE partnership.

Data collection strategies and implementation. The participants were given an introduction and briefing to the study by the researcher about the purpose of the needs assessment and the overall evaluation process. After the presentation, participants were asked to complete the survey sometime during the day and return it to the registration table by the end of the day. Participants who were not able to complete the survey during the day were given stamped envelopes and instructions to mail back the survey by December 23, 1998.

Participants. Forty-nine (56%) participants returned the survey. However, only 42 (48%) were useable. The unusable returns were incomplete or were returned too late to be included in the sample data. Although this is a statistically acceptable rate of return, the goal was a 60% return rate. Therefore, we continued efforts to collect surveys by following-up with participants who had not returned their survey. The attempts included a reminder in the *CTE Status Report*, e-mail using on-line messaging, U.S. mail, and telephone calls. These attempts were ineffectual.

Qualitative data analysis. The needs assessment table represents the educators' comments, suggestions, and opinions reported on needs assessment. The data are reported verbatim from the instruments.

However, because the information lends itself to both quantitative and qualitative analysis, appropriate data analysis strategies were employed using NUDIST™ statistical analysis methodology and member checks for the positive and negative rating criteria. Descriptive data and inferential reporting for these primary strategies allowed the analysis of the 42 participants' returns.

Quantitative Data Analysis

Cronbach coefficient alpha test of reliability. A small pilot study was administered to a group of ten educators (general and special educators) to evaluate the reliability of the items. The Cronbach coefficient alphas for the study's list of sets were used to determine the internal

consistency of the items used to measure each variable. The standardized alpha for all twenty-eight items was .7909.

As presented in Table 13, the lowest internal consistency was “knowledge and awareness” ([KA] .6076), next “information dissemination” ([ID] .8217), then “professional development” ([PD] .8624), and the highest alpha was for “technical assistance”([TA] .8722). Dropping one outlier from knowledge and awareness increased the internal consistency (reliability) of the KA variable.

Pearson correlation analysis. The significant Pearson correlations for the IMPACT needs assessment are described in Table 14. The Pearson correlation is valid only when a straight line is a reasonable model for the relationship (Agresti & Finlay, 1997). The Pearson correlation is denoted by the symbol r . Pearson is a measurement of strength in a linear regression model, which uses a straight-line prediction equation to describe the relationship between two quantitative variables. It is represented by the prediction equation

$$Y = a + bX$$

$$r = \frac{(S_x)b}{(S_y)}$$

The correlation must fall between -1 and $+1$. A large absolute value of r generally represents the strength of the association of the variables. Therefore, the Pearson measure was

Table 13. Cronbach coefficient alphas for needs assessment knowledge and awareness, information dissemination, professional development and technical assistance

| Concepts | N | Number of Items | Cronbach Alpha (Internal Consistency) |
|------------------------------------|----|-----------------|---------------------------------------|
| Knowledge base and Awareness [KA] | 41 | 4 | .6076 |
| Information and Dissemination [ID] | 42 | 5 | .8217 |
| Professional Development [PD] | 38 | 9 | .8624 |
| Technical Assistance [TA] | 40 | 12 | .8722 |

selected as the most efficient method to look at the relationship between the four primary variables because it would be useful in comparing relationships of these variables, which were measured with different units. The correlations for all four variables in this survey are represented in Table 14. All variables were highly correlated. A test for multicollinearity revealed little among the variables. This means that the four primary variables in the CTE model do not function independently. The highest association was Technical Assistance and Professional Development (.769). The correlation was significant at the .01 level (2-tailed); then Information Dissemination and Professional Development (.701) and significant at .01 (2-tailed); Information Dissemination and Technical Assistance (.681) and significant at .01 (2-tailed); Knowledge and Awareness and Technical Assistance (.630) at .01 (2-tailed); and Knowledge/Awareness and Information Dissemination (.547) at .01 (2-tailed). It is important to note that Knowledge/Awareness and Professional Development (.371) were significant at .05 (2-tailed). See Table 14.

Preliminary analysis indicated high percentages of *extremely* and *very important* ratings on all 28 items as priority training and support needs. The responses were ranked on a Likert range of 1-4, from extremely important to not important. However, the Needs Analysis Survey results revealed priorities through an analysis of the descriptive statistics.

These data provide a comprehensive picture of the priorities for MATN member educators. Based on this information, the evaluation focused more intense examination of these as primary variables to prioritize other variables as they emerged in the research evaluation data collection and analysis process.

Correction to Statistical Analysis of the Regression Table

Multiple Regression Coefficients Analysis

As noted in Figure 4, there are three major components of the technical assistance factor that emerged as significant in the professional development and support model. Table 14 shows the results of the multiple regression equation,

Table 14. Pearson Correlations between Professional Development and CTE-MATN activities linked to target indicators.

| | K1 | K2 | K3 | K4 | I1 | I2 | I3 | I4 | I5 | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 | T11 | T12 |
|-----|-----|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| PD1 | .39 | .44 | .42 | | | .39 | | | | | .45 | .50 | .50 | | .50 | .42 | .40 | .44 | | | |
| PD2 | | | | | | .47 | | | | | .44 | | | | | | | | | | |
| PD3 | | | | | | | | | | | .45 | | | | | | | | | | |
| PD4 | | | .43 | | .53 | .59 | | | | .43 | .52 | .47 | .42 | .23 | | | .56 | | | | .48 |
| PD5 | .39 | | .62 | | .47 | .54 | | | | | .50 | .39 | | .50 | | | .42 | | | | |
| PD6 | | | .49 | | | .45 | | | | | | | | .41 | | | | | | | |
| PD7 | | | .52 | | .40 | .60 | | | .43 | | .47 | | | .50 | | | .46 | | | | .45 |
| PD8 | | | | | .55 | .52 | .46 | .54 | | | | | | | | | | | | | |
| PD9 | | | | | | | .41 | .51 | | | | | | | | | | | | | |

PD = Professional Development, K = Knowledge and Awareness, I = Information Dissemination, T = Technical Assistance

PD1–Expand professional development activities for assistive technology professionals in the MATN to help provide various levels of support required at the district level.

PD2–Offer a variety of topics, formats, and options for participation in MATN meeting. For example, increase the number of annual MATN meetings from two to three.

PD3–Encourage and reinforce participation in the MATN by offering MSDE professional experience credits to those who participate in two of the three meetings throughout the year.

PD4–Provide training and technical support to MATN to facilitate their participation in the on-line discussions and other Internet-related activities.

PD5–Develop the capacity to expand on-line communication about MATN issues using the CTE website.

PD6–Plan for a discussion board about a member selected topic.

PD7–Plan a discussion board for an open discussion.

PD8–Plan a discussion board to identify and share valuable Internet resources to support delivery to assistive technology devices.

PD9–Provide training and technical assistance to directors of special education, MATN members, Partners for Success staff, and related constituents of MSDE to support professional development of assistive technology teams with district level responsibilities.

K1–Consider integrating assistive technology into the Individual Education Program (IEP) process in Annual Review and Dismissal (ARD) meetings.

K2–Extend the knowledge base and awareness levels of educators, administrators, and policymakers of how technology can improve learning results for children with disabilities.

K3–Extend knowledge and skills of assistive technology experts responsible for providing assistive technology services in their districts or agencies through MATN.

K4–Reduce the number of assistive technology issues that are barriers to effective delivery of assistive technology devices and services.

Table 14 (continued)

- I1–Expand the use of on-line discussion groups on the CTE Website to include a focus on the essential issues of assistive technology integration and professional development.
- I2–Identify a critical area for action research similar to that which resulted in the monograph, *Adapted Pencils to Computers: Strategies for Improving Writing*.
- I3–Broadcast professional development activities undertaken by MATN members in the CTE newsletter.
- I4–Publish an article about MATN and CTE activities in the newsletter and CTE discussion boards.
- I5–Gather and disseminate references and resources created through the MATN discussion boards.
- T1–Develop information that will assist students who struggle with writing.
- T2–Conduct a needs assessment of MATN members to determine an area of technology to investigate.
- T3–Survey the research for best practices for AT integration, curriculum adaptation, and accommodations for students with special needs.
- T4–Design a methodology to collect and report data on the relative strengths and weaknesses of certain devices from student, parent, caregiver, and teacher perspectives.
- T5–Report the findings and post the process on the CTE website.
- T6–Increase the adaptation of curriculum and instruction through the use of technology to accommodate individual learning needs.
- T7–Increase the use of technology (hardware, software, and assistive technology devices) in schools to meet individual student needs.
- T8–Improve communication and collaboration among policymakers, administrators, curriculum specialists, and other educators concerning the provision of assistive technology information, devices, and services to improve the learning results of children with special needs.
- T9–Increase the number of accommodations for students with disabilities that support their participation in the Maryland School Performance Program (MSPP).
- T10–Increase the awareness level of policymakers and administrators of the training and support needed to build the capacity to use technology in instructional practice.
- T11–Assist the state and districts in technology policy development and implementation, and keep the MATN members informed of these developments.
- T12–Continue to serve on various state and local boards and committees as they have in the past, and seek new opportunities for carrying out this work (CTE staff).

which was used to test the strength of the model components. The CTE-MSDE partnership model included combinations of the four factors measured in the needs assessment.

Each model tested indicated information dissemination is not an independent variable but is significant as a predictor of educators' perceptions of their need for professional development. However technical assistance emerge as the most critical success factor. The following three components were the greatest contributors to the emergent model.

- Survey the research for best practices
- Design a methodology to collect and report data on AT/IT integration in practice
- Increase the training and support for adaptation of curriculum and instruction for technology integration and inclusive education.

Model Strength

Understanding the strength of the model components is best achieved by examining the betas. Because, the variables in this model are somewhat dependent on each other as indicated by the Pearson correlations, this analysis may not be considered a straight-forward measure of the contribution of each variable to the model. However, research shows that in evaluation and policy research the model does not have to be experimental to interpret unstandardized betas as indicators of effects. In this the variables do function independently with very little evidence of collinearity. However, the data does show that each variable functions more effectively with or among the other variables, which explains why they are so effective in CTE's model because they yield highly consistent statistical results when performing together. Table 4 shows that adaptation of curriculum and instruction is the most significant variable in the model because it appears to add strength to each variable especially when working with technical assistance as shown in Tables 14 and 15.

Results

A high percentage of the variance in professional development is accounted for by three technical assistance factors survey the research for best practices, design a methodology to

Table 15. Research for Best Practices/Methodology to Collect and Report Data/Curriculum and Instruction Adaptation Model Results

| Variables | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|-----------------------------|----------------|---------------------------|-------|--------|
| | B | Standard Error | Beta | t | Sig |
| Constant | .371 | .500 | ----- | .741 | .464 |
| Survey the research for best practices TA | .222 | .116 | .233 | 1.905 | .065 |
| Design a methodology to collect and report data TA | .198 | .089 | .263 | 2.229 | .033** |
| Increase the adaptation of curriculum and instruction TA. | .501 | .102 | .567 | 4.922 | .000** |

Dependent Variable is Professional Development for General and Assistive Technology. Data are given for the most significant technical assistance and support factors with professional development as the dependent variable: Educators priorities reported in the needs assessment. **p < .05. Variable inflation rates (VIFs) were good: and average 1.145. Average collinearity statistic was .874.

collect and report data, and increase the adaptation of curriculum and instruction to integrate new educational and assistive technologies. Therefore, the null hypothesis is rejected for the factors of knowledge and awareness, professional development, information dissemination, and technical assistance because there are strong relationships and dependencies among and between these variables that work together to effect impact on perceptions and outcomes of professional development in this model.

Interpretive Analysis (Open-ended)

Table 16 shows that based on JHU-CTE's needs analysis conducted at the MATN Congress, the educators' priorities are focused on the following professional development, technical assistance, and access barriers:

1. on-going staff training,
2. securing funding,

Table 16. Analysis of participant responses to open-ended questions on the needs assessment technology training and support survey

| Comments Participant Returns | Suggestions Open-ended Questions | Comments Positive (+) or Negative (-) |
|--|--|--|
| 1. Dissemination of information is critical to our continued existence. | How about sharing training modules? | + |
| | Develop a standard format for us to submit. | - |
| 2. I think many of the categories designed have very important needs. | It might be more useful to prioritize them. | + |
| 3. None | None | 0 |
| 4. None | None | 0 |
| 5. Website access/Internet access does not yet exist in my corner of Prince George's County. To access on-line information is tough. | Help schools get technology needs. | - |
| | Please remember those of us who are still paper-based. | - |
| 6. Increase the knowledge level of high-end administration (general and special education). | It is critical to having them allocate resources for AT throughout the school system. | - |
| 7. | | 0 |
| 8. | | 0 |
| 9. | | 0 |
| 10. | | 0 |
| 11. | | 0 |
| 12. | | 0 |
| 13. | | 0 |
| 14. | | 0 |
| 15. | | 0 |
| 16. | | 0 |
| 17. | | 0 |
| 18. | | 0 |
| 19. | | 0 |
| 20. | | 0 |
| 21. Each district has a technology plan. | These should be looked at when considering the integration of technology into the classroom. | + |
| 22. | | - |
| 23. I don't disagree with any of the statements in reality. They are all equally important. | How to fund regular curriculum technology plans in the state rather than funding AT first? | + |
| 24. | | - |
| 25. | | 0 |
| 26. | | 0 |
| 27. | | 0 |
| 28. Would like more opportunities to network. | | - |

Table 16 (continued)

| | Comments Participant Returns | Suggestions Open-ended Questions | Comments Positive (+) or Negative (-) |
|-------|--|---|---|
| 29. | | | 0 |
| 30. | | | 0 |
| 31. | | | 0 |
| 32. | Everything seems important - difficult to make judgments of degrees of importance based on rating scale. | | + |
| 33. | | | 0 |
| 34. | | | 0 |
| 35. | Strategies and programs to address needs of students with multiple disabilities ex-hearing impaired/autism/EP/MR | Behavioral management-best practices. | - |
| | | More instructional resources that can be downloaded on-line. | - |
| 36. | | | 0 |
| 37. | | | 0 |
| 38. | | | 0 |
| 39. | Biased in one-direction. | | - |
| 40. | | | 0 |
| 41. | | | 0 |
| 42. | | | 0 |
| 43. | Increasing the knowledge level of high-end administration (general education and Special Education) is critical to having them allocate resources for AT throughout the school systems. | | - |
| Total | | 50 responses | Positive = 5 /10% Negative = 15 / 30% No Resp = 30/60% |

3. standards for monitoring and effectively managing documentation services for individual education plans for students and the use of technology,
4. access to general and assistive technologies, especially telecommunications,
5. use of existing technology plans to set training, support, and technology priorities,
6. opportunities for networking and sharing of information with other professionals,

7. information and research about best practices, especially for working with students with multiple disabilities,
8. administrators' consideration for allocation for assistive and general technology,
9. knowledge and awareness levels of high-end administration about AT/IT, and
10. information about professional development and instructional resources that can be downloaded from the web.

Teachers' Performance-based Projects

In the summers of 1997 and 1998, CTE conducted training programs for educators and administrators at the Baltimore site. The institutes were designed to increase educators' access to uninterrupted training and professional development time. The teachers registered to attend the four-day institute, which allowed them to choose among an average of 15-20 workshops.

Researcher's Observations

The teacher-participants routinely attend training individually, in small groups, and in pairs. The instructional environment is hands-on, collaborative, and project- and team-based. Teachers are provided with time to reflect and share with peers and others throughout the day. The instructors are facilitators to guide instruction and provide direct and individualized instruction as needed. The Maryland State Department of Education offers teachers incentives that range from affordable tuition rates to continuing education credits (CEUs). In most cases, the participants are not required to attend this training. The characteristics of these educators are similar to those found in the pilot study in that teachers with less than 10 years are more dominant in this group. Although teachers are offered the incentive of CEUs, they must earn the credits by participating in a follow-up study.

The study asked teachers to monitor and report their activities for six months, which translates into teachers completing the study by January of the preceding year. Therefore, 1996 participants returned their responses in January 1997 and 1997 participants returned their study in January 1998. The determining goal was two-fold: 1) to evaluate the usefulness and quality

of the 1997 Summer Institute in technology training and special education, and 2) to evaluate the impact of the Institute on teachers practice, once they returned to their respective learning communities.

Instrument

The instrument for this qualitative inquiry was developed by the CTE administrative and instructional teams for both 1997 and 1998. The instruments were similar for both years but had slightly different formats.

The 1997 instrument included sections that entailed 12 pre-decided categories of responses designed to follow-up on teachers' activities after four days of training in new and assistive technologies: demographics and access, technologies, technical support, training, and funding sources. Next, the participants were asked to keep a log of activities related to the implementation of information gained at the 1997 Summer Institute. Teachers completed a log describing at least three separate activities that incorporated strategies or information presented during the four-day CTE training. The log required responses to six variables: 1) date, 2) goal, 3) activity, 4) technology applications, 5) description of the target students, and 6) correlation to the Maryland School Performance Program outcomes, if applicable.

In 1998, the goals and objectives, and the access variables remained the same, but the variables were revised. The teachers were asked to provide: 1) performance indicators, 2) student characteristics, 3) activity and strategy, 4) technology applications, and 5) assessment results and outcomes. The changes to the instrument did allow the teachers to report more explicit information about their activities than in 1997.

Sample. Thirty-six educators who teach pre-K to elementary level returned the logs. There were approximately 225 registrants. The 36 represent 16% of registered teachers. However, not all attendees were enrolled for credit. The noncredit participants were not included in the sample for this study. A CTE administrator estimated that about 50% attend for credit, or 112, which would increase the return rate to approximately 32% overall for the two-

year period. The return rate for 1998 was increased by over 50% from 1997. This increase was attributed to a more aggressive follow-up, including telecommunications and face-to-face interviews, to encourage the teachers to return the logs.

Methodology. The qualitative information was processed using the NUDIST™ software. The researcher consulted with qualitative research specialists and data analysts to decide how to organize the data to examine new themes and to develop an understanding of the research questions posited in this research study about CTE's technical support and professional development activities. As a result, the decision was made to code the data to answer questions about how teachers transfer their new knowledge into practice and if any barriers emerged in the process.

Interpretive analysis. A subsequent goal was to examine how the teachers' use of technology evolved over time and the impact on classroom practice. In addition to NUD-IST™ the researcher examined the 36 logs to verify the software analysis. A third review was completed by a research assistant as a member check to further validate the interpretations, inferences, and assumptions derived from the teachers project reports. See Appendices B for models and data analysis strategies.

Results. The teacher projects were similar to the pilot study. Teachers focused on the software and hardware applications from the training. Teachers seem to use the software independently of the content areas in a few cases. There were a variety of pattern uses. This made it difficult to assess the integration over time in such a limited study. In addition, there were inconsistencies in the tracking of the technology integration activities in the classroom. This did not provide an adequate opportunity to determine the extent of innovative uses of the technologies or the collaborative efforts among peer teachers to share the new knowledge.

The use of high-end technology packages such as Excel™, Clarisworks™, Boardmaker™, Intellikeys™, Hyperstudio™, Adaptive Talking Books™, and others were described as being used as designed by the product developer. The WWW was more widely

used to research and find information versus the more extending thinking activity of creating webpages or posting teacher and learner projects. Yet, the same educators expressed a need for more sharing of information through the Internet and a desire for more downloadable projects and lesson plans.

However, a small cadre of exemplary models did emerge in the analysis process. A summary of the 15 best practices that emerged and the frequencies of occurrences can be found in Appendix B. The most effective or frequently occurring practices in the projects occurring in the schools were:

1. use of AT for inclusion,
2. use of IT for all learners,
3. individualizing instruction,
4. embedded assessment,
5. planning for funding,
6. ongoing training and professional development in schools,
7. technical support and assistance,
8. content-based adaptation,
9. standards-based lessons planning, and
10. focused on critical processing and learning skills.

Occurring less frequently, but included in the 15 best practices were:

1. innovative use of technology,
2. integration of new or nontraditional instructional strategies,
3. reports of adequate access and availability of technology,
4. action research activities, and
5. systematic curriculum adaptation for specific disciplines.

Reports on assessment strategies were consistent with the reporting of the activities.

There was a wide variety of strategies with varying designs. Table 17 summarizes and provides

Table 17. Teacher summer institute 1998

| Goals/ Objectives of Training | Activity | Technology Application | Target Student |
|---|---|---|--|
| Creating web pages, organizing thoughts, word and phrases, playing games, communicating about activities at school, creating pictures, making bulletin boards, etc. | Web searches, improve motion control, develop web pages, web page design, | Board Maker, Smart Money, Hyper Studio, Scanner, Adobe Page Maker, Gif Converter, Paint Shop, Paint Shop Pro, Kid Pix, IntelliKeys, IntelliTalk, Dynavox, Big Macks, McCaw, CoWriter, Overlay Maker, E-mail, Excent, Sticky Keys, Hawk, Super Hawk, Speakeasy, Picture Exchange Communication, Music Writer, Touch Window, MS Publisher | LD, Ed, ADHD, PROFESSIONAL DEVELOPMENT, Average to above average ability, autism, 21/2-7 year olds, adult learner (parents), middle school students, gifted, borderline, ADHD, age 3-21, age 7-13, limited motor abilities, limited verbal abilities, autism spectrum disorder, 1-4 years old, cerebral palsy, learning disabilities, multiple-handicapping. |

some examples of how the teachers' used the new knowledge and technology skills by the grade levels of K-3 and elementary (4-8).

In the 4-8 grade levels, the emergence of e-mail, Touch Window, and spelling and grammar check features of MSWord™ emerged. Consequently, based on observations, project logs, and the NUDIST™ analysis, there does appear to be a difference in how the early childhood teachers use technology and the elementary teachers.

The Inferential and Interpretive Findings

Question 1: How does the CTE/MSDE professional development partnership for educators improve access to continuing professional development activities in new and assistive technologies for Maryland's educators?

Table 18. A comparison of elementary early childhood teachers use of educational and assistive technologies

| Grade Level | Activity | Technology Application Reported |
|---------------------------|---|--|
| Pre-K-3 | <ol style="list-style-type: none"> 1. Developed a slide show for parents to view during conferences. Children added the sound to each show. 2. Developed a social skills book for a child with special needs in my class. 3. Identified living versus non-living things. 4. Developed categories collaboratively with children for stamps to adapt software. 5. Assessed information using the Internet, which included web searches using different engines. 6. Created and maintained personal and class web site. 7. Used swim ring and communications pictures for autistic child. | <p>Hyperstudio™</p> <p>Hyperstudio™ computer and mouse, Boardmaker™, and glove puppets</p> <p>Communications boards, sign language, and Boardmaker™</p> <p>KidPix™</p> <p>Internet (telecommunications), Picture Exchange Communication System</p> <p>Internet</p> <p>Personal Communication System (AT device)</p> |
| Elementary Teachers (4-8) | <ol style="list-style-type: none"> 8. Developed customized communication bib and picture symbols to work with special students. 9. Facilitated development of concepts of print and vocabulary building. 10. Students developed a chat room with other students in other schools. 11. Developed a placement language board for snack time. | <p>Boardmaker™, Dynavox™, Intellitools™, Smart Money™, Stick Keys, Spelling/grammar check</p> <p>Personal Communication Systems, Adaptive Books, Boardmaker™, and Touch Window Technology</p> <p>E-mail, Computer, and Internet</p> <p>Boardmaker™</p> |
| Total n= 36 | Activities = 11 | Types of Technology = 18 |

Table 19. Summary of data analysis process: descriptive, inferential, and interpretive research

| Design Area | Question 1 | Question 2 | Question 3 | Question 4 | Summative |
|--|---|---|--|---|---|
| Driving Research Questions | How does the CTE/MSDE professional development partnership for educators improve access to continuing professional development activities in new and assistive technologies for Maryland's educators? | What is the relationship between or among the variables of professional development, technical support, knowledge and awareness, and dissemination to CTE-MSDE's ability to meet the needs of Maryland's educators in need of training in new technologies? | How does the CTE/MSDE professional development and training model in new and assistive technologies decrease barriers to technology support programs for Maryland's Educators? | To what extent do current teacher education and technology standards support access to training in new technologies and instructional strategies for inservice teachers to meet the needs of all learners in technological and diverse learning environments in selected Maryland school districts? | Grand Tour: Do we need professional development and technology training policies to ensure inservice teachers have access to appropriate training in new technologies and instructional methods to prepare all learners for the 21st Century? |
| Methodology : Population/ Participants | MATN Members Special Educators (24) General and Special Education Teachers | General Educators Special Educators Administrators | MATN Members Special Educators (24) General and Special Education Teachers | General Educators Special Educators MSDE/CTE Policymakers | Policymakers Educators Administrators |
| Instruments | Needs Assessments (2) Administrator Interviews Researcher Observations Member Checks | Pilot Survey Needs Assessment Administrator Interviews Teachers Projects Member Checks | Needs Assessments (2) Administrator Interviews Researcher Observations Member Checks | Pilot Survey Needs Assessment Interviews/ Observations Maryland Technology Plan ISTE Standards Member Checks | Literature Review All data collection tools Member Checks |

Table 19 (continued)

| Design Area | Question 1 | Question 2 | Question 3 | Question 4 | Summative |
|--|---|---|--|---|---|
| Driving Research Questions | How does the CTE/MSDE professional development partnership for educators improve access to continuing professional development activities in new and assistive technologies for Maryland's educators? | What is the relationship between or among the variables of professional development, technical support, knowledge and awareness, and dissemination to CTE-MSDE's ability to meet the needs of Maryland's educators in need of training in new technologies? | How does the CTE/MSDE professional development and training model in new and assistive technologies decrease barriers to technology support programs for Maryland's Educators? | To what extent do current teacher education and technology standards support access to training in new technologies and instructional strategies for inservice teachers to meet the needs of all learners in technological and diverse learning environments in selected Maryland school districts? | Grand Tour: Do we need professional development and technology training policies to ensure inservice teachers have access to appropriate training in new technologies and instructional methods to prepare all learners for the 21st Century? |
| Data Collection | Small purposeful samples | Same | Same | Same | Same |
| Data Analysis | SPSS Nudist Researcher coding/analysis | Same | Same | Same | Same |
| The Findings/ Results/ Recommendations | Researcher | Researcher | Researcher | Researcher | Researcher |

There were significant correlations between and among all four training and support variables in the CTE model. The results indicate that the most significant contribution to professional development is the technical support activities strategies and activities provided by CTE to Maryland's educators. There were 25 significant correlations between nine professional development activities and twelve technical assistance support services. Table 19 shows the most significant contribution as technical assistance to improve communication and collaboration among policymakers, administrators, curriculum specialists, and other educators concerning provisions for assistive technology information, devices, and services to improve the learning results of children with special needs. There was a strong correlation between this variable and training and technical support to facilitate their participation in on-line discussions and other Internet related activities (.56). The next highest was the priority for CTE to continue conducting needs assessment to support the development of topics for the on-line discussion (r-.52). The remaining correlations were all between .39 and .50.

Question 2: What is the relationship between or among the variables of professional development, technical support, knowledge and awareness, and dissemination and a number of additional factors believed to be related to CTE-MSDE's ability to meet the needs of Maryland's educators in need of training in new technologies?

Participants in the needs assessment, teacher projects, and administrator interviews provided significant findings or understandings about the relationship between these factors. In Table 14 Pearson correlation analysis (r) results indicated significant positive relationships among three variables from the CTE partnership conceptual model for professional development. There are strong correlations among and between the variables that indicate a consistent level of dependency. There were 50 significant relationships with r-values that ranged from .50 to .60 between and among the variables and the items. The regression analysis model identified technical assistance as the best predictor of professional development needs of educators. See Table 18.

Question 3: How does the CTE/MSDE professional development and training model in new and assistive technologies decrease barriers to technology support programs for Maryland's educators? Participants in the needs assessments and administrator interviews indicated that CTE's greatest contribution has been increasing the knowledge and awareness levels of educators and administrators. The desire for knowledge and awareness about the legal and educational policies and practices must be a continuing focus in the educational process in assessing the role of general and assistive technologies. As found in the literature, this indicates information can no longer be simply handed to administrators.

Administrators and policymakers must receive appropriate training and support to understand new technologies and their potential impact on learning and teaching in their schools. The data indicate that educators identify barriers and CTE responds by working with LEAs administrators and educators to find solutions (e.g., products, training, information, technical support resources) that are intended to decrease barriers through technical assistance and information dissemination networks and teams that CTE assists school districts in organizing. Through the MSDE partnership for professional development and technical support, the CTE network and electronic learning community addresses barriers, such as the ones below, are reduced.

Table 15 shows barriers identified by the participants in the JHU-CTE's needs assessment. These comments were entered verbatim into the NUDIST™ database with anchors to identify barriers in terms of negative and positive comments. Through the Maryland Assistive Technology Network, CTE collaborators plan and implement technical support and training to reduce these barriers by working with policymakers and educators to find solutions that meet national, state, and local standards. CTE undertakes this effort by working with MSDE and LEAs on various boards and committees to influence policy to improve practice based on their ongoing action research agenda.

Question 4: To what extent do existing technology standards support access to learning and practice in new technologies and instructional strategies for inservice teachers to meet the needs of all learners in technological and diverse learning environments in selected Maryland school districts?

The results from the educators' profile survey indicated that CTE training and support services support access to training in new technologies for educators consistent with the ISTE standards. However, the results from the needs assessment open-ended responses and teachers' performance-based projects verified a desire for more technical assistance. Despite this potential boundary, teachers' perceptions about their performance levels were very high. General and special education teachers' reported comfort levels technology as *extremely high*. On the Likert five-point range, this represented a mean score of 4.67. The overall mean confidence level in technology skills and applications was 4.3. In Table 8: Attitudes and Support, teachers reported a high confidence level about using new technologies.

The educators rated feeling at ease and enjoying learning about new technologies over all the other responses. They ranked their belief that technology will change the way they teach and is essential to helping their students learn as the third highest level of confidence. The educators strongly disagreed that computers were confusing or they were not useful in their careers. In general, the teachers were extremely confident in their ability to learn and use new technologies. Overall, educators averaged a mean confidence ability level of 3.7 on a 5-point range.

Conclusions

Grand Tour. To what extent do current technology standards appear adequate as guidelines for educational technology training infrastructure for inservice teachers?

The results of this study indicate that current technology standards are adequate as guidelines to support Maryland's educators' needs for basic foundation skills in new and assistive technologies. However, this support seems highly restricted to the use of technology as

a productivity tool rather than an instructional support strategy. However, concerns were preempted by more experienced teachers that training needs of teachers are very often not taken into consideration prior to training.

Consequently, individual teacher training needs in new technologies often go unrealized in some professional development and training programs in new technologies. There were a number of open-ended comments from educators that may explain these interpretive findings:

1. "Many times the instructor does not survey the class to see what level the class is on."
2. "Some training programs need to access better multimedia applications to better instruct."
3. "I am never assured of having any technology available, let alone Internet connections."
4. "It would be helpful if we could focus more on our own classroom opportunities vs. excess reading [in technology training classes]."

Summary. Therefore, without modifications, the guidelines may be inadequate to serve as a foundation for an educational technology training infrastructure for teachers on a large scale. The literature shows that developing a profile of teacher quality is a necessary tool for tracking teachers' progress in training programs to learn new technologies and instructional approaches. However, it is a task that should not be oversimplified or fall short of considering the complexity of teaching as a phenomenon. Furthermore, complicating the problem of assessing teacher quality and technology training programs is the problem that little consensus exists on how to measure effectiveness.

However, the National Teacher Quality Studies report two broad elements that represent teacher quality when evaluating performance: teacher preparation and qualification, and teaching practices. This study was an attempt to support the process for developing a profile of CTE-MSDE educators, which can augmented the annual Technology Teachers' survey. MSDE

administers an assessment of its technology plan by surveying educators across the entire state in the fall of each school year. The results could be used to extend efforts to create teacher profiles. This research study helps CTE observe strategies to incorporate diverse methods to verify survey results: classroom observations, survey, photography, document and project reviews, and conversations with administration, faculty, staff, and most importantly, the educators.

The purpose of this pilot study was to:

1. enhance knowledge about characteristics to improve understanding educators' needs, who enroll in CTE's continuing education programs in new technologies,
2. provide new data about educators to help CTE administrative, instructional faculty, and staff plan and prepare for future offerings or to improve on existing courses,
3. provide information to share with policymakers, which might help gain support for a future action research agenda to study the long-term impact of CTE teacher training in new technologies, and
4. establish a framework for the research and evaluation study for the CTE-MSDE Professional Development and Support Five-Year Partnership.

As a result, the research effort's responses to these ambitious goals were derived in the findings. Consequently, it concluded that CTE's focus on providing teachers with new instructional and technological competencies and technical support services is helping shape the foundation for learning more about what teachers need to learn and use new and assistive technology integration into their classrooms.

CTE's greatest asset lies in its people resources. The highly qualified and committed team seems well-positioned to help CTE realize its goals. However, a potential barrier lies in environmental factors such as time and support for the team members to reflect on their own professional development and research to identify ways to improve current efforts.

The research shows constant change is characteristic of learning organizations such as CTE. As with the consistent debate on teacher training practices, there is also the debate over the amount of time educators and administrators in higher education spend in the classroom vs. scholarly activities. While, it is a challenge to strike a balance during a period of constant growth and change, the lack of attention to organizational issues may begin to reflect on the quality of overall training and development support to teachers in technology. This attention must be focused on, training/course content offered in summer institutes and technical support for educators participating in the CTE programs and partnership activities, if they are not addressed in a timely manner. Research shows these factors perform a significant impact on the attitudes and perceptions of educators about the efficacy of CTE's support.

Recommendations for CTE-MSDE Partnership

Creating access to appropriate training, support, and new technologies to improve general and special education of inservice teachers should continue as an ongoing concern to the CTE and Johns Hopkins University Continuing Education Division. This research suggests that CTE is experiencing success in building a community of learners who are willing to help reshape and transform teaching and learning practices to accommodate the needs of all learners. This including special needs students which are documented in the teacher projects and the documentation of these efforts. It is critical to disseminate these best practices to its constituents, peer teachers, and administrators to enhance their understanding of how the technology facilitates the learning and teaching in the classroom.

It is highly recommended that CTE-MSDE continue to focus on the four critical components in the professional development and support partnership model to increase equal access to training and technical support to both general and special educators to learn new technologies. In addition to core goals of the CTE mission, it is important to take into account the results of this profile study of educators in technology training classes. Further actions might include the following efforts.

1. Work closer with schools to expand interagency partnerships for professional development schools within public schools. This would provide an on-going support system for teachers and thereby, assist in the transition and transfer of learning from the coursework to technology integration in the classroom. Currently, there are too many teachers reporting significant numbers of computers in computer labs instead of the classroom.
2. CTE must face the problem of how to provide more technology, maintenance, and adequate technical support to its instructional team and staff as CTE expands its training, technical support operations, research, and development expertise.
3. CTE is well positioned to develop a model teaching and training program in new technologies for inservice teachers. However, CTE will need more systematic strategies for acknowledging their accomplishments to enable others to learn from them and support its potential to develop as a national model.
4. Consider implementation of an extended awareness program for administrators in new and assistive technologies. This effort might further inform administrators of teachers' needs to facilitate education reform efforts to reach local, state, and national standards for high quality teaching to meet the needs of a growing diverse learning environment.

Validity

Suggestions for practice must come with some level of assurance that strategies were employed to increase the confidence levels of findings driving the recommendations described in this study. Multiple data collection strategies and analyses were used to support several different independent sources (Miles & Huberman, 1994). In this study, the term triangulation is replaced by the reference to multiple methods.

The analysis of the various data sources included weighting evidence, looking at negative evidence, making if-then relationships, acknowledging intervening evidence (variables),

and getting feedback from other researchers and participant-informants. In Table 19, the strategies for each primary question were illustrated by summarizing the methods found in Chapter 3, Methodology. Yet, there will undoubtedly be rival explanations that may derive different hypotheses to support other potential explanations.

Research shows, based on the nature of integrated research models (qualitative-quantitative research), rival explanations are relatively easy to conceptualize, especially when the sample is relatively small (Miles et al., 1994).

Consequently, the researcher selected the most plausible explanations supported by the findings. However, no emergent evidence to the contrary will be discarded, but is advantageous as alternative strategies for extending this early study into the future.

Limitations

The goal was to answer the question about the impact of CTE/MSDE's professional partnership in Maryland to prepare educators in educational and assistive technologies in selected school(s) and/or districts. In nature, this included the learning environment of teachers and students associated with Maryland's educational system.

Two primary limitations of these results limit their generalization:

1. the sample size,
2. the absence of an experimental groups or random samples, and
3. the generalizability of small purposeful samples to larger populations.

It is anticipated that in the future, a cohort of different groups of teachers, students, and administrators can be identified so that differences in experiences and between groups can be ascertained more concisely. Table 16 summarizes the data collection and analysis process for reporting the descriptive, inferential, and interpretive descriptions in this discussion of the findings.

A matrix coding system was used to operationalize the qualitative variables by systematically assigning quantitative values to calculate the frequency of events and

practices. This was used extensively to analyze the teachers' performance-based practices. As a result, 15 technology integration practices emerged from the coding and analysis process. These practices were then sorted and placed in categories highly related to other variables in the teacher's pilot survey, needs assessment, open-ended responses, and observations. This information was used to frame the level of development for teachers within the ACOT™ and CBAM models, discussed in Chapter 5.

CHAPTER 5. SUMMARY, SIGNIFICANT FINDINGS, CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

This closing chapter summarizes the research in six sections: a summary of the study; summary of significant findings; conclusions; discussion; limitations of the study; and recommendations for research, policy, and practice.

Summary of the Study

The purpose of this study was to examine the efficacy of ISTE/MSDE technology standards to support the CTE-MSDE partnership in providing preparation and technical support that educators perceive they need to use new assistive and educational technologies to achieve national and state standards, and to create inclusive learning environments in Maryland's schools. Five major factors were studied, which related to educators' perceptions of their priority needs for training and support services to integrate general and assistive technologies. These were measured and examined in the study: 1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination, and 5) availability of new technology. In addition, 16 other variables, believed to affect the impact of CTE's efforts, were studied. These are summarized in the following categories: current usage, standards of usage, technical support, skills and applications, and attitudes and support. For administrators, the measurements include demographics, background information, processes for acquiring access to assistive and computer technologies, technology integration practices in the local school district or local education agency, building, access, and format for materials and resources for assistive technology.

Two hundred and eighty participants comprised six small purposeful samples for this study. These groups included general and special educators, and administrators. The majority of the participants in the study were female, predominantly European Americans, with 1-10 years of service. The African Americans, Hispanics, and American Indians were clearly under represented in the technology in education leadership population. There were 153 educators

(teachers) 53% represented in the sample. The remaining 47% were administrator and education staff, and specialists who support the educators (teachers) in their local schools or districts.

The researcher did not have access to or the independence to select the sample. The CTE administration was the primary decision-maker because the intent was to conduct the study in the most unobtrusive way possible to maintain the credibility and reliability of the results by approaching those groups most directly affected by CTE's services and technical support. Other criteria included political, financial, and time constraints for completing the study which precludes large random samples. CTE believed these constraints would render large amounts of data that would not enhance understanding the dynamics of a multi-dimensional partnership for technology and technical support.

It was theorized further that small purposeful samples would produce richer information to enhance programmatic or political change. It is important to note that within these small purposeful samples (characteristic of qualitative research), the research captured approximately 80% of the representative population for Maryland's 24 local education agencies. Only five LEAs (central Maryland) were not included in all parts of the study. The instruments employed study at different intervals are summarized below.

Teacher's Survey

The teacher's survey was a study of teachers in technology for the educator's program to develop a model for profiling teachers' perceptions about technology training, support, and uses in the classroom and more. During the summer of 1998, twelve variables and 125 items, plus open-ended questions, comprised an instrument used in a pilot study. The instrument was adapted from a formerly validated instrument (Curry School of Education, 1997).

Needs Assessment

This instrument was developed collaboratively by ISU and JHU team members under the direction of the researcher. It was designed for administration to general and special educators to assess their perceptions of their expertise in new and assistive technologies. There

were five variables—Demographics, Knowledge and Awareness, Information Dissemination, Professional Development, and Technical Assistance—and 28 objective items on the Likert scale with ranges from 1-4 that ranked responses from not important to extremely important. In addition, there were two open-ended questions.

Teachers' Performance-based Projects

Teachers' performance-based projects were developed by teachers who submitted to JHU to evaluate teacher transition of skills from summer technology training institutes into the classroom. Projects, that represented a two-year period, were collected, analyzed, and examined by the researcher and research assistants (*member checks*). These included thirty-six questionnaires with eight sets of variables: Demographics, Goals and Objectives, Classroom Activities, Technology Applications, Description of Targeted Students, Correlation to Maryland School Performance and Learning Outcomes, Funding Sources, and Access to Technology. Six months after attending a summer institute, educators were required to return a monitoring instrument that documented their pattern of technology use in practice by responding to these variables in an open-ended format.

Interviews

The researcher participated in a CTE study as one of four interviewers in the data collection from local and state administrators to determine knowledge and awareness levels about the benefits of general and assistive technology, and the training and support teachers may need. The researcher conducted formal 30-minute interviews with administrators to determine their knowledge and awareness levels, preferences for technology training, and perceptions of their educators' needs for training and support to integrate AT/IT to create inclusive learning environments. There were five variables and 33 items with open-ended comments.

Observations

The researcher participated in four professional development and training sessions in new and assistive technologies as a participant-observer over an extended 10- to 12-month period. The researcher was the tool for the observations. These included ATLAS training, Early Childhood, Infant/Toddler Programs, and the 1998 Teacher Training Summer Institute. In addition, other visits were made for data collection and formative data sharing with the CTE research support team for Equal Access.

The Focus Group

The discussion focused on technology training needs for teachers, which included 30 educators who were invited by the CTE administrator to participate in a focus group to discuss the technology training and accountability needs to further facilitate CTE/MSDE's support and training services. Data were captured via computer entry using a laptop computer and from a web-based discussion board. Three facilitators used these multiple methods. The summary of each mini-focus group within the group of 30 was summarized through group reports, which used PowerPoint software and computer technology to capture and display each group's consensus about issues that emerged in their groups as important to support professional development in new technologies. The primary researcher, using a cassette tape and recorder, recorded the sessions.

Other reports and studies involved the professional development partnership activities and evaluations from training sessions for a two-year period. These included self-reports, formal evaluations, and studies conducted over the last five years.

Significant Findings

The study resulted in a number of significant findings from the quantitative and interpretive strategies. These are summarized below.

1. Research shows that the Maryland Department of Education is experiencing an aging and decreasing teaching population. Maryland's noninstructional staff is the

fastest growing segment of the Maryland Department of Education. During the three-year period from 1995-1998, this group increased by 46%. The declining growth is within the instructional and experienced teaching workforce. Teachers with more than 20 years experience comprise the largest group of teachers (36%) and has increased by 2% in three years. Teachers with 11-20 years experience (24%) decreased by 4%, teachers with 6-10 years experienced no change, and teachers with 1-5 years experience (26.5%) increased by only 2% in three years.

2. Demographics from the study show a significantly low representation of people of color participating in technology and leadership activities. The same observation was made about the CTE and support teams. The policymaking and administrative participants mirrored these results. Only eight minority participants were accounted for in the sample of 280 participants, or 3%. Therefore, in this study the circulating standards remains questionable as to their efficacy to drive support and to ensure equal access to training and support in new technologies for all teachers, especially minority teachers in metropolitan and in some pockets of rural areas. One possible explanation might be the selected sites for CTE's efforts, which concentrated in rural and suburban areas for access outreach. Since many minorities reside in the innercity, this would explain the lack of participation in the selected training and support activities from which the small purposeful samples in this study emerged. Therefore, reaching minorities to assess their needs may require a more extensive research effort by CTE and MSDE.
3. Best practices for teacher training in new technologies are accounted for in CTE-MSDE's knowledge/awareness and technical support efforts. However, research-based practices, adequacy of resources (funding), and policies that govern access are areas that could not be investigated adequately, given the limitations of this study. Table 20 represents a comparative and interpretive analysis of best practices

identified in the literature and CTE's service indicates that CTE's programs address approximately 80% (.80) of the criteria from the literature for best practices. This analysis was confirmed through three-dimensional qualitative data analyses. These included combinations such as member checks with other research assistants, data from teacher projects, and the open-ended responses from the Teacher Profile Survey, Administrator Interviews, and the Needs Assessment. See the summary of data collection in Table 19.

4. There is a strong association of knowledge, skills, and abilities in new technologies reported by Maryland educator-participants in this project with the ISTE technology recommended basic foundations in technology standards. This was expected because the state technology plan and vision technology integration in Maryland schools for technology and CTE's training and support practices for educators in new technology are based, in a large part, on these ISTE standards and the ACOT™ professional development model. The teachers' basic skills and applications adequately reflect the foci of the ISTE standards for entry level technology skills and pedagogical knowledge.
5. *The four critical factors in the CTE-MSDE model do not operate independently.* There are significant correlations between and among the four variables in the CTE Model. The translation is that to be effective, the strategies and activities must be closely aligned, if goals are to be attained. The Pearson correlation analysis resulted in identifying professional development partnership activities that improve access to continuing training in general and assistive technologies. This finding is also evidenced by the number and structures of learning opportunities offered in the summer institutes; nonstructured ongoing training and support for knowledge/awareness, information dissemination through interagency collaboration with Maryland Instructional and Technology Coordinator's Annual Conference and

regional meetings. CTE services extend to site-based location through their professional development schools located in public and private schools throughout Maryland. This access is facilitated through technical assistance in training local technology plans, grants proposals, and by influencing policymaking activities within MSDE. Interagency collaboration to infuse technology with Early Childhood programs, Parent Assistance networks, and Infants and Toddlers Programs for children with special needs. All educators participating in this study were taking advantage of these opportunities voluntarily.

6. The needs assessment results, teacher projects, and technology for educators programs are provisional evidence that the CTE-partnership and support decreases barriers to technology, training, and technical support largely through the knowledge and awareness, and information dissemination, and on-line learning community for educators who have access to the technology. CTE also maintains an extensive database of technology print resources for teachers who are not connected.
7. CTE-MSDE partnership for technology training activities influences educators' practice in the classroom is evidenced by the performance-based projects returned by teachers and on the Teachers' Survey. Over 90% (.90) of the teachers reported feeling extremely motivated to learn new technologies. The Maryland Assistive Technology Network of technology team leaders and facilitators participation in CTE's activities as peer mentors to support general and special education teachers is evidence of CTE's influence on best practices for technology integration to address the needs of all students.
8. Educators and administrators perceive technology integration in the curriculum, especially assistive technology for special needs students, to be priorities. Seventy-one percent (.71) of the administrators in the interviews indicated a high priority for technology integration in their districts or LEAs. Teachers indicated on the needs

assessment and on the profile survey that technology integration is a priority for improving the achievement levels of their students, especially students with special needs.

9. The nature of current national and state standards driving support and training for Maryland's educators in new technologies include ISTE's Recommended Foundations in Technology Standards, Maryland State Department of Education Plan for Technology in Education vision, and key six objectives with objectives 1 and 2 being equal access and ongoing professional development for technology.

Summarizing the study's findings to determine the efficacy of the data to address the two hypotheses posited in Chapter 1 follow. These results are critically discussed in the next section.

Hypotheses

Two hypotheses were developed to answer the research questions posited in this study. Research questions one through twelve did not require hypotheses, since they were approached primarily from evaluation and interpretive research perspectives, which require no hypotheses be tested. However, in Chapter 1, two prevailing hypotheses for questions nine and ten were presented in the null hypothesis form.

H₀¹

1. Based on the Pearson product moment correlation analyses and interpretation, there are no significant correlations among the following training and support variables of knowledge and awareness, professional development, technical assistance, information dissemination, and access to new technologies (general and assistive).

H₀²

2. Educators' perceptions about knowledge and awareness, professional development, technical assistance, and information dissemination needs are not the best predictors of educators' priorities for training and support needs from the CTE-MSDE partnership.

Results

Both null hypotheses were rejected on the basis of the stepwise multiple regression and the Pearson product moment analyses.

1. There are significant correlations among the training and support variables in the CTE-MSDE partnership model components: 1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination, and 5) access to new technologies (general and assistive). These analyses along with other data from administrators' interviews and teacher performance-based projects indicate that all four variables are critical components which contribute to Maryland's educators' perceived need for technical support.
2. Educators' perceptions about knowledge and awareness, professional development, technical assistance, and information dissemination needs are the best predictors of educators' priorities for training and support needs from the CTE-MSDE partnership. Technical assistance emerged in this study as the best predictor of technology preparation and support for Maryland's educators' professional development in new and assistive technologies.

Discussion

This study focused on the efficacy of existing state and national technology standards to ensure access to appropriate technology training and support for Maryland educators. A needs assessment was administered to determine if educators perceived value in the support provided by CTE to help educators achieve national, local, and state technology standards and integrate technology in professional practice. As a result of a pilot study during the summer of 1998, five critical factors were theorized by this researcher as contributors to educators' perceptions about their need for training and technical support services to integrate general and assistive technologies. The factors were 1) knowledge and awareness, 2) professional development, 3) technical assistance, 4) information dissemination, and 5) new technology.

Table 20. Analysis of significant findings for best practices for CTE partnership

| Best Practice Indicators from the Literature | CTE Conclusions |
|--|-----------------|
| 1. Centered on learning and practice needs of each teacher as an adult learner and as an individual. | X |
| 2. Linked to organizational context, subject matter content, pedagogical practices, behavioral, and social science theoretical frameworks. | X |
| 3. Connected to new technologies (specifically, telecommunications, Internet, distance learning). | |
| 4. Supported by time, funding, and opportunity for teachers to learn, practice, and reflect on their new learning and how to best use it to improve their teaching. | |
| 5. Embedded, assessment, evaluation, and reporting system to measure impact of and support of teacher technology competence in practice, and the effects on student learning, especially for special needs students. | |
| 6. Focused on meeting the needs of a more diverse student-teacher learning environment by incorporating special strategies by integrating instructional and assistive technologies to facilitate inclusion. | X |
| 7. Planned collaboratively in partnerships with business, industry, and higher education-colleges of education. | X |
| 8. Integrated action research to plan future professional development. | X |
| 9. Developed and managed locally within framework of national goals. | X |
| 10. Formatted in flexible, learning-practice evolving and cyclical format. | X |

One purpose of the study was to determine the relationships between and among the administrator's 1) knowledge and awareness, 2) beliefs about the value of technology and access and use by students with disabilities, 3) information and skills needed by key administrators to increase technology access, and 4) kinds of information and training resources administrators perceived as valuable to increase technology access and professional development for their educators.

The researcher hypothesized that policymakers need more research-based information to increase their knowledge and awareness of inservice teachers' training and development needs in new technologies. This new research could be used to provide administrators with evidence to support decision-making and new policies to increase access to high-quality training and development in new technologies for educators (teachers).

The arguments in this study are premised on the researcher's belief that professional development alone is not enough to effect long-term change in teacher practice and technology integration. One argument is that teacher training in new technologies must be followed up with revolving access to support. Teachers will require different levels of support for implementation and transition from a traditional classroom environment to a technology-based, constructivist learning community. A second argument is for establishing standards for experienced teachers in new technologies. It is theorized that without training guidelines in new technologies, some teachers will continue working unprepared to meet the challenge of the new 21st century education standards for high quality teaching, be displaced, or leave the education profession.

Despite the effectiveness of CTE's current support in new technologies, the need is growing and what has worked in the past may not be adequate in the future. This is evidenced by the implementation barriers and perceptions of needs defined by the participants in the study. For one, CTE has focused much of its efforts and resources on creating knowledge and awareness of the technology and its capabilities. Since 1986, over a decade ago, when the partnership began, the CTE team has invested considerable resources in information dissemination and professional development. Based on the ACOT™ and CBAM models, Maryland's educators are indicating the need to move from adoption to adaptation of technology. This will require more technical assistance involving modeling of technology use, evidence of best practices from the research, and strategies for curriculum adaptation for an increasingly diverse student population. The new inclusion mandates and the proposed merger

of assistive and instructional technology integration presents notable and complex challenges to educators and administrators in public education.

The most significant finding in this study was speculative evidence of a direct relationship between educators' perceptions of professional development and technical assistance. In a linear regression model, technical assistance emerged as the best predictor of educators' attitudes and perceptions about professional development needs. Other variables in the model included knowledge and awareness, and information dissemination. However, technical assistance accounted for 50% of the variance with professional development as the dependent variable, the next highest was information dissemination, followed by knowledge and awareness, respectively.

There were fifty significant correlations between and among the four factors in the CTE model. Twenty-five of the most significant R-square values were within the categories of professional development and technical assistance correlations. Cronbach alphas for all four factors were .82 and higher, with the exception of knowledge and awareness (.60). There were 30 items measured in this examination of educators' perceptions about support for technology in their schools.

At this point, it is important to be clear about what the research is referring to as standards. In this study, standards refer to the specific guidelines for decision-makers that provide indicators that can

1. produce observable evidence that schools are providing appropriate access to and support teachers and especially minority educators who need to learn and practice new technologies, and
2. ensure that preparation provided by schools is adequate to prepare teachers to meet new emerging higher quality licensing and certification standards which increasingly includes technology competencies.

Guidelines for development and implementation of training can be measured by assessment instruments or processes to ascertain the adequacy of an individual teacher's preparation in technology (general and assistive). Inherent in this definition is the understanding that external criteria needs to be established to validate this process (Levin, 1998). The evidence to support the rationale for guidelines emerged in part, based on the barriers and perceived needs of the participant-educators in this study. The next section brings attention to some issues that may need addressing to continue to expand the support the CTE-MSDE framework.

Access to Technology and Technical Support Challenges

What are the potential barriers to the effective use of computers and telecommunications technologies in the participant Maryland educators' schools?

1. Access to technology. For educators in Maryland, access is defined by format, location, time, and other factors such as scheduling. This is particularly important in the case of computer laboratories and can affect the teachers' motivation and ability to use the technology.
2. Ill-structured technology domains. It was reported that often when they return to their schools, teachers' schedules change or are not relevant to their classroom practice. Training is often not geared towards the individual needs of the teachers and their different levels of proficiency.
3. Technology for Teaching Critical Skills. Teachers do not feel adequately prepared for this task, nor do they report using technology for problem-solving as a priority (Pittman, 1998b).
4. Technology used as productivity tool. Teachers continue to use technology as a production and management tool to increase and diversify activities—not an instructional tool connected to standards of learning for specific subject domains (Needs Assessment, Pilot Study, Administrator Interviews, and Researchers' Observations).

5. Lack of general and special education teachers' knowledge and awareness of assistive technology. By far one of the greatest barriers to creating learner-centered, inclusive learning environments for all students was the teachers' lack of awareness and assistive technologies. Seventy-eight percent of the teachers reported feeling uncomfortable with assistive technology, which means only 22% were comfortable.
6. The average length of teacher's service, 14.5 years, was the smallest group participating in technology and support. Teachers enrolled in continuing education were new teachers and career teachers who will likely reach retirement decisions within the next 10 years. Teachers in the 11-15 years of service range, who represent the largest experienced teacher group for models and mentors for new teachers, were the most underrepresented in this study and in the literature. This may not be significant, yet it is consistent with national statistics on high- and low-end educators' technology users in the classroom.
7. The majority of computers remain in computer laboratories. Research indicates that the continued practice of locating computers in laboratories is a barrier to classroom integration. It seems obvious that if teachers do not have the technology in their classroom and must deal consistently with the complexity of scheduling in public schools, it substantially limits their ability to integrate IT/AT in the classroom.
8. Lack of consistency in the use of technology. Teachers' reports and comments indicate a gap in consistent allocation and utilization of the available technologies in the schools and in the classroom. This makes it difficult to assess the contribution to learning and achievement for students without a system to collect evidence and gauge progress. The uses are widely dispersed among several different approaches. However, this may not be a barrier and may be explained by the diversity of learner needs in Maryland classrooms, based in part on the policy of inclusion. Observation

revealed that multiple technologies often were encouraged, but the instructional strategies in practice were not clearly detected in this study.

9. Multimedia is the least reported activity. When reflecting on the results of the standards of learning and technology use, problem-solving, critical thinking, hypermedia, creating and managing spreadsheets and databases, and reports were the lowest ranked by the educators in terms of their importance in the use of technology. The mean score on a 4-point range averaged from 1.94 to only 2.7, and other “how to skills” mean scores ranged from 3.2 - 4.0.
10. Funding is inconsistent and unstructured in some localities. Some teachers indicated that they started elaborate and/or technology programs only to lose the funding. Much time and productivity was lost as a result and this does result in adverse effect on the students’ programs and motivation.

Summary of Emergent Issues

1. Declining teacher pool in the state.
2. Site-based management and varying priorities.
3. Infrastructures for technology priorities.
4. State-wide formats.
5. Access to technology.
6. Technical support.
7. Curriculum adaptation.
8. Administrators and general educators’ knowledge and awareness of AT/IT.
9. Accountability.
10. Availability of research-based practices.
11. Assessment and evaluation strategies.
12. Funding for AT and IT.

Conceptual Frameworks

This part of the discussion compares the analysis of significant findings in the study and the relationship to partnership activities and barriers that emerge which thwart efforts to prepare teachers in new technologies. The C-BAM and ACOT™ models both propose teachers' professional growth and development in learning new technologies progress in predictable and evolving stages on an individual basis. The frameworks make it possible to develop a profile of teacher knowledge, information, and skills as they initiate and take charge of their learning.

In this study the researcher discusses the results within the context of these frameworks. The goal is to share an understanding that may contribute knowledge about developing teachers' profiles to establish a framework on a system of assessment and accountability for teachers in new technologies. This information will support the development of ways to monitor teachers' ability and comfort levels in technology integration following training. This new information allows for ongoing planning of appropriate training and development for teachers (Milken Exchange on Education Technology, 1999).

New research-based information will enable policymakers to establish more appropriate funding to support ongoing technology and development that brings about long-term change. Research shows that the links between research, policy, and practice are only likely if teachers' concerns are addressed as they emerge through learning and practice. Table 20 represents the overlapping of two models at different stages of teacher's development when learning new technologies. Hall's model shows that questions or concerns will emerge throughout the learning and practice processes. To educators, getting the technical support of information they need could be critical during the teaching and learning interactions that emerge in the classroom in a constructivist learning setting. Hall's theory asserts that if these issues are not addressed on a consistent and satisfactory level, educator's progress and/or decision to continue is compromised. In the ACOT™ Model, research has shown that teachers move into different stages of development in an evolving process. The decisions they are forced to make in Hall's

model will affect the stages of development. There are other factors that also contribute such that when combined, the process becomes more revolving rather than proceeding in a straight-line, or upward, progression. The progression seems more S-curved. As discussed in Chapter 2, Cuban (1986; 1997) advocates that within these development stages are causal factors explaining why many teachers avoid or limit their participation in technology integration.

Personal values and beliefs are not so easily compromised if the new innovation (the means) proves to conflict with those values without adequate clarification of the end (p. 3). For example, teachers, who value the social interactions involved in learning and teaching, view technology not as a support but an interruption of the relationships that could potentially develop. Therefore, support systems must provide technical assistance that demonstrate how these social values can be preserved through instruction.

These are issues that may be difficult to standardize, but technology training guidelines may encourage provisions for time and resources for teachers and policymakers to reflect and study emerging issues. Educators and administrators consistently voiced the need or desire for more research-based practices and information to facilitate technology in the teaching process.

An interpretive analysis and synthesis from questions posited in this study indicates that Maryland educators participating in this study are beyond Hall's level 0-1 and are making efforts to move into levels 2 and 3. The ACOT™ and CBAM levels appear to overlap, beginning at ACOT™s adaptation stage 3. Table 21 illustrates this overlap. Although these factors were not statistically measured in the study, the culmination of the qualitative and quantitative data strongly support the researcher's synopsis and interpretive observations. The Xs mark the point of overlap of the two models.

Conclusions

In conclusion, the results are statistically significant. The explanations and interpretations are plausible, based on the evidence examined. Although these results may have practical significance, due to strong reliability coefficients and factors, the size of the small

Table 21. ACOT's™ five stages of development of technology integration^a

| Concerns-Based Adoption Model Levels of Concern (CBAM) | Entry 1 | Adoption 2 | Adaptation 3 | Appropriation 4 | Invention 5 |
|--|------------|---------------|-----------------|--------------------|----------------|
| Awareness 0 (not really concerned about AT) | X | | | | |
| Informational 1 (would like to know more about IT) | X | | | | |
| Personal 2 (wonders how IT will affect or change the way they teach) | | X | | | |
| Management 3 (amount of time to prepare and learn to use new /adapted materials) | | | | X | |
| Consequences 4 (how the use of IT/AT will affect learners) | | X | | | |
| Collaboration 5 (opportunities to relate to peers to compare notes) | | | X | X | |
| Refocusing 6 (ideas about how to improve the use of AT and related services) | | | | X | X |

^a EGASE conceptual framework for recycling information for analyses was used to cross-reference these overlapping stages of concern and development to demonstrate their potential association as teachers move through these learning, practice, and technical support needs cycles (Evaluating, Gathering, Assessing/Analyzing, Synthesizing, Evaluating Information).

purposeful samples places a statistical and moral boundary on the extent to which these results can be generalized beyond the unique groups of Maryland's educator-participants in this study. This research was designed in two phases: quantitative and qualitative research designs, called the *integrated research design* in this study to answer the following overriding question:

Do existing national and state professional development and technology standards have the capacity to ensure that all of Maryland's inservice teaching force have access to programs for continued improvement and opportunities to acquire the knowledge and skills needed to meet the new high quality teaching standards in the 21st century?

While the results fully support the model for the study, the implementation into practice on a large scale must proceed with some caution pending further investigation. However, many important relationships emerged in association with the four primary factors examined in this study. The results indicate that the relationships between and among these variables are sophisticated, interrelated, and relatively unexplored. As a result, it is less important to determine weight and further treatment of the factors in this study.

Therefore, based on the limitations and conditions of this study, the researcher reserves the above question for more extensive research. There is compelling evidence that indicates the weakness may not exist in the technology standards, but does exist in the technical assistance and support that is needed to achieve the competencies identified in the standards. Other issues emerged like barriers and technology. Yet, educators completing the CTE technology programs reported high comfort and skills levels with technology above the national averages reported in the U.S. Department of Education's Teacher Quality Study (U.S. Department of Education, 1999). Therefore, the four components in the CTE-MSDE model may provide some insight into guidelines for educators in new technologies.

Implications for Adopting Guidelines to Prepare Inservice Teachers in New Technologies

The literature consistently reminds us that the ultimate success of technology integration is dependent on the classroom teacher (Darling-Hammond, 1997b; Means, 1996). With this in

mind, the following questions are raised about developing standards for professional development for inservice teachers based on these questions:

1. Who will set the guidelines?
2. What should be the nature of the standards?
3. In what format should the standards be written?
4. How will teachers' progress be reported?
5. What will teachers be held accountable for?
6. How will the efforts be evaluated?

Recommendations for Research, Policies, and Practice

Criteria for Evaluating Models for Profession Development in New Technologies

Do We Need Guidelines for Educators in New Technologies? The TIMMS Study, *Pursuing Excellence* (1997), reported findings of important differences between U.S. teachers' opportunities for learning and improvement of their teaching, and the opportunities of their Japanese and German counterparts. Experts in the TIMMS report found that the quickest way to improve student achievement and learning opportunities is to improve the instruction provided by teachers (Levin, 1998; Peak, 1997).

Standards to Prepare Inservice Teachers in New Technologies. The USDE's Principles of High Quality must be adapted to provide a coherent way to think about issues related to standards-based professional development efforts to develop models to retrain inservice teachers in new technologies. The guidelines focus on improving the current conditions of professional development by providing criteria for guidelines and standards.

It is presumed that educators and the public currently use these guidelines to gauge the nature of programs that are training inservice teachers to integrate new technologies and new instructional practices into their teaching practices. Having a set of indicators will help provide a useful way to think about why we need guidelines and gauge the merits of standards-based preparation for inservice teachers.

Connection to Current Standards. The results in this study indicate standards for professional development of teachers to use new technologies cannot be isolated from other standards that hold teachers accountable. To discuss the need for technology training standards without including the connections to other professional development standards for licensure, certification, content, and teacher preparation would overlook the tensions that exist among them (Gitomer, Latham, & Ziomek, 1999).

Potentially, excluding or overlooking connections of the various standards could contribute a more difficult environment for collaboration to develop a cohesive, systematic approach to training teachers for the 21st century education (Council for Basic Education, 1996; Donmoyer, 1998). For example, licensure standards consistently must consider the certification needs for teachers to include everything teachers are held accountable for during their performance appraisals; likewise, the teacher preparation programs which enroll both inservice and preservice teachers must somehow try to meet the needs of both groups.

Currently, higher education is responsible and held accountable through standards from NCATE and others for preservice teachers in the learning and use of new technologies (ISTE, 1997). The research found no entity that unequivocally accepts the responsibility for developing guidelines and standards to train and support inservice teachers to:

1. develop the knowledge about technology and skills they are expected to learn, and
2. determine how they will be asked to show what they have learned.

The answers to these issues are fragmented and complex. The responses vary from one school district to another. It may very well be that standards should be localized. However, to achieve national standards, an infrastructure of guidelines, standards, and/or strategy is necessary. Guidelines and standards for professional development for technology may contribute to ensure teachers are provided with equal access and opportunity to develop the necessary skills to link student achievement to new learning standards and new technology. Standards provide a foundation against which to measure and compare progress towards high

quality professional development and the use of new technologies in the teaching practice. Standards can assist districts in developing goals professional development systems with and objectives that are realistic and equitable, given their individual available resources and needs. Administrators and educators can provide justification for funding to support the best professional development practices for training teachers in the new technologies. These issues raise many questions. The potential for various demands of standards for training teachers in technology can either strengthen or weaken the overall quality of support for inservice teachers without effective guidelines.

Why Current Guidelines Emerged Inadequate. Research about teacher training standards indicates that the source of the problem may not be the recommended foundation technology standards (ISTE), but the access to technical assistance and new technologies. The ISTE recommended foundation standards were examined within the fabric strands of best practices where a lack of research emerged to support them. Although there was a strong indication that the standards are successfully driving basic skills in new technologies, a second gap appeared that was a lack of emphasis on the critical process skills. The indicators of problem areas can be summarized within the framework of meaning, legitimacy, and practicality (Council for Basic Education, 1996).

The purpose in this study was to determine the capacity and acceptability of the guidelines in promoting high-quality professional development and training for inservice teachers in new technologies as called for by educational reform. All ten areas explored in the literature review are crucial to the development of new guidelines, core content standards, and a strategy for a system of professional development for inservice teachers in new technologies. An indicator may be broad, narrow, or weak, yet remain a value in the formation of new guidelines for training in new technologies. These indicators (guidelines) initially were designed to guide teacher education professional development overall, not for veteran teachers in technology. The veteran teachers may lack prerequisite skills for learning new technologies.

A second question to follow in this analysis of current indicators (guidelines) was how do we identify the strengths and weaknesses of teachers, take advantage of what is good about these guidelines, and build on them to develop more appropriate guidelines to accommodate the need of inservice teachers?

Criteria for Guidelines. Before discussing the criterion used in analyzing the guidelines (indicators) further, it is important to clarify the use of the language in this section. Teaching standards are educational experiences provided by teachers; that is, the quality of instruction, classroom activities, and learning projects they offer to their students. Meeting teaching standards is normally a substantial part of meeting the opportunity to learn standards. Teaching standards are also used to compare and gauge the relationship between what students are taught and how they learn in the classroom, and what the corresponding content and performance standards demand that students know and be able to do (Council for Basic Education, 1996).

Professional development and training guidelines for inservice teachers should be clear in identifying the most important knowledge, skills, and abilities that teachers are expected to acquire and how they will be assessed (Peterson, 1995). Guidelines must be clear in the intentions and purposes of the various facets of training inservice teachers in new technologies. To what extent do the existing professional development guidelines

1. reflect the essential elements, intrinsic importance, and practical significance of training inservice teachers to use and integrate technology (general and assistive) to improve student achievement?
2. identify a core of knowledge necessary for inservice teachers' future education, personal lives, work, and civic and cultural activity involving the use of NIT?
3. balance the need for computer literacy and important facts, ideas, and instructional practices with the kind of advanced intellectual and practical skills inservice teachers need to fully understand and practice the activities of the new technologies?

4. support the need for the best available research possible to join training in new technologies with professional development overall to achieve the goals of educational reform (Yocam, 1997)?
5. provide strategies used by policymaking groups to identify overlapping features of related professional development needs and requirements (NETS, 1998)?
6. promote valuable opportunities for integration of interdisciplinary approaches, or do they promote or represent pointless duplication of traditional and generic training practices (Wang et .al., 1998)?
7. permit comparisons with standards for professional development of inservice teachers with other education systems in the global education world (Council for Basic Education, 1996)?

Guidelines for Legitimacy

The former Office of Educational Research and Improvement (OERI) Assistant Secretary, Christopher Cross, (1991) observed, "For student learning to improve, teacher learning must also improve." A Report of the Goal 4 Resource Group Teacher Education and Professional Development, National Education Goals Panel (1995) legitimizes the need for new professional guidelines. This concept is represented in their vision of professional development standards as including both preservice and inservice teachers that include "rigorous and relevant strategies and organizational supports that ensure the career-long development of teachers and other educators." OERI further supports the position that new forms of teacher development are needed to sustain the current teaching force through site-based, context driven, professional development that is teacher-centered and focused on student learning (NEGP, 1995).

Professional development guidelines and standards provide criteria for determining the legitimacy of training inservice teachers as a justifiable set of expectations that the public is entitled to demand that teachers meet. Guidelines for new standards for training inservice (IST)

teachers depend on their conformity to recognize and validate principles of learning and teaching. These principles and questions raised in this discussion are an attempt to influence how guidelines and standards for training inservice teachers in new technologies which might be envisioned for inservice teachers, developed, adopted, and implemented. These questions emerged in the interpretation and synthesis of the findings and conclusions in this study about the legitimacy of current guidelines for teacher in general. Do the guidelines

1. represent a broad consensus achieved through the participation of the public, parents, educators, local, and state policymakers?
2. provide support for a reasonable and ongoing process of design, development, and refinement to include training inservice teachers in the new technologies?
3. reflect voluntary adoption by the education community?
4. provide for the equitable treatment of all teachers?
5. articulate how performance standards and assessments challenge all teachers—including teachers in central city schools with large diverse populations?
6. guide the teachers' attitudes towards professional development and achievement in the use of technologies overall?
7. demonstrate promises based on research that teachers' use and integration of technology in the teaching practice will increase overall?
8. incorporate a valid research and evaluation plan?
9. identify how, who, and what the assigned responsible of stakeholders are that are accountable for the identified measures?
10. include accountability for educators, public, and the policymakers (Council for Basic Education, 1996)?

Guidelines for Practice

The Council for Basic Education (CBE) takes the position that practical reform in education requires tools of reform to be effective and suitable for use by the people

implementing the reforms. Professional development standards for inservice teachers in new technologies is a tool. A tool that offers the potential to serve a diversity of practical purposes and different audiences given the call for schools to connect more to communities and families. New technologies provide many opportunities for innovative communication networks to support this goal, but teachers need training in why and how to use resources to achieve these competencies.

In this research, professional guidelines and standards are reflected on as to whether they are designed to meet this challenge of guiding teachers into the 21st century schools. Recognizing that pragmatic aspects of guidelines for training inservice teachers in new technologies will no doubt affect the development and guidelines and standards for training inservice teachers, depending on the purpose, various considerations come into play in the different school communities and learning environments (Hall & Loucks, 1979). CBE posits the following questions when evaluating content standards, which are important when the integration of curriculum and technology. With some adaptations for the context of this paper, these questions may emerge.

1. How well do the current guidelines contribute to a coordinated system which also includes curricula, performance standards, assessments, and teaching standards?
2. How well do the current guidelines and standards reflect both relevant research and common sense regarding teachers' development and learning of technology?
3. How well do the guidelines represent a reasonable evaluation of the time commitment required for teachers to attain knowledge and skills needed to use and integrate new and assistive technologies?
4. How well do the guidelines promote public understanding of what teachers are expected to learn?
5. Do they encourage public support of technologies in learning and teaching?

6. How well do guidelines and standards enable policymakers to make decisions and develop initiatives to improve the education system as a whole?
7. Will new guidelines and standards for training teachers in technology make a difference for student achievement?

Summary of Implications. Technology guidelines should be designed to support training teachers to use technology in practice for personal productivity and to improve student learning during instruction (Mackowiak, 1991). These should not constrict teaching and learning. Shared expectations for learning can support a coherent approach to teacher training and development, especially for teachers who are new or moving from one school to another or progressing from one level to the next. At the same time, the guidelines and standards need to be flexible enough to allow teacher discretion in curricular and teaching decisions to suit particular teaching conditions and learner needs (Council for Basic Education, 1996).

The congressional research and literature about Ed-Flex states discussed in Chapter 2 and the effective local reform efforts that have emerged in these states indicate that guidelines must be shared, understood, and supported by all stakeholders and can be highly effective when developed and implemented at local and state levels. Before the general public, parents, and students understand the benefits of new technologies, they must have the opportunity to experience the profound connections to information that new technologies make possible (Birman et al., 1997). Research tells us that technology is only a tool. It cannot build new knowledge, but it can serve as a catalyst to link information to support strategies for acquiring knowledge and understanding in different ways. Consequently, learners and teachers must continue at the forefront of decision-making for professional development and technical assistance technology needs.

To achieve this, it is proposed that five major ingredients are in the recipe. In Figure 5, these five components are two-dimensional. Two primary variables dominate this conceptual model. The first variable is professional development (passive learning) that entails knowledge

and awareness in relation to the research, policies, and practices about the roles and about the criteria within each component. The other variable, technical assistance, requires the interactive engagement of knowledge, skills, and abilities of the individual teacher.

Each of the two primary components, technical assistance and professional development contribute to the growth and development cycles of educators. The cycles that seemed to emerge in this study are illustrated in Figure 6 as the Professional Technology Integration in Assistance Model (P-TIAM).

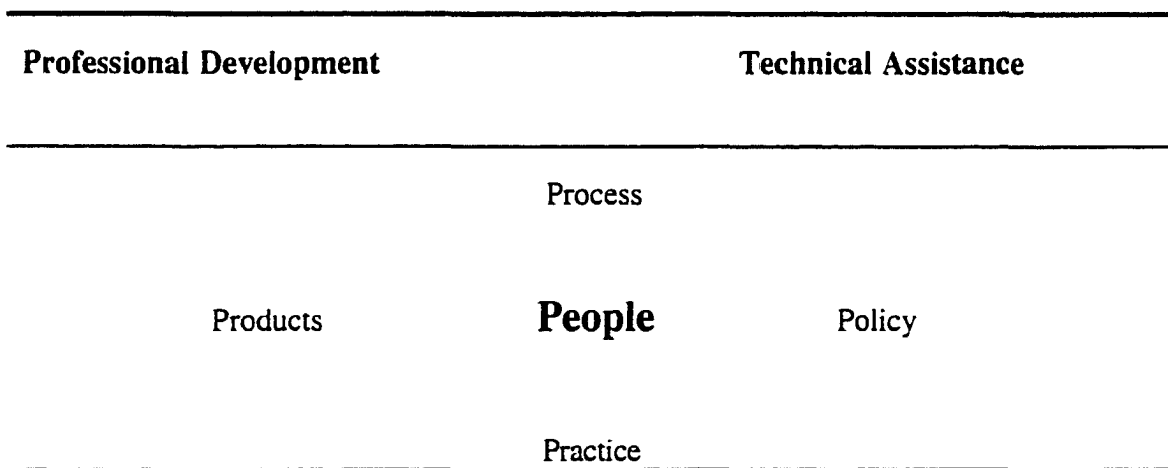


Figure 5. Conceptual framework teacher and technical assistance

0-Awareness, 1-Exploration, 2-Knowledge, 3-Training, 4-Adaptation, 5-Practice,
6-Adoption, 7-Transformation, and/or 8-Career Transition

Figure 6. Training for technology integration in assistance model (P-TIAM)

Plainly stated, the following theoretical scenario simulates the process for how the model might emerge in practice.

Step 0. The teacher is made aware of the technology and the capacity to affect and effect change in teaching and learning practice.

Step 1. The teacher is provided with an opportunity to explore and reflect on this new awareness to develop new knowledge throughout research and experimental learning.

Step 2. The teacher begins to prepare for the change and information transitions into new knowledge. Ideally this process might begin with an inventory or assessment of existing technology competencies and prerequisites to acquire the most benefit from the new learning.

Step 3. During this process the teacher begins to gradually adapt teaching methods and materials with assistance from other experts.

Step 4. The teacher begins to internalize and personalize the new knowledge from professional development and experiential learning.

Step 5. The teacher becomes more proficient and confident in practice based on extrinsic (incentives and recognition for achievements) and intrinsic rewards (seeing the improvement and inclusion of more students in the classroom and on assessments).

Step 6. The teacher then proceeds to become more innovative.

Step 7. Progressively the teacher's practice is transformed from a traditional teacher-centered approach to a technology-based and learner-centered approach to teaching or

Step 8. Begin career transition assistance and the decision-making process. This could lead back to any of the steps 0-8 or it could mean career exit planning.

The scenario depicted is one that incorporates interpretations from best practices, the C-BAM, and ACOT™ Models.

Suggestions for Future Research, Policy, and Practice

Extend research to:

1. organize a national study to examine the efficacy of technology standards and the impact on teaching and student learning specific to each major content area, based on the complexities of cognitive theories, new learning paradigms, and the affective domain.

2. explore the workability of local and national secured databases or clearinghouses for teacher professional development needs, to follow stages of concern and development, and for curriculum adaptation and instructional resources. System should include a way to evaluate the relationship to teacher performance and student achievement.
3. evaluate teacher perceptions of the effects of inclusive education and the merger of assistive technology with instructional technology to expand the concept of new technologies.
4. develop profiles of all K-12 educators, especially educators of minority status to determine their preparation and technical support needs in relation to reform goals and technology integration in inner city schools with large populations of special needs learners.
5. expand the CTE-MSDE partnership evaluation Goal 1 to include Goals 2 and 3, technology integration and building new leadership to study the implications of the significant findings from this Phase I of the research (e.g., study effect size based on variables in the CTE-MSDE model).

APPENDIX A

HUMAN SUBJECTS INFORMATION

ISU/JHU

Information for Review of Research Involving Human Subjects
Iowa State University

(Please type and use the attached instructions for completing this form)

1. Title of Project: A Profile of Teachers In an Instructional Technology Program for Educators - Project Impact _____

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are protected. I will report any adverse reactions to the committee. Additions to or changes in research procedures after the project has been approved will be submitted to the committee for review. I agree to request renewal of approval for any project continuing more than one year.

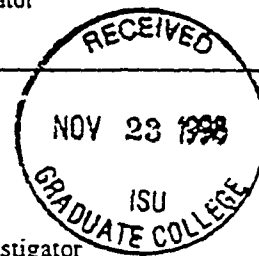
Joyce A. Pittman
Typed name of principal investigator

11/23/98
Date
Joyce A. Pittman
Signature of principal investigator

Curriculum & Instruction
Department

E006 Lagomarcino Hall
Campus address

(515) 294-6919 (Jamie)
Phone number to report results



3. Signatures of other investigators Date Relationship to principal investigator
X Harry D. Phipps _____ Supervisor/Director
Cass D. Thompson _____ Committee Chair

4. Principal investigator(s) (check all that apply)
 Faculty Staff Graduate student Undergraduate student

5. Project (check all that apply)
 Research Thesis or dissertation Class project Independent Study (490, 590, Honors project)

6. Number of subjects (complete all that apply)
40+ # adults, non-students _____ # ISU students _____ # minors under 14 _____ other (explain)
_____ # minors 14 - 17

7. Brief description of proposed research involving human subjects: (See instructions, item 7. Use an additional page if needed.) Project Impact is an evaluation project involving a partnership with Johns Hopkins University and the Maryland State Department of Education. On Dec. 3, the principal investigator will implement a needs assessment to estimated 150 Maryland Assistant Technology Specialists to determine training needs as Phase I of project. Subsequent data collection will be in the form of surveys and questionnaires beginning January 1999 - August 30, 1999.

(Please do not send research, thesis, or dissertation proposals.)

8. Informed Consent: Signed informed consent will be obtained. (Attach a copy of your form.)
 Modified informed consent will be obtained. (See instructions, item 8.)
 Not applicable to this project.

9. Confidentiality of Data: Describe below the methods you will use to ensure the confidentiality of data obtained. (See instructions, item 9.) Participants will not be required to give their names. Random numbers will be assigned.
10. What risks or discomfort will be part of the study? Will subjects in the research be placed at risk or incur discomfort? Describe any risks to the subjects and precautions that will be taken to minimize them. (The concept of risk goes beyond physical risk and includes risks to subjects' dignity and self-respect as well as psychological or emotional risk. See instructions, item 10.) None.
11. CHECK ALL of the following that apply to your research:
- A. Medical clearance necessary before subjects can participate
 - B. Administration of substances (foods, drugs, etc.) to subjects
 - C. Physical exercise or conditioning for subjects
 - D. Samples (blood, tissue, etc.) from subjects
 - E. Administration of infectious agents or recombinant DNA
 - F. Deception of subjects
 - G. Subjects under 14 years of age and/or Subjects 14 - 17 years of age
 - H. Subjects in institutions (nursing homes, prisons, etc.)
 - I. Research must be approved by another institution or agency (Attach letters of approval)

If you checked any of the items in 11, please complete the following in the space below (include any attachments):

Items A-E Describe the procedures and note the proposed safety precautions.

Items D-E The principal investigator should send a copy of this form to Environmental Health and Safety, 118 Agronomy Lab for review.

Item F Describe how subjects will be deceived; justify the deception; indicate the debriefing procedure, including the timing and information to be presented to subjects.

Item G For subjects under the age of 14, indicate how informed consent will be obtained from parents or legally authorized representatives as well as from subjects.

Items H-I Specify the agency or institution that must approve the project. If subjects in any outside agency or institution are involved, approval must be obtained prior to beginning the research, and the letter of approval should be filed.

Last name of Principal Investigator Phve

Checklist for Attachments and Time Schedule

The following are attached (please check):

- 12. Letter or written statement to subjects indicating clearly:
 - a) the purpose of the research
 - b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see item 17)
 - c) an estimate of time needed for participation in the research
 - d) if applicable, the location of the research activity
 - e) how you will ensure confidentiality
 - f) in a longitudinal study, when and how you will contact subjects later
 - g) that participation is voluntary; nonparticipation will not affect evaluations of the subject
- 13. Signed consent form (if applicable)
- 14. Letter of approval for research from cooperating organizations or institutions (if applicable)
- 15. Data-gathering instruments

16. Anticipated dates for contact with subjects:

First contact

Last contact

December 3, 1998

August 30, 1999

Month/Day/Year

Month/Day/Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

N/A

Month/Day/Year

18. Signature of Departmental Executive Officer

Date

Department or Administrative Unit

Henry Phve

19. Decision of the University Human Subjects Review Committee:

Project approved

Project not approved

No action required

Patricia M. Keith

Name of Committee Chairperson

11/25/98

Date

PM Keith

Signature of Committee Chairperson

APPENDIX B

FOCUS GROUP QUESTIONS AND PROCESS

Focus Group Questions

Administrators

1. Briefly describe how you are supporting assistive technology in your schools.
2. What impact have your technology plan (s) and/or school improvement plan had on assistive technology use in your school?
3. What does "assistive technology integration into the curriculum mean to you?"
4. How do you support and/or evaluate teachers' integration of assistive technology?
5. How does assistive technology enable teachers to change how and what they teach?
6. How does assistive technology enable students to change how they participate in the MSPAP assessment process? In the classroom?
7. How would you characterize the support you've received from CTE and MSDE in promoting assistive technology integration?

Teachers

1. Briefly describe how you use assistive technology at school and/or at home. Prompt.
Give examples.
2. What does "integration of assistive technology into the curriculum" mean to you?
3. What motivates you to integrate technology into the curriculum or into your classroom lessons?
 - Examples:
 - technology plan and school improvement plan
 - staff development
 - colleagues
 - administrators
4. What are some of the barriers to integrating technology into the curriculum or into your IEPs?
5. Where do you get your information about assistive technology training, hardware, or software?
6. How will assistive technology enable teachers in your school or department change how and what they teach?
7. How will both general and assistive technologies enable students to change how and what they learn?
8. Look down 5-10 years, what role do you envision technology playing in teaching and learning?

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Science means that I will be faithful to the cause of free inquiry, and will accept truth where I find it, no matter how relentlessly it may tear out the roots of prejudice and superstition. I will not be blinded by the new or the spectacular, condemning the old and tried simply because it is old and tried. I will not distort or weigh evidence to support a favored theory, suspending judgment for more nearly adequate evidence. This I pledged to science.

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