ABSTRACT

CORN, JENIFER O'SULLIVAN. Investigating the Quality of the School Technology Needs Assessment (STNA) 3.0: A Validity and Reliability Study. (Under the direction of Ellen Vasu and Kevin Oliver.)

Schools and districts should use a well-designed needs assessment to inform important decisions about a range of technology program areas. Presently, there is a lack of valid and reliable instruments available to schools to effectively assess their educational needs to better design and evaluate their projects and initiatives. The School Technology Needs Assessment (STNA) is a free, user-friendly online survey tool that meets this need for planning and formative evaluation of technology projects in educational settings. This study used existing data from a robust sample (n=1918) of educators from across North Carolina to examine the reliability and validity of STNA. A collective review of study results including the literature review, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and internal consistently reliability analysis indicate that STNA is a high quality instrument. The literature supports the selection and inclusion of STNAs subconstructs. Items in STNA cluster together into 10 factors that support the reliability of the existing constructs identified in STNA. Factors focusing on technology program objectives (Teacher Technology Use, Student Technology Use, Teacher Impact, and Student Impact) were identified as stable, reliable, and invariant across multiple school-level response groups. Additionally, the pattern of responses across school-level groups was the same for 30 out of 49 STNA items related to technology program strategies. A copy of the survey is included in the appendix (see Appendix A) and is available online at http://srvlive.serve.org/Evaluation/Capacity/EvalFramework/resources/STNA.php.

Investigating the Quality of the School Technology Needs Assessment (STNA) 3.0: A Validity and Reliability Study

by

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BIOGRAPHY

Jenifer O'Sullivan Corn was born in California in 1975, but spent a good deal of her childhood in Greensboro, North Carolina. She graduated from Page High School in May of 1993 and enrolled at the University of North Carolina at Chapel Hill (UNC) in August of that same year. During her studies at UNC, Ms. Corn worked as a research assistant in the Psychology department for three semesters. Ms. Corn also participated in a study abroad program in the spring of 1996 in Florence, Italy where she studied the Italian language and culture. Ms. Corn earned her Bachelor of Arts degree in Psychology in May 1997.

After graduation, Ms. Corn worked as a 4-H Program Associate with the Wake County Cooperative Extension Service in Raleigh, North Carolina. While working full-time with the Wake County 4-H program, she enrolled as a part-time student at UNC to earn a graduate degree in education. She graduated with a Masters of Education in Educational Psychology, Measurement, and Evaluation in December 2002. Her graduate studies focused on education, instructional psychology, integrating technology in the classroom, and educational research.

In 2003, Ms. Corn was hired as an Education Technology Specialist with the Technology in Learning (TiL) Program at the SERVE Center at University of North Carolina at Greensboro. Ms. Corn's work with SERVE reflects the overall organizational goal of helping schools, districts, and states improve teaching and learning by building their internal capacity to successfully integrate technology into the on-going educational programs. Ms. Corn has helped plan, design, implement, and evaluate professional development, technical assistance, and resource development and dissemination in the areas of curriculum and instruction, leadership for technology, policy, planning, and evaluation. Promotion to the TiL Program Coordinator, provided an opportunity to manage various aspects of on-going programs at SERVE including: collecting and analyzing data to determine reliability and validity of TiL instruments; conducting qualitative research and evaluation studies to gain a better understanding of how innovative technology use in the classroom facilitates 21st century learning; and providing data analysis and synthesis for the external evaluation of state-level technology professional development grant.

In January 2008, Ms. Corn was hired as Senior Research Associate at the Friday Institute for Educational Innovation at North Carolina State University. Ms. Corn serves as the project coordinator for the evaluation of the implementation and impact of technology-enabled innovations in K-12 classrooms.

Ms. Corn is currently enrolled as a doctoral candidate in the School of Education at North Carolina State University, in Curriculum and Instruction with an emphasis in Instructional Technology. Much of her course work has included studying current research and practices in the areas of adult learning, curriculum, teaching in the online environment, educational testing and measurement, statistical methods, applied research methods in education, design and evaluation of instructional materials, computer applications, and curriculum integration in K-12 instruction.

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CHAPTER I

INTRODUCTION

Research Problem

The No Child Left Behind (NCLB) Act requires educational project accountability to demonstrate impact on student learning objectives and/or teaching practices (U.S. Department of Education, 2002b). In as much, many states are requiring that schools and districts plan and implement an evaluation of their on-going education projects, especially those tied to federal monies allocated through NCLB (McNabb, Hawkes, & Rouk, 1999). Presently, there is a lack of research sharing valid and reliable instruments available to schools to effectively assess their education technology needs to better design and evaluate their projects and initiatives. In fact, a recent search of the Educational Resources Information Center (ERIC) database produced only 60 journal-article citations containing the terms needs assessment, school, and technology for Pre-K-12 settings. The School Technology Needs Assessment (STNA) (see Appendix A), described in this study, provides a free, user-friendly online tool that meets this need for planning and formative evaluation of technology projects in educational settings. This study addresses the potential contribution of STNA, provides background on the development of the instrument, shares related research, and investigates the validity and reliability of the instrument.

Schools should use a well-designed needs assessment to inform important decisions about a range of technology program areas. STNA collects data about educators' perceptions around a variety of areas of technology implementation in schools: including status of a supportive environment for technology use; provision of high quality, targeted professional development for technology; frequency of appropriate technology use for teaching and learning; and changes in instructional practices and student learning. These data can help school-level leaders make planning and evaluative decisions related to technology projects.

Potential Contribution

STNA collects data about educators' perceptions around a variety of areas to determine the collective needs of school staff related to the use of technology for teaching and learning. The model underlying STNA assumes that it can positively impact learning outcomes through effective utilization of the data collected, with regard to each of the constructs to inform decisions about school technology programs. As illustrated in Figure 1, STNA collects data on school technology program strategies (status of a supportive environment for technology use and provision of high quality, targeted professional development for technology), and school technology program outcomes (appropriate technology use for teaching and learning, and changes in instructional practices and student learning outcomes).

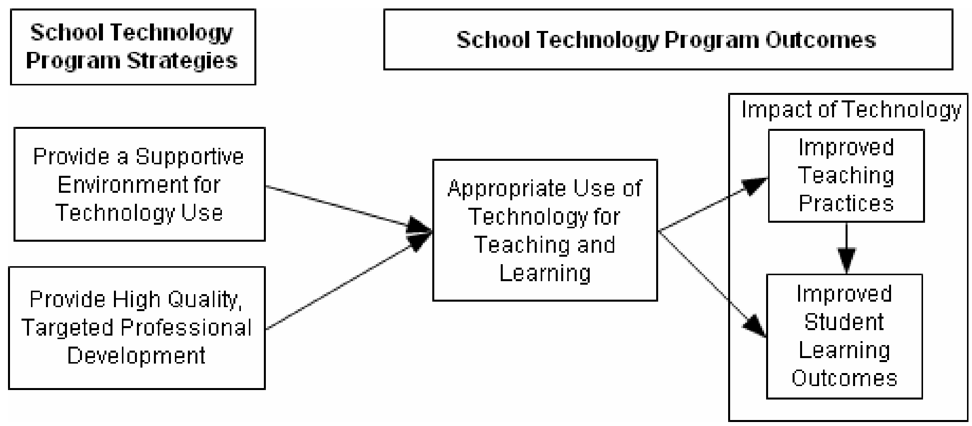

Figure 1. Logic Model of the Constructs Included in STNA.

By collecting data from school staff about each of the construct areas, STNA data are intended to be utilized by decision-makers for the purpose of formative evaluation of the school technology program. Therefore, it is necessary to make an explicit distinction between formative and summative uses of evaluation (Scriven, 1967), based on the intended use of evaluation findings (Patton, 1994). Formative evaluation is used strictly for program improvement and decision-making purposes, rather than for accountability purposes or for making decisions about program continuation (Patton, 1997). Defined in this way, formative evaluation efforts focus on collecting and analyzing data to examine both implementation (i.e., the quality of the program strategies) and impact (i.e., how effectively desired outcomes are met).

STNA enables school staff to plan, implement, and evaluate their own technology programs by providing an easy-to-use data collection tool to make judgments and interpretations about programs and use data to inform decision-making. Expectations of the value of STNA are captured in the definition of empowerment evaluation as an evaluation “approach that helps achieve program success. By providing program developers with tools for assessing the planning, implementation and results of programs, community stakeholders have the opportunity to improve planning, implement with quality, [and] evaluate outcomes…thereby increasing the probability of achieving results” (Wandersman, 1999, p.96).

Background

In 2003, the Instructional Technology Division of the North Carolina Department of Public Instruction (NCDPI) was one of 10 states to receive a federal grant to study the impact of a state-level instructional technology initiative. This grant, LANCET (Looking At North Carolina Educational Technology), included research and evaluation of the implementation and impact of the North Carolina’s Enhancing Education through Technology (EETT) sub-grants (North Carolina Department of Public Instruction, 2003b). Eleven North Carolina schools were awarded these three-year competitive sub-grants.

EETT funds were allocated to each of the states as part of federal technology funds, Title IID of No Child Left Behind, which required that 25% of the grant funds support professional development efforts, while the remaining 75% of funds could be spent on any combination of hardware, software, personnel, or other technology-related purposes (U.S. Department of Education, 2002a). In addition to these federal mandates, the North Carolina sub-grant recipients also were required to implement the IMPACT model, North Carolina’s guidelines for media and technology programs (Public Schools of North Carolina, 2005). IMPACT components include: having a full-time technology facilitator and media coordinator in place; developing a school-wide focus on flexible access to computer labs, mobile computer carts, and libraries; in combination with collaborative planning. Each of the 11 IMPACT schools was awarded approximately $450,000 a year for three years to fully implement each component of the IMPACT model (North Carolina Department of Public Instruction, 2003b).

The Technology in Learning program at the SERVE Center at the University of North Carolina at Greensboro (UNCG) was one of the principle collaborators with NCDPI on the LANCET grant, along with the College of Education at North Carolina State University and the Friday Institute for Educational Innovation. The SERVE contribution to the LANCET project included, providing professional development and technical assistance to the IMPACT schools on formative evaluation and guiding the development and validation of instruments for formative evaluation (North Carolina Department of Public Instruction, 2003b).

The North Carolina EETT IMPACT schools were not the only EETT projects required to conduct a program evaluation. According to the *National Trends* report commissioned by the State Educational Technology Directors Association (SEDTA), 86% of all states require their EETT competitive award grantees to conduct an evaluation of their project (Lemke, Wainer, & Haning, 2006). This statistic clearly illustrates the need for high quality instruments and other evaluation resources for the EETT competitive award grantees.

SERVE's work with the IMPACT schools led to the development of the Capacity for Applying Project Evaluation (CAPE) framework. The CAPE Framework is composed of three crucial components: a collection of evaluation resources; a professional development model; and a conceptual framework that guides SERVE's work to support evaluation planning and implementation in schools and districts. SERVE has continued to revise and improve these components based on feedback from participants as well as state agency collaborators. SERVE's role in the framework is one of collaborator, facilitator, and technical assistance provider. School and district teams serve as active participants in the professional development and ultimately as formative evaluators who use CAPE evaluation resources.

SERVE's work with schools to facilitate planning and implementation of their evaluation plans, as well as data from recent interviews and focus groups with past CAPE participants, led to the identification of a number of essential sources of data for effectively evaluating the implementation and impact of technology projects in schools. These data sources include staff needs assessments, student surveys, teacher reflection logs, technology use logs, classroom observations, professional development questionnaires, rubrics and scoring guides for evaluating lesson plans and student projects, and family and community partnership surveys (Knestis, Byrom, Matzen, Corn, & Thrift, in press). One instrument developed as part of this process was STNA, the focus of this study.

Schools (n=335) from across the United States used STNA to plan, implement, and evaluate their own technology programs. According to SERVE records, schools have used STNA in a variety of ways to make judgments and interpretations about their programs. Schools share findings of STNA with their school and district staff to increase buy-in of evaluation efforts, improve project implementation, and facilitate discussions around the purpose and status of the school technology program. Additionally, schools have used STNA data to support the narrative for a technology grant proposal as evidence of technology needs. Other schools have incorporated STNA data into their School Improvement Plan or Technology Plan to define priorities, plan professional development, and/or allocate resources. Finally, other schools have implemented STNA annually to track changes in the school STNA "profile" over time.

Results from two pilot studies were used to modify and improve previous versions of STNA (Corn, 2006, 2007). Based on a those results, SERVE staff implemented a careful review process where each existing STNA item was confirmed, revised, or removed; additional items were added; constructs and subconstructs were reorganized or renamed. Also, a new demographic section was added to the revised instrument, expressly for research purposes. The resulting instrument, STNA 3.0 is the focus of the current study. A sample of STNA 3.0 (see Appendix A) is available for review at http://srvlive.serve.org/Evaluation/Capacity/EvalFramework/resources/STNA.php .

STNA 3.0 is made up of 86 self-report, five-point Likert scale items. Based on the results of the pilot studies, national technology standards and best practices as recommended by research and specialists in the field of educational technology, STNA items were organized into the following 4 constructs and 12 subconstructs:

A. Supportive Environment for Technology Use
    1. Vision and Shared Leadership (7 items)
    2. Organizational Conditions (10 items)

3. Flexible Scheduling (3 items)
4. Infrastructure (5 items)
5. Staff Support (3 items)
6. Media and Software (4 items)

B. Professional Development

7. Professional Development Needs: Instruction (7 items) & Planning (8 items)
8. Professional Development Quality (7 items)

C. Use of Technology for Teaching and Learning

9. Teacher Use: Instruction (7 items) & Planning (8 items)
10. Student Use: Information and Communication Technologies (8 items)

D. Impact of Technology

11. Teaching Practices (4 items)
12. Student Outcomes (5 items)

Research Questions

The purpose of this study was to investigate the quality of STNA 3.0. Therefore, the central research question was: Is STNA a high quality instrument? The central research question can be further separated into the following five subquestions:

1. To what extent does the literature support the selection and inclusion of STNA's constructs and subconstructs?
2. To what extent do the items in STNA cluster together into factors?
3. To what extent do those factors support the validity of the existing constructs identified in STNA?
4. Are the identified factors invariant among elementary, middle, and high school staff respondents? and
5. To what extent does STNA demonstrate internal consistency reliability both across constructs and within each of the subconstructs?

The ensuing discussion describes in detail the literature relevant to the study and identified methodological procedures to address each of the research subquestions. Answering these questions will partially determine if, ultimately, STNA is a high quality instrument that provides a valuable resource to help schools and districts formatively evaluate their technology programs.

CHAPTER II

REVIEW OF LITERATURE

A review of literature relevant to the development and implementation of STNA is multifaceted in nature. Because the purpose of STNA is to provide a high quality resource to help schools and districts formatively evaluate their technology programs, it is important to understand how STNA fits into the larger context of program evaluation models. Subsequently, STNA is but one tool identified within SERVE's CAPE Evaluation Framework. Therefore, it also is imperative that the CAPE Framework be explored, as well as other technology needs surveys available to schools and districts. Additionally, the research supporting the selection and inclusion of STNA's constructs and subconstructs lies at the heart of determining the quality of the instrument itself. Finally, certain literature in the field of education that addresses needs assessment instruments as well as the use of online surveys also contributes to understanding how STNA can most effectively be utilized by educators.

Program Evaluation Models

The Joint Committee on Standards for Educational Evaluation (1994) defined program evaluation as "the systematic investigation of the worth or merit of a program" (p. 3). There are many different approaches to program evaluation, which can be organized into the following categories: 1) *objectives-oriented* approaches focus on specifying goals and objectives and determining the extent to which they have been attained; 2) *management-oriented* approaches focus on identifying and meeting the informational needs of decision-makers; 3) *consumer-oriented* approaches focus on helping consumers choose among competing products and services; 4) *expertise-oriented* approaches use professional expertise to judge the quality of program of interest; 5) *adversary-oriented* approaches focus on the opposing points of view of different evaluators; and 6) *participant-oriented* approaches involve participants in determining the values, criteria, needs, and data for the evaluation (Fitzpatrick, Sanders, & Worthen, 2003). Determining which approach to use is dependent upon a number of factors such as the evaluation's purpose and use, the evaluator's philosophy and training, and the context of the educational program.

The approach that best represents the philosophical intentions in which STNA was created is the *participant-oriented* approach. STNA involves the school and district staff in planning and implementing their evaluation. They are the ones deciding what evaluation questions to ask, which instruments to use, what data to collect, and how results should be reported. In this way, lessons about the value of the participants' involvement in the evaluation are taken from the participant-oriented approach (Fetterman, 2005a; Patton, 1997; Wandersman, Imm, Chinman, & Kaftarian, 2000). Several evaluation models, couched within the participant-oriented approach, align with this intended use of STNA in schools, including Empowerment and Utilization-Focused Evaluation.

Empowerment evaluation.

"Empowerment evaluation is the use of evaluation concepts, techniques, and findings to foster improvement and self-determination" (Fetterman, 2005b, p. 10). Building the capacity of project staff to plan and implement evaluations of their own projects is thought to increase the chance the projects will achieve results (Wandersman, 1999). Increased involvement of program stakeholders promotes buy-in for the participation in the evaluation process and confidence in the evaluation results (Cousins & Whitmore, 1998; King, 1998). In this case, STNA is an evaluative tool used by the educators in the schools, where technology projects and professional development programs are being evaluated. STNA is selected and deployed by the schools, and STNA results are used to inform project implementation.

Utilization-focused evaluation.

Utilization-focused evaluation "begins with the premise that evaluations should be judged by their utility and actual use" (p. 20, Patton, 1997). Utilization-focused evaluations are highly situational and influenced by the context in which they are conducted (Patton, 1997). Similarly, STNA was developed for individual schools to use for their own evaluative purposes. It is one part of a larger evaluation effort where its appropriateness is judged by the context. It is clear, however, that STNA is only as useful as the actions taken based on its results. In as much, SERVE staff work with STNA school site coordinators to impress upon the schools that the value of most instruments lies primarily in the use of results found.

CAPE Evaluation Framework

STNA is one instrument developed through SERVE's work with schools and districts through the CAPE Framework. The basis for the CAPE Framework—the substance—is a classic project evaluation model based on work conducted by the National Evaluation Center at Western Michigan University. This traditional model organizes evaluation around seven major functions that include 1) focusing an evaluation and clarifying its purpose; 2) designing an evaluation; 3) collecting information; 4) analyzing information; 5) reporting information; 6) managing evaluation activities; and, 7) evaluating evaluation efforts (Brinkerhoff, Brethower, Hluchyj, & Nowakoski, 1983). Each of these components is considered within the CAPE Framework. Subsequently, the CAPE Framework has evolved over time to also address the requirements of federally funded technology grant programs and to meet national program evaluation standards (Joint Committee on Evaluation Standards for Educational Evaluation, 1994). The CAPE Framework is composed of three crucial components: a collection of evaluation resources; a professional development model; and, a conceptual framework that guides SERVE's work to support evaluation planning and implementation in schools and districts.

CAPE evaluation resources.

The CAPE Evaluation Resources contain three main elements: logic maps, detailed templates showing how each project strategy and objective will be evaluated, and an evaluation management plan. During professional development sessions, teams of participants clarify their project goals, objectives, and strategies and then develop logic maps that show the connections among their goals, objectives, and strategies. A logic map provides a tool for conceptualizing the relationships between project inputs, strategies, objectives, and goals (W.K. Kellogg Foundation, 1998), thereby providing an effective means of presenting a project (Julian, Jones, & Deyo, 1995) and identifying the process and outcome goals (Coffman, 1999; Julian, 1997).

Next, participants fill in templates of charts showing how each project strategy and objective identified in their logic map will be evaluated (Frechtling, 2007). Participants identify and ask appropriate process-based implementation and outcome-based impact evaluation questions; identify methods and measures for data collection; specify benchmarks; and describe what decisions will be made based on findings (Frechtling, 2002; Royse, Thyer, Padgett, & Logan, 2006). Collectively, the templates for each objective and strategy comprise the evaluation plan. Once completed, participants review the plan in its entirety and identify a list of all the activities associated with implementing their evaluation (e.g. evaluation committee meetings, data collection, data analysis, sharing results with stakeholders). This list of evaluation activities, as well as related timeframes, persons responsible, and necessary resources make up the Evaluation Management Plan (Worthen, Sanders, & Fitzpatrick, 2004).

SERVE's work with schools and districts to develop and implement their evaluation plans using the CAPE Evaluation Resources led to the identification of a number of essential sources of data for effectively evaluating the implementation and impact of technology projects in schools. These data sources included staff needs assessments, student surveys, teacher reflection logs, technology use logs, classroom observations, professional development questionnaire, rubrics and scoring guides for evaluating lesson plans and student projects, and family and community partnership surveys (Knestis et al., in press). One instrument developed as part of this process was STNA, the focus of this study.

CAPE professional development model.

The CAPE Professional Development model is based on national standards and best practices of professional development for educators (National Staff Development Council, 2001) and is consistent with the guidelines of the Partnership for 21st Century Learning (2006b). An initial step in the model recommends working closely with state education agency (SEA) staff to determine how the CAPE Framework can best be tailored to the needs and contexts of the district and school teams. SERVE then designs a targeted evaluation support program based on those identified needs (Speck & Knipe, 2001). As shown in Figure 2, a typical CAPE professional development program begins with an intensive face-to-face event where educators work in teams, with guidance from SERVE staff (Joyce & Showers, 1995), in developing evaluation plans for their projects. This approach engenders buy-in and furthers a cohesive understanding of how the project and the evaluation work (Liberman & Miller, 1999).

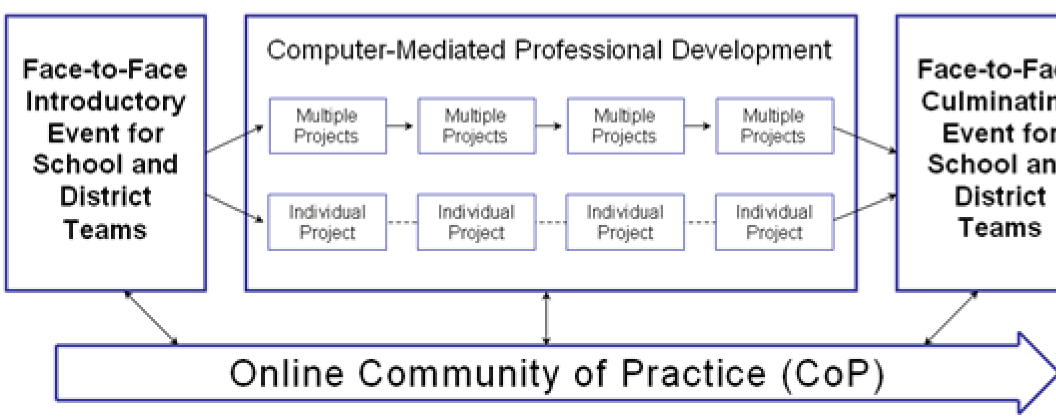

Figure 2. CAPE Professional Development Model.

The face-to-face event is followed by a variety of technical assistance services, according to the teams' progress and the nature of challenges they may encounter (National Staff Development Council, 2001). SERVE utilizes a web-based collaborative meeting environment, Computer Mediated Professional Development (CMPD) to facilitate technical assistance sessions at a distance. CMPDs are designed to provide individual project support to a single team or provide an opportunity for multiple projects teams to come together to learn from one another (McLaughlin & Talbert, 1993). SERVE uses these follow-up work sessions to review and to provide feedback to teams on their evaluation plans and provide continued technical assistance for evaluation implementation (Loucks-Horsely, Love, Stiles, Mundry, & Hewson, 2003). The CMPDs also provide an environment for the teams to acquire additional information that will help them implement their evaluations (e.g., how to manage the implementation of the evaluation, how to collect baseline data, how to maximize school buy-in and community support, how to analyze and interpret data, etc.).

Over the entire course of the training, participants are enrolled in an online Community of Practice (CoP) through which they have access to a full range of opportunities for furthering their understanding of the evaluation. These opportunities and resources include the following: linkages with others interested in project evaluation, mini-course modules, public and private file sharing, calendaring, news and article distribution, threaded discussion boards, and real-time text chats. The CoP platform utilizes Moodle, an open-source learning content management system that is supported by SERVE technology support services staff. The follow-up sessions and CoP enable participants to network and provide mutual support (Wenger, McDermott, & Synder, 2002).

Throughout the professional development process, school teams receive information and guidance about a variety of evaluative instruments they can use to measure and assess the quality of their technology programs. STNA is one of these instruments. SERVE staff introduce STNA during the initial face-to-face event, provide follow-up support about the implementation of STNA at their schools, and then may help with analysis and interpretation of STNA data during the CMPDs.

Finally, SERVE organizes a culminating event for school and district teams to share their successes, challenges, and lessons learned from their experiences evaluating their technology projects. The format of this event is coordinated with the SEA staff and can take on a number of different formats. For example, the event could be held in conjunction with a state technology conference wherein CAPE participants present at a poster or concurrent session highlighting their work, or it could be a special reception held in the participants' honor. Another option would be a separate event scheduled for the express purpose of bringing the teams together where each team has an opportunity to present and share.

CAPE conceptual framework.

Schools, districts, and state-level educational organizations are experiencing a great shift in the way they do the business of education. This shift focuses on accountability, specifically through the expectation of the effective utilization of evaluative-focused efforts to guide and support decisions about educational program implementation. Therefore, the development of the CAPE Framework, and subsequently the successful use of STNA as a tool for school-based evaluation of technology projects, is based on the research and literature on the change process, the adoption of educational innovations, and capacity building in education settings (Knestis, Byrom, Matzen, Corn, & Thrift, in preparation).

Table 1 illustrates how changes in schools are influenced by three driving forces - engaging moral purpose, understanding the change process, and building capacity (Fullan, 2005). Fullan argues that it is necessary to activate both educators' fundamental beliefs, or moral purpose, about how the innovation will ultimately benefit students and convince them to "own" the change that is required to fully implement the innovation. The awareness, acknowledgement, and emphasis of the change process that all stakeholders must go through (Fullan, 2005; Hall & Hord, 2006; Horsley & Loucks-Horsely, 1998; Rogers, 2003; Waters, Marzano, & McNulty, 2003) comprise another vital component of this conceptual frame. This notion of 'capacity building' is dependent on changes in educators' knowledge, skills, and attitudes (Guskey, 1986, 2000); the availability and utilization of relevant resources (F. Newmann, B. Smith, E. Allensworth, & A. Bryk, 2001); participation in a professional community around the innovation (Wenger et al., 2002); building a sense of unity and coherence around program (Newmann, King, & Youngs, 2001); and sharing leadership responsibilities among key players (Lambert, 2002).

Table 1

CAPE Conceptual Framework for Change in Schools

<table>
<tr><td rowspan="2">Foundation Drivers for Change in Schools (Fullan, 2005)</td><td colspan="3">1. Engaging Moral Purpose
Engaging teachers' beliefs, the need or motivation to undertake formative project evaluation (Fullan, 2005)</td></tr>
<tr><td colspan="3">2. Understanding the Change Process
Engendering ownership of evaluation work (Fullan, 2005; Hall & Hord, 2006; Horsley & Loucks-Horsely, 1998; Rogers, 2003; Waters et al., 2003)</td></tr>
<tr><td rowspan="5">Capacity for Applying Project Evaluation (CAPE)

Desired change is the adoption of formative project evaluation practices</td><td rowspan="5">3. Capacity Building
Collective and ongoing policies, strategies, resources, and other actions to increase organizational power to implement project evaluation (Newmann, King, & Youngs, 2001, as cited in Fullan, 2005).</td><td colspan="2">A. Knowledge, Skills, and Attitudes of Individuals
(Guskey, 1986, 2000)</td></tr>
<tr><td colspan="2">B. Resources – planning documents, instruments, management tools, and time</td></tr>
<tr><td rowspan="3">Shared Identity
Motivation to work together on evaluation (Fullan, 2005)</td><td>C. Professional Community
(Fullan, 2005; Wenger et al., 2002)</td></tr>
<tr><td>D. Program Coherence
(F. M. Newmann, B. Smith, E. Allensworth, & A. S. Bryk, 2001)</td></tr>
<tr><td>E. Shared Leadership
(Lambert, 2002)</td></tr>
</table>

This conceptual framework expands the traditional definition of capacity building beyond the knowledge, skills, and attitudes of individuals. Further it recognizes that the resources necessary to apply them to the desired end emphasize the importance of shared identity, professional community, program coherence, and shared leadership. This framework is limited to furthering change in terms of capacity to plan and implement formative evaluation; it might be applied to any education innovation—an idea perceived as new by an individual or group (Rogers, 2003).

Technology Needs Surveys

SETDA has compiled a database of over 225 different instruments designed to collect data on every aspect of educational technology (State Educational Technology Directors

Association, 2004). Of these, over 100 were identified as surveys/questionnaires addressing everything from attitude to usage to efficacy to technology literacy of students, teachers, and administrators. However, only a few surveys identified in the SETDA database collected data on school technology needs across a large number of areas, which could then be used for formative evaluation purposes – ultimately to make decisions about technology whole program improvement. These multifaceted surveys included enGauge Online Assessment, Texas STaR Chart, Level of Technology Implementation Questionnaire (LoTiQ), School Climate Inventory (SCI), Teacher Technology Questionnaire, Teachers' Attitudes toward Computers Questionnaire (TAC), Learning with Technology Profile Tool, and Utah Technology Awareness Project Rubrics (UTAP).

The enGauge Online Assessment was developed to collect data on district, not school-level, technology needs, and although originally funded through federal education monies, currently a fee is associated with implementation and data collection (North Central Regional Educational Laboratory, 2000). Use of Texas STaR Chart by other states, districts, and schools is not viable because the survey aligns to the Texas Long Range Plan for Technology and is copyrighted by the Texas Education Agency (Texas Education Agency, 2001, 2002). The LoTiQ Level of Technology Implementation Questionnaire, recently renamed the DETAILS for the 21st Century Questionnaire, is available at no cost for individual questionnaire results, aggregating educator data for an entire school, however, requires a fee (National Business Education Alliance, 2006). The School Climate Inventory and Teacher Technology Questionnaire were tools developed by the researchers at the

University of Memphis' Center for Research in Educational Policy as part of the Formative Evaluation Process for School Improvement (FEPSI) project and are available to schools and districts only through contracted work with the center (Center for Research in Educational Policy, n.d.). Christensen and Knezek's (1996, 2000) Teachers' Attitudes toward Computers Questionnaire (TAC) is a valid and reliable 105-item Likert instrument for measuring teachers' attitudes toward computers on seven subscales. However, the TAC only focuses on teachers' perceptions of computer importance, enjoyment, anxiety, seclusion, etc. and does not give a complete picture of technology issues at the school level, such as administrator support of technology. Finally, the Learning with Technology Profile Tool (NCRTEC, 1997) and Utah Technology Awareness Project Rubrics (Utah Education Network, 1999) are both multidimensional scales that provide data for technology planning at the school level. However, these instruments are no longer supported by the organizations that developed them. Although each of these surveys addresses a variety of technology-focused constructs, none of them are easily accessible to schools and districts.

STNA Constructs and Subconstructs

Construct validity answers the question: Does what the instrument measures translate into meaningful information about the constructs pertinent to the questions at hand (Linn & Miller, 2005)? The realm of technology in teaching and learning is thick with complex conceptual relationships and structures—constructs. If the findings are going to be couched in terms of these constructs, it must be established that the instrument is sensitive to all aspects of them and the theoretical relationships that they define.

As shown in Figure 3, STNA provides an important formative evaluation tool for collecting data on the status of school technology program strategies (i.e., status of a supportive environment for technology use and provision of high quality, targeted professional development for technology), and school technology program outcomes (i.e., appropriate technology use for teaching and learning, and changes in instructional practices and student learning). According to relevant research and professional literature, each of the constructs included in STNA is a vital component of a successful school technology program.

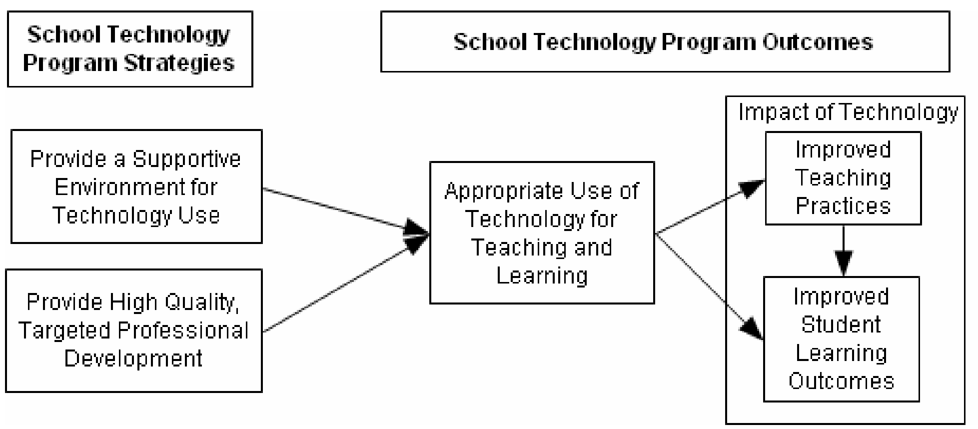

Figure 3. Logic Model of the Constructs Included in STNA.

The "Supportive Environment for Technology Use" construct primarily focuses on the level to which conditions are in place at the school to support effective technology use. These items ask if the right tools, resources, staff, opportunities, etc. are in place to enable teachers and other staff to successfully integrate technology. STNA items that assess *supportive environment for technology use* in a school setting include the following:

- Vision and Shared Leadership - administrators who effectively model and communicate a vision for technology use and support education technology innovators (Davis, Darling-Hammond, LaPointe, & Meyerson, 2005; International Society for Technology in Education, 2002; Interstate School Leaders Licensure Consortium, 1996; Lambert, 2002; Marzano, Waters, & McNulty, 2005; Stein & Gewirtzman, 2003);
- Organizational Conditions - having a stakeholder-supported long-range technology plan in place that includes an adequate budget for technology resources and provisions for evaluation of the technology program (Bradshaw, 2002; Lemke et al., 2006; November, Costello, & Huske, 1998; Office of Technology Assessment, 1995; Ringstaff & Kelley, 2002; U.S. Department of Education, 2004);
- Flexible Scheduling - library and technology resources that are flexibly scheduled to allow students and teachers maximum access to education and technology resources (Public Schools of North Carolina, 2005; Ringstaff & Kelley, 2002)
- Infrastructure - a reliable technology infrastructure that facilitates electronic communication (Culp, Honey, & Mandinach, 2003; Epstein, 2001; Otterbourg, 1998; Penuel et al., 2002)
- Staff Support - technical and instructional staff to mentor and support teachers as they integrate technology into lessons (Ertmer, Gopalakrishnan, & Ross, 2001; Hofer, Chamberlin, & Scot, 2004; McKenzie, 2002; Public Schools of North Carolina, 2005; Reilly, 1999); and,

- Media and Software - access to a wealth of electronic resources that consider both the needs of the learners and the curriculum (CEO Forum, 2001; Ertmer et al., 2001; Guha, 2001; Shelly, Cashman, Gunter, & Gunter, 2002)

The “Professional Development” construct is organized into two sections where respondents indicate level of need for specific professional development opportunities and quality of past professional development experiences. Items addressing potential professional development needs address the use of technology for both instruction and planning. These items align with items in the following section of STNA related to how often teachers use technology for both instruction and planning. Comparing response rates for these items across constructs can inform future professional development planning. The Professional Development Quality section provides a general description of the quality of the current professional development program at the school level.

STNA items that address *high quality, targeted, technology professional development* in a school setting include the provision of training for teachers targeted on effective, research-based strategies for implementing technology in the classroom (Cohen & Hill, 1998; Joyce & Showers, 1995; National Staff Development Council, 2001). The professional development program should be timely, relevant, and ongoing (Dick, Carey, & Carey, 2005; Garet, Porter, Desimone, Birman, & Yoon, 2001; Loucks-Horsely et al., 2003; Merriam, Caffarella, & Baumgartner, 2007; Speck & Knipe, 2001). Participants should have the opportunity to evaluate the professional development activities, and the impact of technology professional development should be assessed using data on classroom practice and student learning (Darling-Hammond & McLaughlin, 1996; Guskey, 2000; Killion, 2002).

The items included in the “Use of Technology for Teaching and Learning” construct examine school staff’s current use of technology for instruction and planning practices. Items included here also examine how students use information and communication technologies for learning in the classroom. Items 1-15 in this section aligns with items 1-15 in the Instruction and Planning sections from the Professional Development Needs construct.

STNA items address *the effective use of technology for teaching and learning* by focusing on teacher implementation of research-based, technology-enhanced instructional strategies in the classroom, and student use of information and communication technologies in the classroom. As a result of targeted professional development and support, teachers should be able to use strategies such as performance-based student assessments (Pendersen & Liu, 2003), evaluate technology resources (Guha, 2001; Kerrigan, 2002), collect and analyze student assessment data (CEO Forum, 2001; Fuchs & Fuchs, 2002; Sands & Buchholz, 1997), design learner-centered, differentiated teaching strategies (Jonassen, 1999; Land & Hannafin, 2000), and emphasize both content standards and student technology standards (International Society for Technology in Education, 2000b; Kanaya, Light, & Culp, 2005a; Ringstaff & Kelley, 2002).

Students’ use of information and communication technologies in the classroom includes utilization of a variety of technologies such as productivity, visualization, research, and communication tools in order to communicate and collaborate with others, access online resources, work on technology-enhanced projects that involve real-world applications, solve problems, support higher-order thinking, and create new ideas and representations of information (International Society for Technology in Education, 2000a; Partnership for 21st Century Skills, 2006a; Ringstaff & Kelley, 2002; Shelly et al., 2002).

Finally, STNA constructs include items that address the *impact of technology* use by teachers and students by focusing on *improvements in teaching practices and student learning outcomes.* The items included in this construct examine school staff's perception of the impact of technology on teaching practices and student outcomes. Examples of expected shifts include instructional practices that are student-centered and interactive, and emphasize student uses of technology for project-based or cooperative learning (Apple Computer Inc., 1995; Boethel & Dimock, 1999; Jonassen, 1999; Office of Technology Assessment, 1995; Pendersen & Liu, 2003). These changes in teacher practice will result in students who are more socially aware, confident, and positive about their future (Partnership for 21st Century Skills, 2006a); are independent learners and self-starters (Apple Computer Inc., 1995; Clements & Sarama, 2003); will work more collaboratively (Clements & Sarama, 2003; Tiene & Luft, 2001); are more engaged in their learning (Bangert-Drowns & Pyke, 2002); and, ultimately will achieve greater academic success (Brush, Armstrong, Barbrow, & Ulintz, 1999; Christmann & Badgett, 1999; Cotton, 1991; Joyce & Showers, 1995; Papanastasiou, Zemblyas, & Vrasidas, 2003; Powell, Aeby, & Carpenter-Aeby, 2003; Schacter, 1999).

The description of each these constructs is provided to help illustrate the significance of the factors included in STNA, as they relate to the implementation of a successful school technology program. However, it cannot be emphasized enough that the value of STNA lies in the use of the data collected about each of these constructs by school staff to make adjustments for technology program improvement.

Needs Assessment Instruments

Data from needs assessment surveys are intended to aid in effective decision making about educational program implementation (McKillip, 1987). In as much, STNA was specifically designed to assess the collective needs of a school staff related to the use of technology for teaching and learning, in order to make important decisions about a range of technology program areas including: environmental and contextual factors influencing technology use, the quality of professional development opportunities, and the impact of technology on classroom practice and student learning outcomes.

Research supports the use of a well-designed needs assessment to provide the essential link between staff needs and professional development opportunities, hardware and software purchases, and resource allocation (Baylor & Ritchie, 2002; CEO Forum, 2000a; Kanaya, Light, & Culp, 2005b; Kocher & Moore, 2001; Loucks-Horsely et al., 2003). Hall and Hord (2001) supported the use of needs assessments and other reliable surveys to guide decisions about change in schools and districts. Weston (2004) found that tools used to support formative evaluation efforts of educational technology projects, such as STNA, should be used to improve project design. A series of studies commissioned by SRI International in 2000 found that needs assessments and other measures of opinion should be used to collect contextual data for formative evaluation of technology-related interventions for the purpose of refining the design of the intervention (Haertel & Means, 2000). *Measuring the Impact of Technology on Classroom Teaching and Learning* (Dirr, 2004), a monograph resulting from the collaborative work among two regional technology in education consortia, state education technology directors, and leaders in the field of evaluation of education technology projects, made very specific recommendations regarding future evaluation efforts at the state and local level. One recommendation included the exploration of valid and reliable instruments, such as STNA, that any state and district could use to gather data for education technology project evaluation.

Online Surveys

Most experts agree that online surveys should adhere to sound principles of survey design and implementation, although there are specific issues and concerns that are particular to electronic assessment and data collection (Shannon, Johnson, Searcy, & Lott, 2002). These issues include sampling, access to technology, comfort level with technology and the Internet, confidentiality, and authenticity of responses (Cook, Heath, & Thompson, 2000; Dillman, Tortora, & Bowker, 2001; Fetterman, 2002; Shannon et al., 2002; Solomon, 2001).

Sampling limitations are one of the biggest concerns expressed by survey research experts about the use of electronic surveys (Shannon et al., 2002). Since STNA was designed to be used for a specific targeted population as an in-house survey; to be deployed by and within a single school to an entire staff, sampling limitations are not an issue. However, a related concern for some of the schools that have used STNA is low response rate of targeted respondents. Cook and colleagues (2000) recommend strategies to increase response rates such as follow-up contact with non-respondents, personalized contacts, and contacting the sample prior to sending out a survey. Along with these recommendations, SERVE staff have suggested other strategies such as providing time during staff meetings to complete the survey in the computer lab, providing incentives, and keeping a record of who has and who has not completed the instrument.

Another major concern raised with online surveys is respondents' access to technology and the Internet (Fetterman, 2002; Solomon, 2001). According to the National Center for Educational Statistics (2004), by 2003 99.99% of public schools in the United States had access to the Internet. Since educators deploy STNA in their schools, it can only be assumed that the schools, and therefore the targeted sample, in fact do have access to the Internet. Some researchers are concerned that respondents who are not comfortable with technology might not respond to an online survey and recommend making the online survey as simple and user-friendly as possible (Dillman et al., 2001; Shannon et al., 2002). This issue was certainly a consideration when SERVE staff designed STNA. The only technological skills required to use STNA are that respondents need to know how to open and access the Internet, go to a specific URL, and complete and submit online forms.

Concerns of confidentiality and authenticity of respondents are always present when administering electronic surveys (Shannon et al., 2002; Solomon, 2001). Fetterman (2002) recommended using a web-based survey site, like the one used to develop and deploy STNA, to develop online surveys. Usually these survey sites have the technical capability to employ necessary security measures to ensure the accuracy and authenticity of the response data.

Although demographic information is collected for the purposes of conducting research on the STNA instrument, SERVE staff decided not to include items related to demographic information in the online reports provided to schools. This decision was intended to further protect the confidentiality of respondents. If demographic information is provided to the school sites, there is the distinct possibility of being able to identify individuals.

This review of literature relevant to the development and implementation of STNA demonstrates how STNA fits into the larger context of program evaluation models and within SERVE's CAPE Evaluation Framework. A review of other technology needs surveys found them difficult to access for use by schools and districts. Additionally, the research supported the selection and inclusion of STNAs constructs and subconstructs. Finally, literature on needs assessment instruments, as well as online surveys enhanced our understanding of how STNA can most effectively be deployed in schools and districts.

CHAPTER III

RESEARCH METHOD

This chapter discusses the methodological aspects of the study, including the description of the research design, existing data set, instrument development process, analytic procedures, and strengths and weaknesses of the study design. The central research question is as follows: Is STNA a high quality instrument? The central research question can be further separated into the following five subquestions:

1. To what extent does the literature support the selection and inclusion of STNA's constructs and subconstructs?
2. To what extent do the items in STNA cluster together into factors?
3. If so, to what extent do those factors support the validity of the existing constructs identified in STNA?
4. Are the identified factors invariant among elementary, middle, and high school staff respondents? and
5. To what extent does STNA demonstrate internal consistency reliability both across constructs and within each of the subconstructs?

A correlational research design was identified to organize the study to answer the central research question about the quality of STNA. Within this research process, specific strands of psychometric inquiry align with the research subquestions. An exploratory factor analysis (EFA) was used to identify clusters of factors in STNA. A confirmatory factor analysis (CFA) was used to determine whether those factors support the reliability of the existing subconstructs identified in STNA. A comparison across elementary, middle, and high school response groups, using a multi-group CFA was used determine level of factor invariance. Finally, factors found to be stable were subjected to an internal consistency reliability analysis.

Research Design

As this study focuses on the constructs included within STNA and their relationships to one another, the appropriate research design is correlational (T. Cook & Campbell, 1979; Fraenkel & Wallen, 2003; Gall, Borg, & Gall, 1996). A correlational research design is used to study relationships between and among variables through the use of correlational statistics, such as factor analysis, and is used extensively in test construction and analysis (Gable & Wolf, 1993; Gall et al., 1996; Pett, Lackey, & Sullivan, 2003). A correlational study that simply observes the size and direction of the relationships among variables is considered a nonexperimental design or observational study approach (Shadish, Cook, & Campbell, 2002).

Often the quality of a correlational research study is determined by the depth of the rationale that guides the research design (Gall et al., 1996). In this study, a thorough literature review examining each of the constructs and subconstructs included in STNA provided the theoretical rationale that guided the statistical analysis for the study. In addition, the likelihood of obtaining important research findings in correlational research studies is greater, if the researcher uses theory and the results of previous research to select variables to be correlated with one another. The results of earlier pilot studies informed the modifications of the current version of STNA and were used to inform the statistical analyses of the existing constructs.

The principal advantage associated with correlational research studies is that the researcher is able to analyze relationships among a large number of variables in a single study (Gall et al., 1996). This notion provides strong support for use of this research design for this study, as the current version of STNA includes 86 items organized into 4 main constructs and 12 subconstructs.

Participants

This study investigated the validity and reliability of STNA 3.0, using existing data from STNA respondents from schools that implemented STNA for their formative evaluation purposes. STNA is available to schools as a free online assessment. The data are collected and reported separately and confidentially at the school level. Individual respondents are not identifiable. Schools receive data summaries, via a unique URL provided through the web-based survey site, which report the frequencies and percentages of responses to each item and bar graph representations of those values.

According to SERVE records, schools learned about STNA in a variety of ways including the SERVE website, SEA staff, local education agency (LEA) staff, and professional development sessions facilitated by SERVE staff at local, regional, and state conferences. A school interested in implementing STNA would contact SERVE staff to initialize a STNA administration for their school. School contacts were encouraged to deploy STNA strategically to get the best possible response rate to ensure that the data collected represented an accurate picture of each school as a whole (Fink, 1995). The confidentiality of respondents is emphasized to promote honesty of responses from school staff (Linn & Miller, 2005). SERVE staff worked with school staff to determine opening and closing dates for STNA during which time the school staff responded to STNA using a specific URL. Once STNA was "closed," the school was sent a report showing frequency data, aggregated to the school level for each item with a corresponding bar graph visually depicting the frequency count. Since it was first launched in May of 2005, schools from all over the United States have used STNA to gather needs data from their staff to inform technology decisions for the school.

As of July 2007, the data set for STNA 3.0 used for this study responses included 1918 surveys from 49 schools in North Carolina. The school sites were made up of 32 elementary schools (65.3%), 9 middle schools (18.4%), and 8 high schools (16.3%). See Table 2 for detailed demographic information of the study's response set.

Table 2

Demographic Data for Existing Response Set

Item	Frequency (Percent)							n
Years of Experience	>10 881 (54.2)	11-20 407 (25.1)	21-30 286 (17.6)	31-40 48 (2.9)	41-50 2 (0.1)			1624
Role	Administrator 55 (2.9)	Teacher 1425 (75)	Media 42 (2.2)	Technology 17 (.09)	TA 259 (13.6)	Other[a] 101 (5.3)		1900
Grade	Elementary 1147 (59.8)	Middle 350 (18.3)	High 421 (21.9)					1918
Ethnicity[b]	AI/AN 22 (1.2)	Asian 2 (0.1)	Af-Am 65 (3.5)	NH/PI 2 (0.1)	White 1770 (94)	Hispanic 8 (0.4)	Multi 14 (0.7)	1883
Gender	Female 1600 (84.8)	Male 287 (15.2)						1887
Home Internet Access	None 221 (11.6)	Dial-up 424 (22.3)	Broadband 1254 (66)					1899

Note. Although n=1918, demographic items were optional and missing responses were not included in the analysis.

[a] Examples of "Other" are counselor, school nurse, student teacher, receptionist, literacy/curriculum coordinator, and so forth.

[b] Ethnicity Abbreviations: AI/AN = American Indian/Alaska Native; Af-Am = Black or African American; NH/PI = Native Hawaiian or Other Pacific Islander; Multi = Multi-Racial Selection.

Instrument Development Process

SERVE staff used national technology standards and best practices as recommended by research and specialists in the field of educational technology when determining the constructs and writing items for the beta version of STNA (CEO Forum, 2000b; International Society for Technology in Education, 2000a, 2000b, 2002; Milken Exchange, 1998; National Staff Development Council, 2001; North Central Regional Educational Laboratory, 2000; Public Schools of North Carolina, 2005). Content analysis techniques, a common practice in qualitative research, were employed to organize, code, identify patterns, and synthesize the large amount of text-based data from the professional literature on technology in education (Bogdan & Biklen, 2007). In order to keep a record of which standards related to which constructs and items, SERVE staff developed an item reference matrix (see Appendix B), which was updated as the instrument was revised.

The beta version of STNA was piloted at one of the IMPACT model schools. SERVE staff held an information session with school administrators about the purpose and possible uses of the data collected using STNA. School staff (n=70) took the online needs assessment in the computer lab at the school while SERVE staff members were present. This provided an opportunity for SERVE staff to address any technical issues and observe how recommended administration and deployment procedures actually worked in a school setting. A report was provided to the school that included the data presented in frequencies and a short interpretative review of the responses. SERVE staff then conducted a focus group with a sample of the school staff (n=10) who participated in the STNA beta pilot. The focus group covered topics such as recommended procedures for implementation in other schools, clarity of individual items, cohesion of the instrument, and value of the information provided in the data. Adjustments were made to the instrument based on information gathered through the SERVE staff observations and focus group to create STNA version 1.0. Some of the resulting changes included splitting one item into three separate items, replacing "?" with "Do Not Know" on the response scale, and expanding the instrument's directions to provide additional information to respondents.

STNA 1.0 was then reviewed by six experts, both in the fields of educational technology and educational evaluation. Educational technology experts included state directors and other staff in instructional technology divisions at the state departments of education in two southeastern states. Educational evaluation experts included staff in the Evaluation Program at the SERVE Center at UNCG, and an external evaluator hired under contract from the Evaluation Center at Western Michigan University. Based on feedback from these expert reviews, STNA was updated to reflect many of their recommendations. These updates included a change to the response scale for the *Professional Development – Participation* section from the Likert scale to a dichotomous "Yes-No" scale, and three questions were shifted to a different section of the instrument. The resulting version of

STNA, 2.0, was made available to the public through the SERVE website and was housed on a server on Key Survey (http://www.keysurvey.com), a web survey site.

Two pilot studies were conducted to investigate the validity and reliability of the STNA 2.0. The first study, using data from 2094 respondents from 48 schools in North Carolina, determined estimates of internal consistency reliability. Data analyses showed each of STNA constructs and subconstructs to have high internal consistency reliability, where alpha ranged from .807 to .967 (Corn, 2006). The second study, using a randomly selected sample of responses from 105 schools across the United States (n=2050), included an exploratory factor analysis that largely supported the reliability and validity of the constructs and subconstructs included in STNA 2.0 (Corn, 2007).

Findings from these pilot studies were used to modify and improve STNA. Item distributions, calculated for the initial pilot study, were used to identify items that might need to be revised. Items were reviewed if any of the following criteria were met: only one literature source was cited, the standard deviation of the item distribution was above or below one, or “Do Not Know” responses fell more than one standard deviation above the mean. In all cases, items were confirmed, revised, or removed.

Results from the exploratory factor analysis, conducted as part of the second pilot study, were used to verify the constructs and subconstructs included in STNA and assess whether different items on the survey belong together on one scale. The results revealed 13 factors within an eigenvalue greater than one, accounting for 62.32% of the total variance.

The factor loadings are reported in Table 3, which show the unique associations between each factor and the measured items, controlling for all other items.

Table 3

Pilot Test Factor Loadings for STNA 2.0 Items

	Factor (n=2050)												
Item	1	2	3	4	5	6	7	8	9	10	11	12	13
techplan13	0.94												
techplan12	0.92												
techplan14	0.88												
techplan8	0.78												
techplan7	0.77												
techplan6	0.72												
techplan11	0.59												
techplan9	0.53												
techplan10	0.52												
community32	0.41				0.31								
vision2	0.38							0.33					
instruct7		0.81											
instruct8		0.72											
instruct9		0.61											
instruct10		0.61											
instruct2		0.59											
instruct4		0.53											
instruct6		0.53											
instruct1		0.53											
instruct5		0.44											0.38
tools8			0.87										
tools6			0.83										
tools7			0.82										
tools5			0.81										
tools3			0.76										
tools4			0.66										

Table 3 (continued).

	Factor (n=2050)												
Item	1	2	3	4	5	6	7	8	9	10	11	12	13
tools1			0.62										
tools2			0.60										
student6				0.91									
student9				0.91									
student8				0.91									
student7				0.83									
student5				0.78									
pdopps5					0.76								
pdopps6					0.75								
pdopps4					0.72								
pdopps7					0.62								
pdopps3					0.59								
pdopps2					0.54								
pdopps9					0.41								
pdopps8					0.41								
risk16					0.40								
community31	0.34				0.39								
pdopps1						0.37							
pdpart2						0.73							
pdpart4						0.73							
pdpart1						0.70							
pdpart6						0.70							
pdpart3						0.69							
pdpart5						0.52							
pdpart7						0.31							
infra26							0.80						
infra25							0.68						
infra24							0.64						
infra23							0.41					0.36	
vision5								0.79					
vision4								0.68					

Table 3 (continued).

Item	Factor (n=2050) 1	2	3	4	5	6	7	8	9	10	11	12	13
vision3								0.66					
vision1	0.33							0.45					
risk15								0.33					
teaching2									0.88				
teaching4									0.85				
teaching3									0.85				
teaching1									0.67				
risk18										0.79			
risk17										0.74			
risk19										0.38			
resource29											0.79		
resource28											0.71		
resource27											0.59		
resource30											0.53		
infra21												0.66	
infra22												0.60	
infra20												0.39	
planning2													0.66
planning1													0.54
planning3		0.38											0.51
instruct3		0.40											0.47

All factors were readily interpretable. Factor One consisted mainly of the *Organizational Conditions for Technology Use:* technology planning, budgeting, and evaluation. Factor Two captured *Instruction* - how teachers incorporate technology into their instruction. Factor Three was labeled *Information and Communication Technologies*, because the items that loaded on this factor address students' use of technology as a tool to learn, think critically, solve problems, use information, communicate, innovate, and collaborate (Partnership for 21st Century Skills, 2006a). Factor Four consisted of *Student Outcomes*, or the intended objectives for students in schools where technology is used effectively. Factor Five included items that addressed technology *Professional Development Opportunities* for persons in the school, and Factor Six spoke to respondents' *Professional Development Participation*. Items loading on Factor Seven related to access to adequate technical and instructional technology for *Staff Support*. The items in Factor Eight were collectively called *Vision and Shared Leadership* as they dealt with a clear vision and administrative support for technology use. Factor Nine encompassed *Teaching Practices* or intended impacts on teachers in schools where technology is used effectively. Factor Ten was one of the new constructs identified. The items in this factor specifically addressed the issue of *Flexible Scheduling* of the media center, computer lab, and mobile computers. Access to *Media and Software* resources is collectively addressed in Factor Eleven. Factor Twelve focused on the current status of the school's technology *Infrastructure* – hardware, networks, connectivity, etc. Lastly, Factor Thirteen spoke to teachers use of technology for *Planning* purposes.

Ten of the 13 of the factors were largely the same constructs initially identified for STNA. A few items loaded on new factors unexpectedly. For example, STNA included a construct called Community Linkages, but the results of the data analysis indicated that these items loaded higher on *Vision and Leadership* (Factor Eight). Additionally, the results indicated that some constructs would be better split into two different factors. For example, originally STNA included a section on Technical Infrastructure and Support, whereas the factor analysis revealed this construct should be broken into two separate areas – described previously as *Staff Support* and *Infrastructure.* Additionally, the section focusing on professional development completely revised into two sections focusing on *Professional Development Needs* and *Quality of Previous Professional Development*.

Based on the result of this EFA, the following revisions were done: a few subconstructs were reordered and regrouped, some constructs and subconstructs were renamed for clarity, IMPACT-specific {Public Schools of North Carolina, 2005 #72} items were grouped together, and professional development construct was collapsed into two sub-sections which allowed for the elimination of the "Yes-No-Do Not Know" response set. Items within the professional development and classroom practices sections were aligned to provide cross-construct comparisons. Consequently, 12 factors emerged based on the results of the EFA and subsequent revision to STNA.

Items

SERVE staff developed the constructs and items included in STNA based on nationally recognized standards and best practices in the field of educational technology using a content analysis technique. These standards and practices included the enGauge framework, STaR Chart, National Education Technology Standards for students, teachers, and administrators, National Staff Development Council Standards for staff development, IMPACT Guidelines, and Seven Dimensions for Gauging Progress guide.

Developed by NCREL with the Metiri Group, the enGauge framework provides a comprehensive view of critical factors in an educational system that strongly influence the effectiveness of educational technology. enGauge is a Web-based framework and set of tools designed to help schools and districts use technology effectively for learning, teaching, and managing. The enGauge framework identifies Six Essential Conditions, system (district) wide factors critical to effective uses of technology for student learning (Lemke, 2002; North Central Regional Educational Laboratory, 2000).

Developed by CEO Forum on Education and Technology, the STaR Chart identifies and defines four school profiles ranging from the "Early Tech" school with little or no technology to the "Target Tech" school that provides a model for the integration and innovative use of education technology. The STaR Chart is not intended to be a measure of any particular school's technology and readiness but rather to serve a benchmark against which every school can assess and track its own progress (CEO Forum, 2000b).

The National Educational Technology Standards (NETS) Project is an ongoing initiative of the International Society for Technology in Education (ISTE). This project has resulted in nationally recognized and supported technology standards, assessments, and conditions for students, teachers, and administrators that facilitate the use of technology to support student learning. (International Society for Technology in Education, 2000a, 2000b, 2002). According to their website, “more than 90 percent of U.S. states adopted, adapted, or referenced ISTE's NETS in state department of education documents” (International Society for Technology in Education, 2006, p. 1).

The National Staff Development Council (NSDC) is a well-known source of research-based standards for the development and design of quality professional development programs for educators. The NSDC developed 12 standards for staff development to improve the learning of all students. These standards were organized by Sparks (1983) into context/process/content schema. The *context standards* are the organization, system, and culture in which in the new staff development program will be implemented. The *process standards* refer to the methods learners use to acquire new skills and knowledge. The *content standards* are the new skills and knowledge that learners must know and be able to do through participation in the staff development program. The context, process, and content standards are interdependent on one another to successfully meet the goal of a quality staff development program - improving student learning (National Staff Development Council, 2001).

IMPACT: Guidelines for Media and Technology Programs is a document that provides the set of standards used by North Carolina school districts to develop and maintain quality library media and instructional technology programs. IMPACT is aligned to current research in both school library media and in instructional technology. IMPACT guidelines address teaching and learning, information access and delivery, program administration, system-level guidelines, and research and evaluation (North Carolina Department of Public Instruction, 2003a).

The Milken Exchange developed the Seven Dimensions for Gauging Progress, intended for policymakers, educators, and technology directors to use as a road map when attempting to increase the learning levels of students through technology. It describes the conditions that should be in place for technology to be used to its greatest educational advantage in any classroom. The Seven Dimensions also provides educators with ways to assess movement toward their goals for learning with technology through sets of questions and stages of progress (Milken Exchange, 1998).

A matrix was developed to illustrate how these standards and best practices specifically relate to items included in STNA (see Appendix B). The reference matrices for each of the constructs included in STNA provide support for the construct validity of the instrument. Construct validity addresses how well the instrument adequately represents the intended construct, and how well performance on the assessment can be interpreted as a meaningful measure of quality. Each item is linked to at least one national standard or best practice. Items are grouped into subconstructs within constructs based on those standards and best practices.

Procedure

The researcher analyzed existing STNA data for this study to determine factor stability and internal consistency reliability of the constructs and subconstructs of the revised instrument. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were used to analyze the reliability and stability of STNA's existing constructs (Byrne, 2001; Gable & Wolf, 1993; Pett et al., 2003). If STNA's existing constructs and subconstructs are determined to be stable, STNA responses will then be analyzed collectively to determine the internal consistency reliability (calculated by Cronbach's α) both across constructs and within each of the subconstructs.

Data Analysis

Both exploratory and confirmatory factor analysis are statistical methods used to better understand the underlying components of a complex instrument or measure. Both types of analysis summarize and uncover patterns in a set of multivariate data, reducing the complexity of the data by combining variables that are moderately or highly related (Gall et al., 1996; Landau & Everitt, 2004). These statistical procedures involve a search for clusters of variables that are correlated with each other. The result is a listing of factor loadings that identify items or variables that relate to major concepts contained within a scale (Royse et al., 2006). A factor analysis provides a way to systematically reduce the complexity of survey items into a more parsimonious representation of the underlying dimensions. This analysis is considered a data reduction technique, because the number of underlying factors is often considerably smaller than the number of measures or items (Green, Salkind, & Akey, 2000).

These two types of analysis share some characteristics. The one assumption associated with factor analysis is that the measured variables are linearly related to the factors (Green et al., 2000). Both procedures require a robust sample size (preferably $n>100$). Both procedures use only reliable shared variance of the items or measured variables. Often, these methods are used to contribute to the evaluation of the psychometric quality of a measure, such as providing support for the reliability and validity of an instrument (Green et al., 2000; Royse et al., 2006). Factor analysis has three common applications, which are defining indicators of constructs, defining dimensions for an existing measure, and selecting items to be included on a measure (Green et al., 2000).

Specifically, an EFA is concerned with whether the covariances or correlations between a set of observed variables or items can be explained in terms of a smaller number of unobservable constructs known as common factors (Landau & Everitt, 2004). Two stages are identified for conducting an EFA. Stage one entails the *factor extraction*, which is when an initial decision is made about the number of factors underlying a set of measured variables and whether the factors are likely unrelated (orthogonal solutions) or correlated (oblique solutions). Stage two includes the *factor rotation*, where researchers statistically manipulate the results to make the factors more interpretable and make a final judgment about numbers of factors (Green et al., 2000; Landau & Everitt, 2004). All data analysis can be performed using SPSS, a statistical software package. Using the output results from SPSS, four separate criteria are used by the researcher to identify the number of underlying dimensions or factors. These criteria include preconceived conceptual beliefs based on past research or theory, absolute (greater-than-one) and relative (scree plot) magnitude of the eigenvalues, and interpretability of rotated solutions (Green et al., 2000).

The CFA allows the researcher to test and confirm a hypothesis about the existence of a specific factor structure. Using the AMOS program, a software package specifically designed to conduct confirmatory factor analysis and test structural equation models, the researcher can draw a model depicting the hypothesized relationships between the variables and the factors (Byrne, 2001). The AMOS program determines how well that hypothesized model fits the actual model based on correlation matrices. AMOS conducts a formal test of the hypothesized model and uses a chi-square goodness of fit test as well as other fit indices to determine whether the proposed model successfully reproduced the pattern of covariation in the set of variables.

The major limitation of the EFA is that the methods are descriptive, not inferential, in nature. Since no formal method exists to test a statistical hypothesis or report statistical significance, there are no definitive right or wrong answers. As stated previously, there are recognized criteria used by researchers to guide the identification of the underlying dimensions or factors, however there is no absolute way to determine how many factors really exist. This limitation, however, can be addressed by strict adherence to theory and research to support decisions based on the results of an EFA.

The CFA does include a formal statistical test. Unfortunately, chi-square is not a good fit index, because it is greatly affected by the following factors: sample size - where large samples are more likely to produce significant results; model size – where models with more variables tend to have larger chi-squares; and the distribution of variables. Therefore, many researchers tend to use and report a combination of relative (IFI, TLI, NNFI, NFI), parsimonious (PGFI, PNFI, PNFI2), and confirmatory (RMSEA) fit indices, in addition to the absolute fit index, the chi-square test. This lack of uniformity in determining quality of fit of the hypothesized model leads to a certain level of inconsistency among researchers utilizing this specific statistical procedure.

The decision to use either the EFA or CFA is really based on the research question. If the researcher is interested in determining the underlying factors in a measure, then the EFA would be the appropriate method. However, if the researcher already has some knowledge of the number and relationships of the underlying constructs and wants to test that theory, then the CFA would be the appropriate test. The EFA and CFA can be used separately or in succession, meaning a researcher could conduct a EFA on half of the data and then use those results to conduct a CFA on the remaining data set (Pett et al., 2003), a process appropriate for the purposes of this study, based on the research questions at hand.

A factor analysis is one way to investigate the reliability of the constructs included in an instrument (Byrne, 2001; Green et al., 2000; Pett et al., 2003; Royse et al., 2006). In order to understand how the items in STNA are clustering into constructs or factors, both methods of factor analysis could be performed on existing data from schools. Approximately, 1900 responses to STNA were collected for this study. In order to utilize both factor analysis methods, the existing responses were randomly split into two different sets. Both data sets ($n \geq 950$) met the robust sample size condition for factor analysis. Splitting the existing set is required because factor analysis is highly influenced by the data. It would not be appropriate to run both types of analysis on the same set of data.

For the purposes of this study, initially an EFA was run on one set of the data using a promax, oblique rotation (to allow the factors to be correlated), because it was expected that all the constructs, each addressing some component of technology in educational settings, would be related to one another. Based on the current format of STNA, a 12-factor structure was explored. The criteria described previously, such as eigenvalues and percent variation explained, were used to identify the existing factors in STNA. The results of that EFA analysis were then used to develop a testable pattern of factor loadings for a CFA. Results of the CFA provide a formal statistical test supporting or refuting the existence of the hypothesized factor structure for STNA.

In order to determine if the factor structure identified using the initial CFA was equivalent across sample sub-groups defined by school-level, a multigroup model was tested using data from the elementary, middle, and high school STNA response sets. A series of nested, three-group models with increasing parameter equality constraints between the groups was estimated, providing an increasingly restrictive test of factor invariance (Byrne, 2001; Thompson, 2004). The following list describes the order in which the parameters were set for analysis, as described by Meredith (Allaire, Gamaldo, & Whitfield, 2007; 1993), as was appropriate for the purposes of this study:

- Configural invariance - no parameters are set to equality;
- Factorial invariance – parameter estimates for the factor loadings are constrained to be equal across groups.

Factors shown to be invariant were subject to an analysis of the internal consistency reliability of subconstructs. Internal consistency reliability is the extent to which different items within the instrument measure similar constructs or characteristics (Linn & Miller, 2005). For the purposes of examining internal consistency reliability, the existing participant responses to the online instrument were downloaded into Excel spreadsheets, and then the

SPSS statistical software package, was used to analyze the survey data. As is common practice for analysis of Likert scale instruments, "Do Not Know" responses were coded as missing data and therefore excluded from the reliability analyses (Dillman, 1999).

Strengths and Weaknesses of the Study Design

Although this study is not classified as an experimental design study, certain threats can still jeopardize the validity of research and subsequent results. These factors can threaten both internal and external validity. The internal validity of the research design is the extent to which the effect of extraneous variables are reduced or eliminated in order to better examine the cause-effect relationship between the independent and dependent variables. The external validity of the research design is the extent to which the findings of an experiment can be generalized to individuals and setting beyond those studied (Campbell & Stanley, 1963; Gall et al., 1996). For the purposes of this study, the major threats include self-report survey concerns, selection issues, and limitations of selected statistical procedures.

A threat to the internal validity of this study is the fact that STNA is a self-report survey. A self-report survey assumes that individuals are willing and able to report accurately and honestly (Linn & Miller, 2005). Comfort level with technology and the Internet, and expectations of confidentiality might affect individuals' willingness and ability to respond accurately and honestly. However, only a minimum technology skill level is required to successfully respond to the items included in STNA. Respondents only need to know how to open and access the Internet, go to a specific URL, and complete and submit online forms. In addition, measures to protect confidentiality of respondents were used, such as housing the survey on a secure web survey site and emphasizing in the directions for deploying STNA the value of honest responses for planning purposes not for assessing teacher performance.

Lack of random sampling could be a threat to the external validity of this study. Pre-existing data from schools and districts that implemented STNA will be analyzed for the purposes of this study; therefore, random assignment was not a possibility. However, fears of a non-representative sample are less because of the large sample size. In addition, data about respondents' professional profile (years of experience, current grade level, etc.) and demographic information (race, gender, etc.) were collected to compare with national and state school-based educator populations.

There also are concerns about low response rate within schools introducing error and bias into the data aggregated at the school level. Cook and colleagues (2000) recommended strategies to increase response rates, such as follow-up contact with non-respondents, personalized contacts, and contacting the sample prior to sending out a survey. Along with these recommendations, a list of other STNA implementation strategies were provided to each school, such as providing time during staff meetings to complete the survey in the computer lab and providing incentives.

Finally, some of the selected statistical procedures have limitations. The exploratory factor analysis uses methods that are descriptive, not inferential, in nature. Therefore, recognized criteria will be used to guide the identification of the underlying dimensions or factors with strict adherence to theory and research to support decisions. Another concern is the confirmatory factor analysis uses the ratio of degrees of freedom to chi-square fit index as the formal statistical test, which is highly affected by a large sample size and complex model size. Therefore, a combination of relative (IFI, TLI, NNFI, NFI), parsimonious (PGFI, PNFI, PNFI2), and confirmatory (RMSEA) fit indices, in addition to the chi-square test will be reported (Gable & Wolf, 1993; Pett et al., 2003).

CHAPTER IV

RESEARCH FINDINGS

Participants

As described in a previous chapter, the existing data set for STNA 3.0 included responses to 1918 surveys from 49 schools in North Carolina. The school sites were made up of 32 elementary schools (65.3%), 9 middle schools (18.4%), and 8 high schools (16.3%). See Table 4 for detailed demographic information of the existing response set.

Table 4

Demographic Data for Existing Response Set

Survey Item	Frequency (Percent)						n
Years of Experience	0-10	11-20	21-30	31-40	41-50		1407
	736 (52.3)	372 (26.4)	251 (17.8)	46 (3.3)	2 (0.1)		
Role[a]	Administrator	Teacher	Media	Technology	Other[b]		1642
	55 (3.3)	1425 (86.8)	42 (2.5)	17 (1.0)	101 (6.2)		
Grade	Elementary	Middle	High				1918
	1147 (59.8)	350 (18.3)	421 (21.9)				
Ethnicity[c]	AI/AN	Asian/PI	Af-Am	White	Hispanic	Multi	1642
	21 (.01)	4 (.002)	56 (3.4)	1547 (94.2)	6 (.003)	8 (.004)	
Gender	Female	Male					1642
	1355 (82.5)	287 (17.5)					
Home Internet Access	None	Dial-up	Broadband				1899
	221 (11.6)	424 (22.3)	1254 (66.0)				

Note. Although n=1918, demographic items were optional and missing responses were not included in the analysis.

[a]Teaching Assistants were removed from this analysis in order to compare our sample to the population of certified North Carolina educators provided by the North Carolina Department of Public Instruction.

[b]Examples of "Other" are counselor, school nurse, student teacher, receptionist, literacy/curriculum coordinator, and so forth.

[c] Ethnicity Abbreviations: AI/AN = American Indian/Alaska Native; Asian/PI = Asian or Other Pacific Islander Af-Am = Black or African American; Multi = Multi-Racial Selection.

This sample was compared to a database of all North Carolina certified educators provided by the North Carolina Department of Public Instruction for the following factors: years of experience, role, grade, ethnicity, and gender (M. Cash, personal communication, January 18, 2008). A summary of this data appears in Table 5.

Table 5

Demographic Data for Certified North Carolina School-Level Educators

Survey Item	Frequency (Percent)						N
Years of Experience	0-10 54,911 (47.4)	11-20 30,819 (26.8)	21-30 21,240 (18.5)	31-40 7,813 (6.8)	41-50 231 (0.2)		115,014
Role	Administrator 5,364 (4.4)	Teacher 100,383 (82.0)	Media 2,418 (2.0)	Technology NA	Other[a] 14,200 (11.6)		117,248
Grade	Elementary 44,921 (46.4)		Middle 21,863 (22.6)		High 30,016 (31.0)		96,800
Ethnicity[b]	AI/AN 1,058 (0.9)	Asian/PI 628 (0.5)	Af-Am 16,880 (14.8)	White 93,264 (81.5)	Hispanic 1,575 (1.4)	Multi 1,026 (0.9)	114,431
Gender	Female 92,437 (80.1)			Male 23,037 (19.9)			115,474

[a]Examples of “Other” are counselor, school nurse, student teacher, receptionist, literacy/curriculum coordinator, and so forth.

[b] Ethnicity Abbreviations: AI/AN = American Indian/Alaska Native; Asian/PI = Asian or Other Pacific Islander Af-Am = Black or African American; Multi = Multi-Racial Selection.

SPSS was used to determine if there was a significant difference between the percentages found for the study sample and the state’s population of educators for each demographic factor. Results of Chi-Square tests, shown in Table 6, revealed that the STNA sample was not statistically different than the population of North Carolina certified educators, except for the ethnicity factor. Compared to the population of certified North Carolina educators, there were a higher percentage of White educators and a lower percentage of minority educators including Asian/Other Pacific Islander, Black/African American, Hispanic, and multi-racial respondents in the study sample.

Table 6

Results of Chi Square Tests to Determine Representativeness of Study Sample to North Carolina Educators

Demographic Factor	X^2	P-Value
Experience	3.88	0.42
Type	2.49	0.48
Grade	3.99	0.14
Ethnicity	12.74	0.03*
Gender	0.16	0.69

*p<.05

The North Carolina Department of Public Instruction does not collect data on educators' access to the internet at home. In order to compare the STNA sample to a larger population, a national survey about home internet use conducted by Pew Research Associates was identified. A greater percentage of STNA respondents reported having home internet access when compared to a national sample (Horrigan & Smith, 2007). The national study found 47% of all adult Americans have a broadband connection at home, compared with 66% of our educator respondents. The report indicated that 15% of all adult Americans have dial-up access, compared with 22% of our respondents. Finally, 29% of adult Americans indicated they did not use the internet at home, compared with 11.6% of this sample. These results support the notion that adults with higher levels of education are more likely to have access to the internet at home than those with lower levels of educational attainment. As certified educators working in North Carolina schools, all respondents are expected to have at least a college degree.

Item Analysis

The descriptive statistics (mean and standard deviation) for each item included in STNA can provide important pieces of information regarding the variability of the scores (Gall et al., 1996). Table 7 presents number of respondents, total mean, total standard deviation, and percent of "Do Not Know" responses for each item included in STNA (N = 1918), as well as group means and standard deviations for elementary, middle, and high school respondents. All items in STNA included a five-point Likert scale, plus "Do Not Know" response options. The response scale for items in the Supportive Environment for Technology Use and Professional Development constructs, as well as, items in the Impact of Technology subconstruct, was (1) Strongly Agree; (2) Agree; (3) Neither Agree Nor Disagree; (4) Disagree; (5) Strongly Disagree. Whereas, a (1) Daily; (2) Weekly; (3) Monthly; (4) Once Per Grading Period; (5) Never response scale was provided for items in the Teacher Use: Instruction and Planning and Student Use: Information and Communication Technologies subconstructs. "Do Not Know" responses were coded as missing data and therefore not included in the calculations for mean and standard deviations for each item.

Table 7

Descriptive Statistics for STNA Items (N=1918)

Item #	*n*	*Total M*	*es M*[b]	*ms M*[b]	*hs M*[b]	*Total SD*	*es SD*[c]	*ms SD*[c]	*hs SD*[c]	*DNK*[d]
Supportive Environment for Technology Use										
Vision and Shared Leadership										
1.	1794	2.06	2.03	2.00	2.21	0.92	0.89	0.94	0.95	6.5
2.	1735	2.41	2.35	2.39	2.62	1.00	0.99	1.00	0.99	2.1
3.	1877	2.14	2.06	2.25	2.29	0.96	0.93	1.08	0.92	3.5
4.	1850	1.83	1.84	1.74	1.86	0.74	0.73	0.75	0.77	20.2
5.	1531	2.76	2.79	2.58	2.83	1.21	1.20	1.27	1.19	16.2
6.	1607	2.68	2.69	2.55	2.76	1.10	1.11	1.11	1.05	28.1
7.	1379	2.41	2.34	2.43	2.58	0.93	0.89	1.00	0.98	6.5
Organizational Conditions										
8.	1619	2.11	2.08	1.99	2.29	0.91	0.88	0.94	0.95	15.6
9.	1618	2.23	2.19	2.14	2.41	0.96	0.93	1.00	1.02	9.5
10	1421	2.16	2.12	2.12	2.29	0.93	0.90	1.00	0.92	25.9
11.	1707	2.07	2.05	1.99	2.20	0.83	0.82	0.84	0.83	11.0
12.	1477	3.19	3.14	3.17	3.34	1.22	1.22	1.29	1.16	23.0
13.	1513	3.32	3.29	3.22	3.47	1.23	1.23	1.30	1.17	21.1
14.	1500	2.46	2.47	2.30	2.58	1.04	1.05	1.06	1.00	21.8
15.	1480	2.44	2.39	2.40	2.62	0.96	0.92	1.04	0.99	22.8
16.	1842	2.09	2.05	2.08	2.20	0.86	0.84	0.91	0.87	4.0
17.	1783	2.18	2.12	2.20	2.33	0.90	0.86	0.99	0.90	7.0
Flexible Scheduling										
18.	1881	2.17	2.29	1.94	2.06	1.08	1.10	1.05	1.02	1.7
19.[a]	1870	2.22	2.23	2.22	2.18	1.10	1.05	1.24	1.09	1.5
20.[a]	1557	2.54	2.44	2.65	2.76	1.17	1.13	1.19	1.21	9.0
Infrastructure										
21.	1896	3.01	2.92	3.09	3.17	1.27	1.28	1.26	1.25	0.9
22.	1888	2.13	2.08	2.20	2.19	0.95	0.92	1.03	0.98	1.1
23.	1857	2.21	2.18	2.24	2.27	0.92	0.92	0.94	0.90	2.8
24.	1863	2.40	2.41	2.34	2.40	1.12	1.14	1.10	1.07	2.3
25.	1451	2.40	2.44	2.33	2.37	1.02	1.01	0.98	1.07	23.8
Staff Support										
26.	1857	2.56	2.59	2.44	2.59	1.13	1.15	1.10	1.08	3.2
27.	1879	2.45	2.59	2.14	2.29	1.16	1.20	1.05	1.08	2.0

Table 7 (continued).

Item #	*n*	*Total M*	*es M*[b]	*ms M*[b]	*hs M*[b]	*Total SD*	*es SD*[c]	*ms SD*[c]	*hs SD*[c]	*DNK*[d]
28.	1858	2.84	2.93	2.67	2.73	1.29	1.30	1.28	1.25	3.1
Media and Software										
29.	1848	2.24	2.23	2.14	2.35	0.97	0.98	0.93	0.99	3.6
30.	1742	2.31	2.29	2.29	2.38	0.95	0.95	0.94	0.98	9.2
31.	1853	2.26	2.30	2.16	2.27	0.96	0.97	0.88	0.97	3.4
32.	1799	1.92	1.92	1.83	1.99	0.73	0.73	0.70	0.75	6.2
Professional Development										
Needs										
1.	1866	2.11	2.08	2.08	2.22	0.80	0.77	0.80	0.88	2.7
2.	1891	1.98	1.97	1.96	2.04	0.76	0.74	0.78	0.77	1.4
3.	1847	2.13	2.15	2.01	2.18	0.82	0.82	0.78	0.84	3.7
4.	1859	2.11	2.12	2.01	2.14	0.82	0.82	0.77	0.85	3.1
5.	1863	1.94	1.93	1.89	2.02	0.72	0.70	0.73	0.74	2.9
6.	1874	2.18	2.19	2.06	2.25	0.93	0.93	0.89	0.94	2.3
7.	1864	1.88	1.87	1.80	1.97	0.73	0.72	0.72	0.78	2.8
8.	1902	1.93	1.95	1.88	1.92	0.76	0.75	0.83	0.75	0.8
9.	1896	2.10	2.13	2.01	2.09	0.83	0.82	0.86	0.83	1.1
10.	1899	2.15	2.18	2.04	2.16	0.86	0.86	0.85	0.87	1.0
11.	1865	2.10	2.10	1.98	2.19	0.84	0.83	0.82	0.88	2.8
12.	1860	2.09	2.11	1.96	2.17	0.82	0.81	0.79	0.86	3.0
13.	1854	2.24	2.26	2.14	2.28	0.89	0.88	0.89	0.91	3.3
14.	1858	2.24	2.25	2.12	2.32	0.88	0.87	0.86	0.91	3.1
15.	1894	1.99	1.99	1.91	2.03	0.79	0.78	0.80	0.81	1.3
Quality										
16.	1590	2.39	2.32	2.39	2.56	0.97	0.95	1.01	1.00	17.1
17.	1807	2.44	2.40	2.39	2.61	0.95	0.93	0.97	0.97	5.8
18.	1843	2.17	2.12	2.11	2.35	0.82	0.78	0.85	0.87	3.9
19.	1834	2.23	2.22	2.14	2.33	0.92	0.92	0.91	0.91	4.4
20.	1772	2.14	2.15	2.04	2.22	0.84	0.85	0.77	0.85	7.6
21.	1411	2.68	2.62	2.66	2.85	1.02	1.01	1.00	1.04	26.4
22.	1410	2.62	2.56	2.58	2.81	1.00	0.98	0.99	1.05	26.5
Use of Technology for Teaching and Learning										
Teacher Use: Instruction and Planning										
1.	1768	3.06	3.11	3.02	2.96	1.24	1.26	1.17	1.24	7.8
2.	1821	2.56	2.59	2.60	2.42	1.13	1.15	1.10	1.11	5.1

Table 7 (continued).

Item #	*n*	*Total M*	*es M*[b]	*ms M*[b]	*hs M*[b]	*Total SD*	*es SD*[c]	*ms SD*[c]	*hs SD*[c]	*DNK*[d]
3.	1708	3.36	3.46	3.34	3.11	1.29	1.30	1.26	1.24	10.9
4.	1763	3.13	3.35	2.89	2.76	1.33	1.31	1.31	1.31	8.1
5.	1730	2.84	2.85	2.98	2.71	1.30	1.31	1.34	1.21	9.8
6.	1660	2.18	2.20	2.09	2.22	1.38	1.40	1.33	1.38	13.5
7.	1710	2.59	2.53	2.62	2.71	1.36	1.36	1.34	1.35	10.8
8.	1843	1.93	1.98	2.00	1.71	1.07	1.10	1.13	0.92	3.9
9.	1812	2.85	2.81	2.93	2.87	1.34	1.36	1.33	1.30	5.5
10.	1858	1.90	1.95	1.89	1.80	1.18	1.23	1.13	1.09	3.1
11.	1609	2.81	2.90	2.76	2.60	1.48	1.50	1.45	1.44	16.1
12.	1666	3.27	3.36	3.28	3.04	1.35	1.36	1.35	1.30	13.1
13.	1667	2.76	2.80	2.74	2.65	1.30	1.31	1.27	1.30	13.1
14.	1654	2.88	2.93	2.84	2.77	1.32	1.33	1.31	1.32	13.8
15.	1721	3.27	3.31	3.24	3.19	1.25	1.25	1.21	1.26	10.3
Student Use: Information and Communication Technologies										
16.	1732	2.39	2.37	2.51	2.32	1.16	1.19	1.13	1.11	9.7
17.	1571	3.53	3.76	3.62	2.79	1.58	1.51	1.51	1.61	18.1
18.	1747	2.64	2.71	2.76	2.37	1.24	1.30	1.12	1.13	8.9
19.	1406	3.46	3.69	3.26	3.00	1.43	1.41	1.38	1.42	26.7
20.	1562	3.16	3.33	3.11	2.74	1.33	1.32	1.32	1.26	18.6
21.	1663	2.66	2.80	2.64	2.30	1.33	1.37	1.30	1.17	13.3
22.	1639	2.67	2.77	2.67	2.39	1.30	1.34	1.25	1.18	14.5
23.	1644	2.77	2.88	2.77	2.46	1.27	1.29	1.23	1.18	14.3
Impact of Technology										
Teaching Practices										
1.	1803	2.22	2.21	2.23	2.22	0.89	0.90	0.89	0.87	6.0
2.	1808	2.23	2.21	2.31	2.22	0.87	0.85	0.97	0.86	5.7
3.	1775	2.62	2.72	2.52	2.45	1.04	1.05	1.03	1.00	7.5
4.	1776	2.46	2.50	2.45	2.35	0.98	0.98	1.02	0.94	7.4
Student Outcomes										
5.	1721	2.26	2.27	2.24	2.28	0.87	0.85	0.92	0.90	10.3
6.	1773	2.26	2.23	2.23	2.35	0.89	0.84	0.95	0.98	7.6
7.	1771	2.33	2.34	2.26	2.37	0.92	0.89	0.96	0.96	7.7
8.	1792	2.04	2.00	2.08	2.12	0.82	0.79	0.86	0.87	6.6
9.	1761	2.18	2.17	2.14	2.24	0.85	0.82	0.88	0.89	8.2

[a] Directions for these items indicated to leave the item blank if the school did not have a computer or mobile lab.

[b] es M= elementary school mean, ms M= middle school mean, hs M= high school mean

[c] es SD= elementary school standard deviation, ms SD= middle school standard deviation, hs SD= high school standard deviation

[d] *DNK* = Percent of "Do Not Know" responses for each item coded as "Missing."

Ranges of means for each construct for STNA were as follows: Supportive Environment for Technology Use (1.83-3.32), Professional Development (1.88-2.68), Use of Technology for Teaching and Learning (1.90-3.53), and Impact of Technology (2.04-2.62). Ranges for standard deviations for each construct are as follows: Supportive Environment for Technology Use (0.73-1.29), Professional Development (0.72-1.02), Use of Technology for Teaching and Learning (1.07-1.58), and Impact of Technology (0.82-1.04). Data on school-level group means was provided because subsequent analysis revolves around the similarity or differences found among response patterns for elementary, middle, and high school respondents.

Additionally, the number of "Do Not Know" responses coded as missing data also provides an important piece of information by which to judge the item applicability. The fewer the number of responses coded as missing, the higher the number still included in the sample (Dillman, 1999). Ranges for percent of "Do Not Know" for each construct are as follows: Supportive Environment for Technology Use (0.9-28.1), Professional Development (0.8-26.5), Use of Technology for Teaching and Learning (3.1-26.7); Impact of Technology (5.7-10.3).

Means and standard deviations for each item were calculated in order to provide information about the variation among responses. The range of means and standard deviations was smallest for the Impact of Technology construct and greatest for the Use of Technology for Teaching and Learning construct. Overall the ranges of mean scores and standard deviations indicate variation in responses across items and subconstructs.

Percent of “Do Not Know” responses was included to provide information about missing data. It can be expected that some of the respondents will not have enough information to form an opinion about the topic of an item. However, items with a high percent of responses indicating “Do Not Know” warrant further study by SERVE staff, because this may indicate there is a problem with the item itself – it could be unclear or could be about something school staff are not generally aware.

For the purposes of this study, a percent over 20 is classified as “high,” meaning 20% or more of all respondents did not have enough information to respond to that item. Examples of items with noticeable high percent of “Do Not Know” responses include items 4 and 6 in *Vision and Shared Leadership* subconstruct, 12-15 in the *Organizational Conditions* subconstruct. The range for percent of “Do Not Know” responses for these items is 20.2-28.2. SERVE staff should attempt to determine the cause of a high number of respondents not having enough information to form an opinion about that item. Could the item itself be flawed or could the reason be related to lack of information provided at the school level?

Results

A literature review was conducted and individual responses from schools and districts that used STNA were collectively analyzed to answer the following research questions for the purposes of this study.

Research Question 1: To what extent does the literature support the selection and inclusion of STNA's constructs and subconstructs?

A comprehensive review of literature relevant to the development and implementation of STNA was provided. Empowerment and Utilization-Focused evaluation models, couched within the participant-oriented approach, provided the rationale for STNA's intended use as a tool to help school and district staff conduct evaluations and use the results of that evaluation to make decisions about improving implementation of their own technology programs. This discussion clearly demonstrated how STNA fits into the larger context of program evaluation.

Exploration of the CAPE Evaluation Framework revealed that STNA plays an important role in each of the three components described in the SERVE framework – as one example of the collection of evaluation resources; as the focus of some professional development opportunities provided to CAPE participants; and, strengthened by the conceptual framework that guides the work to support evaluation planning and implementation in schools and districts. This detailed description of the CAPE Evaluation Framework provided background and perspective on how and why STNA was first conceived and eventually developed as a resource to support school and district staff's capacity to conduct formative evaluations.

In order to determine if STNA provides a unique resource for educators, other technology-focused needs surveys available to schools and districts were examined. Of the 225 instruments cited in the SETDA database, only eight were found to collect data on school technology needs across a large number of areas which could then be used for formative evaluation purposes – ultimately to make decisions about technology whole program improvement. These eight technology needs surveys were reviewed and determined to be cost prohibitive, state-specific, classroom-limited, out-of-date, or otherwise inaccessible or unsuitable for schools and districts. In contrast, STNA is a comprehensive whole-school survey that is available to any school and district as a free online assessment. These findings support the contention that STNA does provide a unique evaluative resource to school and district staff.

The research supporting the selection and inclusion of STNAs constructs and subconstructs lies at the heart of determining the quality of the instrument itself. According to the relevant research and professional literature cited, each of the constructs included in STNA is a vital component of a successful school technology program. The discussion included a logic map (see Figure 1) that illustrated how the constructs and subconstructs fit together to form a cohesive picture of school technology needs. The literature supports STNA's use as a formative evaluation tool for collecting data on the status of school technology program strategies (status of a supportive environment for technology use and provision of high quality, targeted professional development for technology), and school technology program outcomes (appropriate technology use for teaching and learning, and changes in instructional practices and student learning). Additionally, a thorough review of each item using national standards and best practices in the field of educational technology outlined in the reference matrices (see Appendix B) provided specific support for the items included in STNA.

Finally, literature on needs assessment instruments, as well as online surveys enhanced the understanding of how STNA could most effectively be deployed in schools and districts. The review of current research for the use of needs assessments and online surveys provided support for the design and deployment strategies for STNA and provided important recommendations for addressing issues such as sampling, access to technology, comfort level with technology, confidentiality, and authenticity of responses.

Research Question 2: To what extent do the items in STNA cluster together into factors?

In order to determine how the items in STNA were clustering into constructs or factors, a principal axis factor analysis was performed. A principal axis factor analysis was selected, because it uses only the reliable shared variance of the factors in the analysis instead of the total variance, both the reliable and unreliable, of the measured variables (Osborne, 2008; Thompson, 2004). Existing responses to the online instrument were downloaded into Excel spreadsheets (n=1918), and then SPSS was used to randomly select half of the sample and perform the data reduction analysis.

As indicated in the previous chapter, the other half of the data set was used to conduct a confirmatory factor analysis to determine replicability of the factor structure and check the instrument's stability. In order to utilize both factor analysis methods, the existing responses had to be randomly split into two different sets. Splitting the existing set was required, because factor analysis is highly influenced by the data. It would not be appropriate to run both types of analysis on the same set of data (Thompson, 2004). Both data sets met the robust sample size condition for factor analysis.

A promax, oblique rotation, to allow the factors to be correlated, was used as it was expected that all the constructs, each addressing some component of technology in educational settings, would be related to one another. Initially, the hypothesized 12-factor structure was explored. Since factor analysis is very sample sensitive, listwise deletion was used for items coded as missing, resulting in a complete data set of n=843. As is common practice for robust data sets, items that loaded more than 0.3 were retained (Thompson, 2004).

Initial analyses suggested that the individual items could be grouped into 16 factors (based on factors with eigenvalues of greater than one). Using results from the STNA pilot studies and literature review, solutions based on 10, 12, or 14 factors were explored more thoroughly with several different models tested, based on comparisons of results from the principal axis factoring analysis. On this basis, a 10-factor solution was accepted. Together, these 10 factors accounted for 56.21% of the common variance with eigenvalues of 21.12, 7.47, 6.01, 2.84, 2.46, 2.03, 1.77, 1.71, 1.51, and 1.43 respectively. These 10 factors were identified as follows:

Factor 1: Teacher Technology Use: Instruction (7 items) & Planning (8 items)

Factor 2: Professional Development Needs: Instruction (7 items) & Planning (8 items)

Factor 3: Supportive Environment for Technology Use: Flexible Scheduling (3 items); Infrastructure (5 items); Staff Support (3 items); Media and Software (4 items)

Factor 4: Vision and Planning (8 items)

Factor 5: Administrative Support: Teacher Technology Use (3 items) & Adequate Budget (4 items)

Factor 6: Impact of Technology: Student Outcomes (5 items)

Factor 7: Student Technology Use: Information and Communication Technologies (8 items)

Factor 8: Professional Development Quality (7 items)

Factor 9: Impact of Technology: Teaching Practices (4 items)

Factor 10: Communication (2 items)

The factor loadings are reported in Table 8, which show the unique associations between each of the 10 factors and the measured items, controlling for all other items.

Table 8

Factor Loadings for STNA 3.0 Items (n=843)

	Factor									
Item	1	2	3	4	5	6	7	8	9	10
instruct1	0.75									
instruct2	0.71									

Table 8 (continued).

Item	1	2	3	4	5	6	7	8	9	10
					Factor					
plan14	0.71									
plan13	0.69									
instruct3	0.64									
instruct5	0.63									
plan11	0.60									
plan12	0.60									
plan8	0.59									
instruct4	0.57									
plan10	0.56									
plan15	0.55									
plan9	0.55									
instruct7	0.55									
instruct6	0.47									
pdplan10		0.80								
pdplan14		0.80								
pdplan13		0.79								
pdplan9		0.78								
pdplan8		0.75								
pdplan12		0.73								
pdplan11		0.73								
pdplan15		0.69								
pdinstr2		0.66								
pdinstr3		0.62								0.37
pdinstr1		0.57								
pdinstr4		0.56								0.46
pdinstr6		0.55								
pdinstr5		0.55								0.43
pdinstr7		0.52								
infra22			0.67							
infra21			0.65							
infra24			0.64							
infra23			0.62							

Table 8 (continued).

Item	Factor 1	2	3	4	5	6	7	8	9	10
media31			0.62							
media29			0.59							
staff26			0.57							
staff28			0.55							
staff27			0.51							
media30			0.42							
flex20			0.40							
flex19			0.38							
flex18			0.35							
media32			0.31							
vision1				0.73						
orgcond9				0.70						
orgcond8				0.69						
orgcond11				0.69						
vision2				0.66						
vision3				0.58						
vision4				0.53						
orgcond10				0.47	0.38					
orgcond12					0.74					
orgcond13					0.74					
vision5					0.57					
orgcond14					0.51					
vision7					0.49					
vision6					0.49					
orgcond15				0.32	0.40					
impacts6						0.86				
impacts8						0.85				
impacts9						0.83				
impacts7						0.81				
impacts5						0.73				
ICT21							0.71			
ICT20							0.70			

Table 8 (continued).

Item	1	2	3	4	5	6	7	8	9	10
					Factor					
ICT23							0.69			
ICT22							0.67			
ICT19							0.64			
ICT18							0.52			
ICT17							0.48			
ICT16							0.39			
pdqual17								0.68		
pdqual22								0.66		
pdqual21					0.35			0.64		
pdqual19								0.62		
pdqual18								0.62		
pdqual16								0.57		
pdqual20								0.54		
impactt4									0.72	
impactt2									0.69	
impactt3									0.62	
impactt1									0.60	
orgcond16										0.44
orgcond17										0.38
infra25										

Extraction Method: Principal Axis Factor Analysis.

Rotation Method: Promax with Kaiser Normalization.

The results from this analysis provide a parsimonious solution that supports most of the hypothesized constructs and subconstructs for STNA (see Table 9). Based on these results, items within the *Vision and Shared Leadership* and *Organizational Conditions* subconstructs are reorganized into three different factors: Vision and Planning (Factor 4); Support for Technology Use & Adequate Budget (Factor 5); and Communication (Factor

10). Subconstructs *Flexible Scheduling, Infrastructure, Staff Support, Media and Software* are collapsed into a single factor, Supportive Environment for Technology Use (Factor 3). The remaining hypothesized subconstructs all align with a single identified factor. Finally, one item (infra25) did not load on any of the 10 factors identified in the analysis. This item was added to STNA after the last pilot test and because it does not appear to be highly correlated with any of the other items, it will be dropped from the instrument and not considered in further analysis.

Table 9

Alignment between Hypothesized STNA Subconstructs and Factors Identified in the Exploratory Factor Analysis

STNA Subconstructs	EFA Factors
1. Vision and Shared Leadership (7 items) 2. Organizational Conditions (10 items)	Factor 4, 5, 10
3. Flexible Scheduling (3 items) 4. Infrastructure (5 items) 5. Staff Support (3 items) 6. Media and Software (4 items)	Factor 3
7. Professional Development Needs: Instruction (7 items) & Planning (8 items)	Factor 2
8. Professional Development Quality (7 items)	Factor 8
9. Teacher Technology Use: Instruction (7 items) & Planning (8 items)	Factor 1
10. Student Technology Use: Information and Communication Technologies (8 items)	Factor 7
11. Impact of Technology: Teaching Practices (4 items)	Factor 9
12. Impact of Technology: Student Outcomes (5 items)	Factor 6

This 10-factor solution was explored further using the remaining half of the data set in a confirmatory factor analysis to determine replicability of the factor structure and determine the instrument's stability.

Research Question 3: If so, to what extent do those factors support the validity of the existing constructs identified in STNA?

The results of the EFA were then used to develop a testable pattern of factor loadings for a CFA. The factor structure of STNA was evaluated by conducting a CFA using the AMOS program, a software package specifically designed to conduct confirmatory factor analysis and test structural equation models (Byrne, 2001). A hypothesized model was specified that included 10 intercorrelated subconstructs. Because a confirmatory modeling approach was used, the researcher focused specifically on the 10-factor solution based on the results of the EFA. Since the Chi-Square statistic is sensitive to sample size, number of variables, and correlations in the model, it was expected that due to the complexity of the model itself and large sample size that Chi-square would be significant. The fit of this model was less than adequate with a significant Chi-square estimate: χ^2 (3524, N =959) = 18935.51, p = .000, (CFI = .83, $RMSEA$ = .048, NFI = .80, RFI = .79, IFI = .83). Since factor loadings were provided in the EFA results section, Table 10 provides a summary of the factor correlations for this 10-factor solution. The correlation table shows that the factors are related but not identical.

Table 10

STNA Factor Correlations Identified through the Confirmatory Factor Analysis

	Factors	Teacher Tech Use	PD Needs	Supportive Environ.	Vision	Administrative Support	Student Impact	Student Tech Use	PD Quality	Teacher Impact	Communication
		1	2	3	4	5	6	7	8	9	10
1	Teacher Tech Use	1									
2	PD Needs	.22	1								
3	Supportive Environ.	.26	.21	1							
4	Vision	.23	.21	.57	1						
5	Administrative Support	.23	.26	.69	.89	1					
6	Student Impact	.55	.32	.36	.31	.32	1				
7	Student Tech Use	.66	.17	.33	.25	.27	.56	1			
8	PD Quality	.30	.34	.65	.65	.71	.39	.28	1		
9	Teacher Impact	.69	.29	.29	.26	.25	.73	.58	.33	1	
10	Communication	.22	.18	.52	.59	.65	.28	.24	.52	.21	1

The initial CFA results indicate that the hypothesized model provides a less than adequate fit, unsatisfactorily reproducing the pattern of covariation in the set of variables. One reason to explain why the hypothesized model does not successfully reproduce the factor pattern could be due to variance among response groups. In order to determine stability, or lack thereof, for factors, elementary, middle, and high school response groups were compared using a multi-group CFA.

Research Question 4: Are the identified factors invariant among elementary, middle, and high school staff respondents?

In order to determine if the factor structure, identified by results from the previous analysis, was equivalent across sample sub-groups defined by school-level, a multigroup CFA was conducted using data from the elementary (n=517), middle (n=181), and high school (n=210) STNA response sets, a condition referred to as factorial invariance (Meredith, 1993). Analyses began by first estimating a hypothesized 10-factor structure in both the desegregated and segregated subsamples. This structure contained 10 intercorrelated factors (i.e., Teacher Technology Use, Professional Development Needs, Supportive Environment, Vision, Administrative Support, Student Impact, Student Technology Use, Professional Development Quality, Teacher Impact, and Communication).

Due to the complexity of the model and size of the sample, the entire factor structure could not be tested at one time using AMOS software. As a result, the structure was broken up into three smaller factor structures based on the results of the STNA logic map (see Figure 1) and CFA correlation matrix provided in Table 10, and tested across the response groups. Those factors identified as technology program strategies versus technology program objectives aligned with the factors found to be most highly correlated and were therefore analyzed together.

- *Factor Structure A* identified as “Technology Program Strategies” was made up of Supportive Environment (Factor 3), Vision (Factor 4), Administrative Support (Factor 5), Professional Development Quality (Factor 8), and Communication (Factor 10).
- *Factor Structure B* identified as “Technology Program Objectives” was made up of Teacher Technology Use, (Factor 1) Student Technology Use (Factor 7), Teacher Impact (Factor 9), and Student Impact (Factor 6).
- *Factor Structure C* was made up of “Professional Development Needs” (Factor 2).

Following the approach outlined by McArdle and Nesselroade (1994), a series of nested three-group models with increasing parameter equality constraints between the three response groups was estimated. Initially, a test of configural invariance, an omnibus test where no parameters were set to equality across the three groups, was conducted. The fit of the configural test for each factor structure produced a less than adequate fit for Factor Structures A and C; and an adequate fit for Factor Structure B based on the relative fit indices, with a significant Chi-square estimate across all three (see Table 11).

Table 11

Results of Configural Tests for Elementary, Middle, and High School Response Groups (n=962)

Factor Structure	χ^2	*df*	*p*	CFI	RMSEA
A	6566.44	1965	.00	.77	.05
B	3681.20	1374	.00	.87	.04
C	1953.90	270	.00	.81	.08

These results indicate that the factor structure is not the same across response groups for Factor Structures A and C. Elementary, middle, and high school teacher groups have different response patterns to items about technology program strategies, including supportive environment for technology, vision for technology, administrative support of technology, quality of technology professional development, and the use of technology for communication. Additionally, elementary, middle, and high school teacher groups have different technology-focused professional development needs. However, Factor Structure B, focusing on technology program objectives such as of frequency of teacher and student technology use, and the impact of technology on teaching and learning, seems to be similar across response groups.

Because an adequate fit was found for Factor Structure B using the omnibus configural test, a more restrictive test of factor invariance was conducted where the loadings for each of the factors were fixed to equality across groups. As shown in Table 12, this did not decrease the fit of the model, indicating that the factor loadings were equal in the three response groups. Based on this test, it can be concluded that Factor Structure B, focusing on technology program objectives, is invariant across groups, which is to say these STNA items are assessing the same underlying constructs for elementary, middle, and high school educators.

Table 12

Invariance Test Model Comparisons for Factor Structure B: Technology Program Objectives (n=962)

Invariance Condition	χ^2	*df*	*p*	$\Delta\chi^2$	Δ *df*	*p*
Model 1: Configural	3681.20	1374	--	--	--	--
Model 2: Loadings	3752.01	1438	.00	70.81	64	n.s.

Note. n.s.= non-significant at $p \leq .05$

In order to determine where differences occurred among the school-level groups, additional invariant tests were conducted for Factor Structures A and C. First, pairwise comparisons of school-level groups were run including Elementary-Middle; Middle-High School; High School-Elementary. The results, provided in Tables 13 and 14, indicate pairwise differences exist for STNA response groups for both Factor Structures A and C. The factor structures are not invariant even when conducting pairwise comparisons.

Table 13

Results of Pairwise Comparison Tests for Factor Structure A (n=962)

Pairwise Comparison	χ^2	*df*	*p*	CFI	RMSEA
Elementary-Middle	6648.962	2003	.00	.77	.05
Middle-High School	6694.164	2003	.00	.77	.05
High School-Elementary	6662.262	2003	.00	.77	.05

Table 14

Results of Pairwise Comparison Tests for Factor Structure C (n=962)

Pairwise Comparison	χ^2	*df*	*p*	CFI	RMSEA
Elementary-Middle	1984.466	285	.00	.81	.08
Middle-High School	1966.390	285	.00	.81	.08
High School-Elementary	1972.584	285	.00	.81	.08

Since pairwise comparisons of school-level respondent groups did not reveal an invariant factor structure, posthoc one-degree of freedom tests for each loading were conducted across groups. Results of this test identified which STNA items were loading differently for elementary, middle, and high school educators.

Table 15

Results of Posthoc One-Degree of Freedom Tests for Factor Structure A (n=962)

Invariance Condition	χ^2	*df*	*p*	$\Delta\chi^2$	Δ *df*	*p*
Model 1: Configural	6566.447	1965	--	--	--	--
Model 2: Item Loadings						
Factor 3: Supportive Environment for Technology Use						
flex18	6567.08	1967	.000	.63	2	n.s.

Table 15 (continued).

Item	χ^2	*df*	*p*	$\Delta\chi^2$	*Δ df*	*p*
flex19	6570.04	1967	.000	3.59	2	n.s.
flex20	6572.37	1967	.000	5.92	2	n.s.
infra21	6566.46	1967	.000	.01	2	n.s.
infra22	6567.99	1967	.000	1.54	2	n.s.
infra23	6568.31	1967	.000	1.87	2	n.s.
infra24	6567.48	1967	.000	1.03	2	n.s.
staff26	6570.85	1967	.000	4.41	2	n.s.
staff27	**6574.11**	**1967**	**.000**	**7.66**	**2**	**.02**
staff28	6571.37	1967	.000	4.92	2	n.s.
media29	6569.19	1967	.000	2.74	2	n.s.
media30	6567.03	1967	.000	.58	2	n.s.
media31	**6579.63**	**1967**	**.000**	**13.18**	**2**	**.00**
media32	6569.24	1967	.000	2.80	2	n.s.
Factor 4: Vision and Planning						
vision1	6569.13	1967	.000	2.68	2	n.s.
vision2	6567.55	1967	.000	1.10	2	n.s.
vision3	**6577.51**	**1967**	**.000**	**11.06**	**2**	**.00**
vision4	**6577.77**	**1967**	**.000**	**11.33**	**2**	**.00**
orgcond9	**6576.30**	**1967**	**.000**	**9.85**	**2**	**.01**
orgcond8	6569.63	1967	.000	3.18	2	n.s.
orgcond11	6567.96	1967	.000	1.52	2	n.s.
Factor 5: Administrative Support						
vision5	**6576.83**	**1967**	**.000**	**10.39**	**2**	**.01**
vision6	**6573.46**	**1967**	**.000**	**7.01**	**2**	**.03**
vision7	6571.52	1967	.000	5.07	2	n.s.
orgcond10	**6574.50**	**1967**	**.000**	**8.01**	**2**	**.02**
orgcond12	6566.99	1967	.000	.76	2	n.s.
orgcond13	6567.84	1967	.000	1.40	2	n.s.
orgcond14	6570.94	1967	.000	4.50	2	n.s.
orgcond15	**6573.20**	**1967**	**.000**	**6.75**	**2**	**.03**
Factor 8: Professional Development Quality						
pdqual16	6569.34	1967	.000	2.90	2	n.s.
pdqual17	**6574.64**	**1967**	**.000**	**8.20**	**2**	**.02**
pdqual18	**6584.52**	**1967**	**.000**	**18.08**	**2**	**.00**
pdqual19	**6576.39**	**1967**	**.000**	**9.94**	**2**	**.01**
pdqual20	6570.10	1967	.000	3.64	2	n.s.

Table 15 (continued).

Item	χ^2	*df*	*p*	$\Delta\chi^2$	*Δ df*	*p*
pdqual21	**6581.33**	**1967**	**.000**	**14.88**	**2**	**.00**
pdqual22	**6581.99**	**1967**	**.000**	**15.54**	**2**	**.00**
Factor 10: Communication						
orgcond16	6566.52	1967	.000	.07	2	n.s.
orgcond17	**6573.10**	**1967**	**.000**	**6.65**	**2**	**.04**

Note. n.s.= non-significant at $p \leq .05$

As shown in Table 15, loadings for 15 of 38 STNA items in Factor Structure A were not invariant across groups (highlighted in bold text). This means staff in elementary, middle, and high schools were responding differently to these 15 questions in STNA. It is interesting to note that staff across school-level groups had variation in the pattern of their responses to items about administrative support for technology (Factor 4) and the quality of their technology professional development (Factor 8). However, these results also showed that the fit of the model was not decreased for more than 23 items for Factor Structure A, indicating that the factor loadings for these items were equal in the three response groups.

Table 16

Results of Posthoc One-Degree of Freedom Tests for Factor Structure C (n=962)

Invariance Condition	χ^2	*df*	*p*	$\Delta\chi^2$	*Δ df*	*p*
Model 1: Configural	1953.90	270	--	--	--	--
Model 2: Item Loadings						
Factor 2: Professional Development Needs						
pdinstr1	1959.22	272	.000	5.33	2	n.s.
pdinstr2	**1967.77**	**272**	**.000**	**13.87**	**2**	**.00**
pdinstr3	1956.47	272	.000	2.57	2	n.s.
pdinstr4	1954.51	272	.000	.61	2	n.s.
pdinstr5	1958.14	272	.000	4.25	2	n.s.

Table 16 (continued).

Item	χ^2	*df*	*p*	$\Delta\chi^2$	*Δ df*	*p*
pdinstr6	1953.96	272	.000	.07	2	n.s.
pdinstr7	1956.53	272	.000	2.64	2	n.s.
pdplan8	1957.83	272	.000	3.94	2	n.s.
pdplan9	**1960.73**	**272**	**.000**	**6.84**	**2**	**.03**
pdplan10	1957.39	272	.000	3.49	2	n.s.
pdplan11	1959.08	272	.000	5.19	2	n.s.
pdplan12	1957.88	272	.000	3.99	2	n.s.
pdplan13	**1960.72**	**272**	**.000**	**6.82**	**2**	**.03**
pdplan14	1957.92	272	.000	4.02	2	n.s.
pdplan15	**1968.08**	**272**	**.000**	**14.18**	**2**	**.00**

Note. n.s.= non-significant at $p \leq .05$

As shown in Table 16, loadings for 4 of 15 STNA items in Factor Structure C were not invariant across groups (highlighted in bold text). This means staff in elementary, middle, and high schools are responding differently to these 4 questions about technology professional development needs in STNA. However, these results also showed that the fit of the model was not decreased for more than 11 items for Factor Structure C, indicating that the factor loadings for these items were equal in the three response groups.

In order to further examine those 19 items identified as variant in both Factor Structure A and C related to technology program strategies, individual item loadings are presented in Table 17.

Table 17

Factor Loadings for Items Identified as Variant across Response Groups

STNA Item	**es loading**	**ms loading**	**hs loading**
Factor 3: Supportive Environment for Technology Use			
staff27 - Library media coordinator and/or media assistant positions are adequately staffed.	.548	.548	.389
media31 - Teachers and students have ready access to a good collection of print, multimedia, and electronic resources.	.744	.702	**.833**
Factor 4: Vision and Planning			
vision3 - Administrators model effective uses of technology.	.709	.744	.594
vision4 - Administrators support changes in school-level systems, policies, and practices related to technology.	.638	.665	.406
orgcond9 - The school technology plan is developed through an effective collaboration among stakeholders, e.g., administrators, specialists, teachers, students, and community members.	.852	*.925*	.864
Factor 5: Administrative Support			
vision5 - Teachers who are innovators with technology receive material incentives, e.g., stipends, perks, waivers, special opportunities.	.635	.741	.561
vision6 - Teachers who are innovators with technology receive non-material incentives, e.g., public recognition, special appreciation.	.646	.665	.538
vision7 - When administrators are seeking or hiring teachers, they consider technology literacy and leadership for technology as criteria for selection.	.580	.695	.543
Factor 8: Professional Development Quality			
pdqual17 - Technology professional development is timely.	.790	.791	.551
pdqual18 - Technology professional development is relevant.	.707	.917	.601
pdqual19 - Technology professional development is ongoing.	.749	.842	.592
pdqual21 - The impact of technology professional development is tracked using data on classroom practice.	.805	.622	**.942**
pdqual22 - The impact of technology professional development is tracked using data on student learning.	.783	.664	**.930**
Factor 10: Communication			
orgcond17 - Technology is used to communicate and collaborate with the community about school programs designed to enhance student learning.	.927	.979	.871

Table 17 (continued).

STNA Item	**es loading**	**ms loading**	**hs loading**
Factor 2: Professional Development Needs			
pdinstr2 - Identification, location, and evaluation of technology resources, e.g., websites, that I can use with my students.	.532	.674	.662
pdplan9 - Ways to use technology to communicate and collaborate with families about school programs and student learning.	.694	.815	.777
pdplan13 - Use of data for reflecting on my professional practices.	.777	.861	.860
pdplan15 - Use of technology to participate in professional development activities, e.g. online workshops, hands-on training in a computer lab.	.609	.756	**.797**

The factor loadings reported in Table 17 show the unique associations between each of the factors and the variant items by response group controlling for all other items. The factors related to technology program strategies were differences were identified, includes supportive environment for technology use, vision and planning, administrative support, professional development quality, communication, and professional development needs. These item loadings show an interesting trend where, generally the pattern of high school responses is different than the elementary and middle school groups, specifically, where items for the high school group load lower on the identified factor than elementary or middle school groups except for (highlighted in bold text) item ‘**media31’** related access to a good collection of print, multimedia, and electronic resources.; items ‘**pdqual21’** and **‘pdqual 22**’ addressing the evaluation of the impact of technology professional development; and item '**pdplan15**' about the need for participation in computer-based professional development.

The results from these one-degree of freedom chi-square tests and variant item loadings provide specific information about which items in STNA do not have similar response patters for elementary, middle, and high school respondents. Although the variant items for all three groups have relatively high loadings on the identified factors, the elementary and middle school response groups seemed to, generally, be more highly associated with the related factor than the high school group except for a few items as identified in Table 17.

This would indicate that perhaps high school staff have different experiences from their elementary and middle school colleagues related to supportive environment for technology use, vision and planning, administrative support, professional development quality, communication, and professional development needs. Perhaps these differences could be explained by the very nature of the school-level groups. One example could be size of the school where most high schools are much larger than elementary or middle schools and therefore have a larger, more diverse staff who might not only implement technology program strategies differently, but who also might have greater diversity of responses to items about technology program strategies. Additionally, a school with a larger student population would have access to more resources for purchasing and providing information resources to staff and students. Another example could be varying degrees of emphasis on different technology program strategies where high schools do a better job of evaluating professional development than their elementary or middle school counterparts.

This analysis would suggest that most of the variation in response patterns seems to be coming from the high school response group. The variation among elementary and middle school groups is minimal. Although STNA is not statistically invariant among response groups, in practical terms it is expected that some differences might exist in the ways the elementary, middle, and high schools implement technology program strategies, and therefore these differences identified in only 19 of the 86 STNA items, related to technology program strategies, to not a warrant major revisions to the instrument.

Research Question 5: To what extent does STNA demonstrate internal consistency reliability both across constructs and within each of the subconstructs?

As indicated in the initial description of the study procedures, factors found to be stable were subjected to an internal consistency reliability analysis. Internal consistency reliability is the extent to which different items within the instrument measure similar constructs or characteristics (Linn & Miller, 2005). Since Factor Structure B was determined to be invariant across elementary, middle, and high school respondents, the items included in those factors were collectively analyzed to determine the internal consistency reliability (calculated by Cronbach's α). Table 18 provides a summary of internal consistency reliability measures for STNA factors included in Factor Structure B described as technology program objectives including Teacher Technology Use, (Factor 1) Student Technology Use (Factor 7), Teacher Impact (Factor 9), and Student Impact (Factor 6). Data analyses showed internal consistency reliability ranged from .855 to .935 for those STNA factors.

Table 18

Internal Consistency Reliability Measures for Invariant STNA Factors

Factor	Subconstruct	# Items	n[a]	α
1	Teacher Technology Use	15	1172	.921
7	Student Technology Use	8	1180	.927
9	Impact of Technology: Teaching Practices	4	1710	.855
6	Impact of Technology: Student Outcomes	5	1681	.935

[a]"Do not know" responses were coded as missing and therefore not included in the analysis.

In social science research where .70 is the widely-accepted lowest alpha for a set of items to be considered a scale, an alpha of .80 or higher is considered to indicate high internal consistency reliability (Miller, 1995). Data analysis of these STNA responses show high internal consistency reliability for subconstructs included in Factor Structure B. The reliability analyses reported in this study indicate that for those factors determined to be invariant, STNA is a high quality survey instrument that provides schools and districts with information that can be used to make decisions about each of the subconstructs. Information about the reliability of STNA will contribute to the data collection resources for educators.

Overall: Is the School Technology Needs Assessment (STNA) a high quality instrument?

Results from the literature review, EFA, CFA, and internal consistently reliability analysis indicate that STNA is a high quality instrument. The literature supports the selection and inclusion of STNAs subconstructs. Items in STNA cluster together into 10 factors that support the validity of the existing subconstructs identified in STNA. The factors in Factor

Structure B, focusing on technology program objectives, were identified as stable, reliable, and invariant across multiple response groups for 67 out of 86 items.

Special analyses was conducted on items and factors included in Factor Structures A and C to examine item variability across groups to determine if separate surveys are needed based on school level for technology program strategies, including supportive environment for technology, vision for technology, administrative support of technology, quality of technology professional development, the use of technology for communication, and technology-focused professional development needs. These tests revealed only 19 of 86 STNA items where the pattern of responses across school-level groups was different, where greatest differences in response patterns seemed to come from the high school response group. Since it is understandable that high schools might operate differently than elementary and middle schools in implementing technology program strategies, major revisions to the instrument are not recommended based on the results of this analysis. STNA is a high quality instrument that schools and districts should use to inform important decisions about a range of technology program areas.

CHAPTER V

DISCUSSION

Study Summary

Presently, there is a lack of research supporting valid and reliable instruments available to schools that will allow them to effectively assess their education technology needs, which are essential to better design and evaluate their projects and initiatives. The School Technology Needs Assessment (STNA) (see Appendix A), described in this study, provides a free, user-friendly online tool that meets this need for planning and formative evaluation of technology projects in educational settings. STNA collects data about educators' perceptions around a variety of areas of technology implementation in schools, providing the multifaceted data necessary to help school-level leaders make planning and evaluative decisions related to technology projects.

The major assumption in the model underlying STNA's use is that it can positively impact learning outcomes through effective utilization of findings, with regard to each of the included constructs, which should be used to inform decisions about school technology programs. As illustrated in Figure 4, STNA collects data on school technology program strategies (status of a supportive environment for technology use and provision of high quality, targeted professional development for technology), and school technology program outcomes (appropriate technology use for teaching and learning, and changes in instructional practices and student learning outcomes).

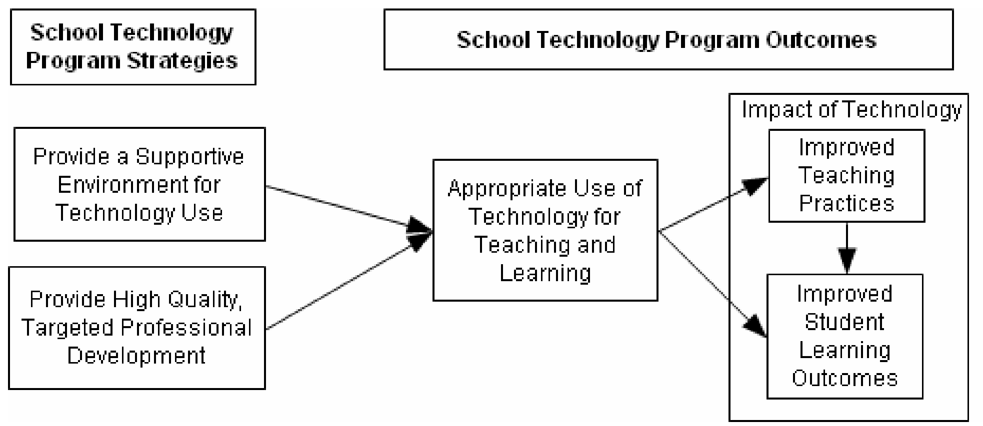

Figure 4. Logic model of the constructs included in STNA.

By collecting data from school staff about each of the construct areas, STNA data are intended to be utilized by decision-makers for the purpose of formative evaluation of the school technology program.

SERVE's work with the NCDPI and NC EETT schools led to the identification of a number of essential sources of data for effectively evaluating the implementation and impact of technology projects in schools. These data sources included staff needs assessments, teacher reflection logs, technology use logs, classroom observations, professional development quality questionnaires, rubrics and scoring guides for evaluating lesson plans and student projects, and family and community partnership surveys (Knestis et al., in press). SERVE staff identified and/or developed a number of instruments to assist schools in gathering this crucial information for planning and decision-making. One instrument developed as part of this process was STNA, the focus of this study. STNA collects data about teachers' perceptions around a variety of areas of technology implementation in schools and is intended to assess the collective needs of a school staff related to the use of technology for teaching and learning.

The purpose of this study was to investigate the quality of STNA 3.0. Therefore, the central research question was as follows: Is STNA a high quality instrument? The central research question can be further separated into the following five subquestions:

1. To what extent does the literature support the selection and inclusion of STNA's constructs and subconstructs?
2. To what extent do the items in STNA cluster together into factors?
3. To what extent do those factors support the validity of the existing constructs identified in STNA?
4. Are the identified factors invariant among elementary, middle, and high school staff respondents? and
5. To what extent does STNA demonstrate internal consistency reliability both across constructs and within each of the subconstructs?

The ensuing discussion described in detail the literature relevant to the study and identified methodological procedures to address each of the research subquestions. Answering these questions enabled the researcher to determine if, ultimately, STNA is a high quality instrument that provides a valuable resource to help schools and districts formatively evaluate their technology programs.

The review of literature relevant to the development and implementation of STNA demonstrated how STNA fit into the larger context of program evaluation models and within

SERVE's CAPE Evaluation Framework. A review of other technology needs surveys found them difficult to access for use by schools and districts. Additionally, the research supported the selection and inclusion of STNAs constructs and subconstructs. Finally, literature on needs assessment instruments, as well as online surveys enhanced understanding of how STNA can most effectively be deployed in schools and districts.

Because this study focuses on the constructs included within STNA and their relationships to one another, the appropriate research design was a correlational study (T. Cook & Campbell, 1979; Fraenkel & Wallen, 2003; Gall et al., 1996). A correlational research design is used to study relationships between variables through the use of correlational statistics, such as factor analysis, and is used extensively in test construction and analysis (Gable & Wolf, 1993; Gall et al., 1996; Pett et al., 2003). A correlational study that simply observes the size and direction of the relationships among variables, such as this study, is considered a nonexperimental design or observational study approach (Shadish et al., 2002).

Within this correlational research process, specific strands of psychometric inquiry align with the research subquestions. An exploratory factor analysis (EFA) was used to identify clusters of factors in STNA. A confirmatory factor analysis (CFA) was used to determine whether those factors support the reliability of the existing subconstructs identified in STNA. A comparison across elementary, middle, and high school response groups, using a multi-group CFA was used determine level of factor invariance. Finally, factors found to be stable were subjected to an internal consistency reliability analysis.

This study investigated the validity and reliability of STNA, using existing data from STNA respondents from schools that have implemented STNA for their own evaluation purposes. As of July 2007, the existing data set for STNA 3.0 included responses to 1918 surveys from 49 schools in North Carolina. The school sites were made up of 32 elementary schools (65.3%), 9 middle schools (18.4%), and 8 high schools (16.3%).

SERVE staff used national technology standards and best practices as recommended by research and specialists in the field of educational technology during the instrument development phase to determine the constructs and write items for the beta version of STNA (CEO Forum, 2000b; International Society for Technology in Education, 2000a, 2000b, 2002; Milken Exchange, 1998; National Staff Development Council, 2001; North Central Regional Educational Laboratory, 2000; Public Schools of North Carolina, 2005). Content analysis techniques, a common practice in qualitative research, were employed to organize, code, identify patterns, and synthesize the large amount of text-based data from the professional literature on technology in education (Bogdan & Biklen, 2007). In order to keep a record of which standards related to which constructs and items, SERVE staff developed an item reference matrix (see Appendix B), which was continually updated as the instrument was revised.

Based on the results of two pilot studies, national technology standards and best practices as recommended by research and specialists in the field of educational technology, the current version of STNA, the focus of this study, is made up of 86 self-report, five-point Likert scale items, organized into the following 4 constructs and 12 subconstructs:

A. Supportive Environment for Technology Use
   1. Vision and Shared Leadership (7 items)
   2. Organizational Conditions (10 items)
   3. Flexible Scheduling (3 items)
   4. Infrastructure (5 items)
   5. Staff Support (3 items)
   6. Media and Software (4 items)
B. Professional Development
   9. Professional Development Needs: Instruction (7 items) & Planning (8 items)
   10. Professional Development Quality (7 items)
C. Use of Technology for Teaching and Learning
   11. Teacher Use: Instruction (7 items) & Planning (8 items)
   12. Student Use: Information and Communication Technologies (8 items)
D. Impact of Technology
   13. Teaching Practices (4 items)
   14. Student Outcomes (5 items)

For the purposes of this study, initially an EFA was run on one set of the data using a promax, oblique rotation (to allow the factors to be correlated) because it is expected that all the constructs, each addressing some component of technology in educational settings, would be related to one another. Based on the current format of STNA, a 12-factor structure was explored. The criteria such as eigenvalues and percent variation explained were used to identify the existing factors in STNA. The results of that analysis were then used to develop a testable pattern of factor loadings for a CFA. Results of the CFA provided a formal statistical test supporting or refuting the existence of the hypothesized factor structure for STNA. Then, in order to determine if the factor structure identified using the initial CFA was equivalent across sample sub-groups defined by school-level, a multigroup model was tested using data from the elementary, middle, and high school STNA response sets. A series of nested, three-group models with increasing parameter equality constraints between the groups was estimated, providing a series of increasingly restrictive tests of factor invariance (Byrne, 2001; Thompson, 2004). Finally, factors shown to be invariant were subject to an analysis of the internal consistency reliability of subconstructs.

In order to determine if the current sample was representative of the larger population of North Carolina educators, the STNA sample was compared to a database of all North Carolina certified educators provided by the North Carolina Department of Public Instruction for the following factors: years of experience, role, grade, ethnicity, and gender (M. Cash, personal communication, January 18, 2008). SPSS was used to determine if there was a significant difference between the percentages found for the study sample and the state's population of educators for each demographic factor. Results of Chi-Square tests revealed that the STNA sample was not statistically different that the population of North Carolina certified educators, except for the ethnicity factor.

Descriptive statistics (means and standard deviations) for each item, as well as response groups, were calculated in order to provide information about the distribution and variation among responses. Overall the ranges of mean scores and standard deviations indicate variation in responses across items and subconstructs. Percent of "Do Not Know" responses was included to provide information about missing data.

A comprehensive review of literature relevant to the development and implementation of STNA was provided to support the selection and inclusion of STNA's constructs and subconstructs, by demonstrating how STNA fits into the larger context of program evaluation models and within SERVE's CAPE Evaluation Framework. A review of other technology needs surveys found them difficult to access for use by schools and districts. Additionally, the research supported the selection and inclusion of STNAs constructs and subconstructs. Finally, literature on needs assessment instruments, as well as online surveys enhanced our understanding of how STNA can most effectively be deployed in schools and districts.

In order to determine how the items in STNA were clustering into constructs or factors, a principal axis factor analysis was performed. Initial analyses suggested that the individual items could be grouped into 16 factors (based on factors with eigenvalues of greater than one). Using results from the STNA pilot studies and literature review, solutions based on 10, 12, or 14 factors were explored more thoroughly with several different models tested, based on comparisons of results from the principal axis factoring analysis. On this basis, a 10-factor solution was accepted. The results from this analysis provided a parsimonious solution that supported most of the hypothesized constructs and subconstructs for STNA.

The results of the EFA were then used to develop a testable pattern of factor loadings for a CFA. A hypothesized model was specified that included 10 intercorrelated subconstructs. Because a confirmatory modeling approach was used, we focused specifically on the 10-factor solution based on the results of the EFA. The initial CFA results indicated that the hypothesized model provides a less than adequate fit, unsatisfactorily reproducing the pattern of covariation in the set of variables. One reason to explain why the hypothesized model did not successfully reproduce the factor pattern, could be due to variance among response groups. In order to test stability of factors, elementary, middle, and high school response groups were compared using a multi-group CFA.

Due to the complexity of the model and size of the sample, the entire factor structure could not be tested at one time using AMOS software. As a result, the structure was broken up into three smaller factor structures based on the STNA logic map (see Figure 1) and the results of CFA correlation matrix and tested across the response groups. Those factors identified as technology program strategies versus technology program objectives, aligned with the factors found to be most highly correlated, and were therefore analyzed together.

- *Factor Structure A* was made up of Supportive Environment (Factor 3), Vision (Factor 4), Administrative Support (Factor 5), Professional Development Quality (Factor 8), and Communication (Factor 10).
- *Factor Structure B* was made up of Teacher Technology Use, (Factor 1) Student Technology Use (Factor 7), Teacher Impact (Factor 9), and Student Impact (Factor 6).
- *Factor Structure C* was made up of Professional Development Needs (Factor 2).

A series of nested three-group models with increasing parameter equality constraints between the three response groups revealed the factor structure is not the same across response groups for Factor Structures A and C. Elementary, middle, and high school teacher groups have different response patterns to items about technology program strategies, including supportive environment for technology, vision for technology, administrative support of technology, quality of technology professional development, and the use of technology for communication. Additionally, elementary, middle, and high school teacher groups have different technology-focused professional development needs. However, Factor Structure B, focusing on technology program objectives such as of frequency of teacher and student technology use, and the impact of technology on teaching and learning was invariant across response groups.

Since pairwise comparisons of school-level respondent groups did not reveal invariance for factor structure, posthoc one-degree of freedom chi-square tests for each loading were conducted across groups. Results of this test identified only 19 of 86 STNA items were loading differently for elementary, middle, and high school educators.

Since Factor Structure B was determined to be invariant across elementary, middle, and high school respondents, the items included in those factors were collectively analyzed to determine the internal consistency reliability (calculated by Cronbach's α). STNA factors included in Factor Structure B described as technology program objectives including Teacher Technology Use, (Factor 1) Student Technology Use (Factor 7), Teacher Impact (Factor 9), and Student Impact (Factor 6). Data analyses showed internal consistency reliability ranged from .855 to .935 for those STNA factors.

Is the School Technology Needs Assessment (STNA) a high quality instrument? is the overarching research question for this study. A collective review of study results including the literature review, EFA, CFA, and internal consistently reliability analysis indicates that STNA is a high quality instrument. The literature supports the selection and inclusion of STNAs subconstructs. Items in STNA cluster together into 10 factors that support the validity of the existing constructs identified in STNA. The factors in Factor Structure B, focusing on technology program objectives, were identified as stable, reliable, and invariant across multiple response groups. Special analyses was conducted on items and factors included in Factor Structures A and C to examine item variability across groups to determine if separate surveys are needed based on school level for technology program strategies, including supportive environment for technology, vision for technology, administrative support of technology, quality of technology professional development, the use of technology for communication, and technology-focused professional development needs. These tests revealed only 19 of 86 STNA items where the pattern of responses across school-level groups was different, where greatest differences in response patterns seemed to come from the high school response group. Since it is understandable that high schools might operate differently than elementary and middle schools in implementing technology program strategies, major revisions to the instrument are not recommended based on the results of this analysis. STNA is a high quality instrument that schools and districts should use to inform important decisions about a range of technology program areas.

Study Limitations

Information provided in previous chapters have raised and addressed some concerns about the study design, including self-report survey concerns, selection issues, and limitations of selected statistical procedures. However, one concern that has not yet been addressed is the issue of variation in implementation of STNA across schools and districts.

This study used existing data from all schools in North Carolina that implemented STNA. These schools varied greatly in the ways in which they deployed the instrument. Some schools simply sent out an email message to their staff requesting they complete the online survey. Other schools made every effort to follow SERVE's deployment recommendations to communicate in advance with staff members about the purpose of the STNA and emphasize the importance of everyone responding to the instrument by providing time during staff meetings to go to the computer lab to complete the survey together. This disparity in school-level implementation strategies resulted in a wide range of school-level response rates.

Recommendations

Practical implications.

There are some practical implications to support consistent STNA implementation in schools. Since STNA data are intended to inform building-level technology decisions, it is critical that schools collect response data from every one of the educators in their school. A recommended target response rate of 90% will help ensure the STNA results are actually representative of technology use in the building as a whole. There are concerns about low response rate within schools introducing error and bias into the data aggregated at the school level. As mentioned earlier, Cook and colleagues (2000) recommend strategies to increase response rates such as follow-up contact with non-respondents, personalized contacts, and contacting the sample prior to sending out a survey. Along with these recommendations, a list of other suggested strategies for successfully implementing STNA has been complied to help schools implement the instrument in such a way that will maximize its value in terms of informing school-level planning for technology use.

Recommendations about planning and administering STNA include convening the team responsible for technology planning in the school to clarify the important evaluation questions for the school technology program. Then have the team review STNA to determine if the data collected will be useful in answering those pertinent evaluation questions. Appoint someone on the committee to be the school-based “STNA manager,” the person responsible for managing the implementation of STNA. It is critical that that person keep a record of who has and who has not completed STNA to facilitate follow-up with non-responders. Next, the team should develop and adhere to a plan for how and when respondents will complete the STNA. It is simply not effective to email the STNA URL to staff members – which can result in a 0% response rate. Helping respondents through the STNA in some coordinated way, in a computer lab during an inservice training day will assure a response rate high enough to have confidence in the STNA. Finally, it may be necessary to provide technical training for school staff, to be sure that they have the skills necessary to use a web-based survey instrument.

Another important recommendation is to communicate in advance with staff members about the purpose of the STNA (Fullan, 2003) - how it fits into school technology or evaluation planning. In addition, it is essential the staff understands that it is impossible to identify individual respondents among the STNA data; that data are reported only at the school level; and that STNA data are not intended to assign awards or sanctions to individual staff members or schools. Finally, the evaluation team should develop a plan for disseminating STNA findings to the entire school staff to promote buy-in of evaluation efforts.

STNA data are provided back to the school staff in the form of a web-based report that includes frequencies, percentages, and bar charts of responses to each item. Separate recommendations address utilization of the STNA report that include: reconvening the evaluation or technology planning team to share and discuss the STNA data report; using a guide provided by SERVE to assist school decision-making efforts; and making appropriate inferences from STNA data by revisiting the pertinent evaluation questions to help focus the decision-making process. It is always a good idea to examine STNA results for surprises or unanticipated findings. Often schools discover that more information is required to understand issues at hand. It may be necessary to convene groups to discuss why staff members may have responded to STNA as they did. It is of utmost importance that the planning team use results from STNA for decision-making purposes to support possible changes to school technology program implementation. Finally, implementing the plan for disseminating STNA findings to the entire school staff can encourage buy-in by increasing the entire staff's involvement in the evaluation process and raising the likelihood of future participation in data collection activities.

Additional recommendations for utilization of STNA data include the following: providing evidence of technology needs in the narrative for a technology grant proposal; incorporating findings into the School Improvement Plan or Technology Plan to define priorities; supporting the professional development plan; and justifying the allocation of limited technology resources. Schools could also implement STNA annually to track changes in the school STNA “profile” over time.

Theoretical implications.

A few recommendations for measure refinement were identified based on the results of the data analysis conducted as part of this study. The literature supports the selection and inclusion of STNAs items and constructs; further it supports how those constructs are related to the STNA logic model. STNA collects data on school technology program strategies (status of a supportive environment for technology use and provision of high quality, targeted professional development for technology), and school technology program outcomes (appropriate technology use for teaching and learning, and changes in instructional practices and student learning outcomes). However, the 10-factor solution identified in the EFA and confirmed by the CFA provides a more parsimonious organization of items into subconstructs. It is recommended that STNA items be reorganized to fit the new factor structure. Additionally, only one item was found not to load on any factor, and therefore should be removed from the instrument. Although most items were identified as invariant across groups, those 19 items found to produce different response patterns were further explored and revealed greatest difference among the high school group when compared to the elementary and middle school groups. The researcher did not recommend creating school-level specific instruments based on the results of these analysis, instead concluding that some small differences were expected.

Further Areas of Study

This study contributed to the body of research on the evaluation of teaching and learning as they relate to technology in the educational setting. Reflection on the results of this study revealed a number of options for future areas of research around STNA. Comparison of the study sample to the population of certified North Carolina educators revealed that minority respondents were not adequately represented. Future research could include the targeted recruitment of schools with high minority populations to ensure adequate representation of all ethnic groups.

Future research could include the study of the fidelity of implementation of STNA in schools (Cordray & Pion, 2006). In order to address the issue of variation across school-level STNA implementation, it is recommended that SERVE staff gather information on the strategies utilized to support STNA deployment. In future STNA studies, this information, along with response rates for school sites, can be used to indicate fidelity of implementation, which should facilitate selection into a study. Also, additional research on STNA might include investigation of the effects of low response rate within schools, which introduces error and bias into the data aggregated at the school level.

Further analysis of the data might provide insights into validity of the instrument. It is obvious that further research and analysis is necessary to make specific recommendations to increase the integrity of the STNA as an evaluation tool. Construct validity could be explored by comparing STNA results to that of another valid technology measurement instrument or results from North Carolina's Annual Media and Technology Report, a yearly snapshot of the state of media and technology programs in North Carolina's schools (North Carolina Department of Public Instruction, 2007). Finally, researchers could develop a testable causal model of STNA factors, based on the STNA logic model, for subsequent analyses using such tools as hierarchical linear modeling.

Conclusion

When educators in schools and districts have evaluation data showing linkages among technology support, professional development, classroom practices, and impact of technology on teaching and learning — they can use that information to improve current strategies, design new ones, or identify/remedy inequities in access and resources in their technology projects. School and district staff members need to gather the necessary data to examine these linkages, which will allow them to answer important questions about on-going technology projects. STNA partially meets this need by providing a useful evaluation tool for schools that is both valid and reliable.

STNA can be an essential source of data for effectively evaluating the implementation and impact of technology projects; it also can help schools with project planning and decision-making. STNA is based on current research, standards, and best practices in the fields of educational technology and evaluation and was developed to empower schools and districts to plan and implement their own technology project evaluations. SERVE should continue to provide STNA as an evaluative resource to schools to support effective evaluation in school settings.

REFERENCES

Allaire, J., Gamaldo, A., & Whitfield, K. (2007). *Examining the factor structure of cognitive ability measures in African-American elders*. Unpublished manuscript.

Apple Computer Inc. (1995). *Changing the conversation about teaching, learning, and technology: A report on 10 years of ACOT research.* Cupertino, CA: Apple Computer, Inc.

Bangert-Drowns, R. L., & Pyke, C. (2002). Teacher ratings of student engagement with educational software: An exploratory study. *Educational Technology Research and Development, 50*(2), 23.

Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers & Education, 39*(4), 395-414.

Boethel, M., & Dimock, K. V. (1999). *Constructing knowledge with technology*. Austin, TX: Southwest Educational Development Laboratory.

Bogdan, R., & Biklen, S. (2007). *Qualitative research for education* (5th ed.). Boston: Pearson Education, Inc.

Bradshaw, L. K. (2002). Technology for teaching and learning: Strategies for staff development and follow-up support. *Journal of Technology and Teacher Education, 10*(1).

Brinkerhoff, R., Brethower, D., Hluchyj, T., & Nowakoski, J. (1983). *Program evaluation: A practioner's guide for trainers and educatiors.* Boston: Kluwer Nijhoff Publishing.

Brush, T., Armstrong, J., Barbrow, D., & Ulintz, L. (1999). Design and delivery of integrated learning systems: Their impact on student achievement and attitudes. *Journal of Educational Computing Research, 21*(4), 475-486.

Byrne, B. (2001). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Mahway, NJ: Lawrence Erlbaum Associates, Inc.

Campbell, D., & Stanley, J. (1963). *Experimental and quasi-experimental designs for research*. Boston: Houghton Mifflin Company.

Center for Research in Educational Policy. (n.d.). CREP Instruments. Retrieved June 8, 2007, from http://crep.memphis.edu/web/instruments/

CEO Forum. (2000a). *School technology and readiness report*. Washington, DC: Author.

CEO Forum. (2000b). Teacher preparation STaR Chart: A self-assessment tool for colleges of education. Washington, DC: CEO Forum on Education and Technology.

CEO Forum. (2001). *Key building blocks for student achievement in the 21st century*. Washington, DC: author.

Christensen, R., & Knezek, G. (1996). *Constructing the Teachers' Attitudes toward Computers (TAC) questionnaire.* Paper presented at the Annual Meeting of the Southwest Educational Research Association, New Orleans, LA.

Christensen, R., & Knezek, G. (2000). Internal consistency reliabilities for 14 computer attitude scales. *Journal of Technology and Teacher Education, 7*(4), 327-336.

Christmann, E., & Badgett, J. (1999). A comparative analysis of the effects of computer-assisted instruction on student achievement in differing science and demographic areas. *Journal of Computers in Mathematics and Science Teaching, 18*(2), 135-143.

Clements, D. H., & Sarama, J. (2003). Strip mining for gold: Research and policy in educational technology - a response to "Fool's Gold". *Educational Technology Review, 11*(1).

Coffman, J. (1999). *Learning from logic models: An example of a family/school partnership program.* Cambridge, MA: Harvard Family Research Project.

Cohen, D., & Hill, H. (1998). *Instructional policy and classroom performance: The mathematics reform in California*. Philadelphia, PA: Consortium for Policy Research in Education.

Cook, C., Heath, F., & Thompson, R. (2000). A meta-analysis of response rates in web or Internet-based surveys. *Educational and Psychological Measurement, 60*, 821-836.

Cook, T., & Campbell, D. (1979). *Quasi-experimentation design and analysis issues for field settings*. Boston: Houghton Mifflin.

Cordray, D., & Pion, G. (2006). Treatment strength and integrity: Models and methods. In R. R. Bootzin & P. E. McKnight (Eds.), *Strengthening research methodology: Psychological measurement and evaluation* (pp. 103-124). Washington, DC: American Psychological Association Press.

Corn, J. (2006). *Studying the validity and reliability of the School Technology Needs Assessment (STNA).* Unpublished master's thesis, North Carolina State University, Raleigh, NC.

Corn, J. (2007). *Investigating the validity and reliability of the School Technology Needs Assessment (STNA): An exploratory factor analysis*. Unpublished manuscript.

Cotton, K. (1991). Computer-Assisted Instruction. Retrieved December 18, 2006, from http://www.nwrel.org/scpd/sirs/5/cu10.html

Cousins, J. B., & Whitmore, E. (1998). Framing participatory evaluation. *New Directions for Evaluation, 80*, 5-23.

Culp, K., Honey, M., & Mandinach, E. (2003). *A retrospective on twenty years of education technology policy*. Newton, MA: Education Development Center.

Darling-Hammond, L., & McLaughlin, M. (1996). Policies that support professional development in an era of reform. In M. McLaughlin & I. Oberman (Eds.), *Teacher learning: New policies, new practices* (pp. 202-218). New York: Teachers College Press.

Davis, S., Darling-Hammond, L., LaPointe, M., & Meyerson, D. (2005). *School leadership study: Developing successful principals*. Stanford, CA: Stanford Educational Leadership Institute.

Dick, W., Carey, L., & Carey, J. (2005). *Systematic design of instruction* (6th ed.). Boston: Pearson.

Dillman, D. (1999). *Mail and internet surveys: The tailored design method* (2nd. ed.). New York: J. Wiley.

Dillman, D., Tortora, R., & Bowker, D. (2001). Principles for Constructing Web Surveys. Retrieved March 23, 2005, from http://www.sesrc.wsu.edu/dillman/papers/websurveyppr.pdf

Dirr, P. (2004). *Measuring the impact of technology on classroom teaching and learning*. Alexandria, VA: Appalachian Technology in Education Consortium.

Epstein, J. (2001). *School, family, and community partnerships: Preparing educators and improving schools.* Boulder, CO: Westview Press.

Ertmer, P. A., Gopalakrishnan, S., & Ross, E. M. (2001). Technology-using teachers: Comparing perceptions of exemplary technology use to best practice. *Journal of Research on Technology in Education, 33*(5).

Fetterman, D. M. (2002). Web surveys to digital movies: Technological tools of the trade. *Educational Researcher, 31*(6), 29-37.

Fetterman, D. M. (2005a). Empowerment evaluation principles in practice: Assessing levels of commitment. In D. M. Fetterman & A. Wandersman (Eds.), *Empowerment Evaluation Principles in Practice*. New York: Guilford Press.

Fetterman, D. M. (2005b). The heart and soul of empowerment evaluation. In D. M. Fetterman & A. Wandersman (Eds.), *Empowerment Evaluation Principles in Practice*. New York: The Guildford Press.

Fink, A. (1995). *The survey handbook* (Vol. 1). Thousand Oaks, CA: Sage Publications, Inc.

Fitzpatrick, J., Sanders, J., & Worthen, B. (2003). *Program evaluation: Alternative approaches and practical guidelines* (3rd ed.). New York: Addison, Wesley, Longman.

Fraenkel, J., & Wallen, N. (2003). *How to design and evaluate research in education* (5th ed.). Boston: McGraw Hill.

Frechtling, J. (2002). *The 2002 user friendly handbook for project evaluation*. Arlington, VA: National Science Foundation.

Frechtling, J. (2007). *Logic modeling methods in program evaluation*. San Francisco: Jossey-Bass.

Fuchs, L., & Fuchs, D. (2002). Curriculum-based measurement: Describing competence, enhancing outcomes, evaluating treatment effects, and identifying treatment nonresponders. *Peabody Journal of Education, 77*(2), 64-84.

Fullan, M. (2003). *The moral imperative of school leadership*. Thousand Oaks, CA: Corwin Press.

Fullan, M. (2005). Partners in Learning: Learning to lead change elite course. Redmond, WA: Microsoft Corporation.

Gable, R., & Wolf, M. (1993). *Instrument development in the affective domain* (2nd ed.). Boston: Kluwer Academic Publishers.

Gall, M., Borg, W., & Gall, J. (1996). *Educational research* (6th ed.). White Plains, NY: Longman.

Garet, M., Porter, A., Desimone, L., Birman, B., & Yoon, K. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.

Green, S., Salkind, N., & Akey, T. (2000). *Using SPSS for Windows: Analyzing and understanding data* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Guha, S. (2001). Integrating computers in elementary grade classroom instruction: Analyses of teachers' perceptions in present and preferred situations. *Journal of Educational Computing Research, 24*(3).

Guskey, T. (1986). Staff development and the process of teacher change. *Educational Researcher, 15*(5), 5-11.

Guskey, T. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press, Inc.

Haertel, G., & Means, B. (2000). *Stronger designs for research on educational uses of technology: Conclusions and implications*. Menlo Park, CA: SRI International.

Hall, G., & Hord, S. (2001). *Implementing change: Patterns, principles, and potholes*. Boston: Allyn and Bacon.

Hall, G., & Hord, S. (2006). Understanding feelings and perceptions about change. In *Implementing Change: Patterns, Principles and Potholes* (2nd ed.). Boston: Allyn & Bacon.

Hofer, M., Chamberlin, B., & Scot, T. (2004). Fulfilling the need for a technology integration specialist. *T.H.E. Journal, 32*(3), 34.

Horrigan, J., & Smith, A. (2007). *Home broadband adoption 2007*. Washington, DC: Pew Internet & American Life Project.

Horsley, D., & Loucks-Horsely, S. (1998). CBAM brings order to the tornado of change. *Journal of Staff Development, 19*(4), 17-20.

International Society for Technology in Education. (2000a). *National educational technology standards for students*. Eugene, OR.

International Society for Technology in Education. (2000b). *National educational technology standards for teachers.* Eugene, OR: International Society for Technology in Education.

International Society for Technology in Education. (2002). *National educational technology standards for administrators.* Eugene, OR: International Society for Technology in Education.

International Society for Technology in Education. (2006). NETS Project Website. Retrieved May 15, 2006, from http://cnets.iste.org

Interstate School Leaders Licensure Consortium. (1996). *Standards for school leaders*. Washington, DC: Council of Chief State School Officers.

Joint Committee on Evaluation Standards for Educational Evaluation. (1994). *The program evaluation standards* (2nd ed.). Thousand Oaks, CA: Sage.

Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional design theories and models* (Vol. II, pp. 215-239). Mahwah, NJ: Lawrence Erlbaum Associates.

Joyce, B., & Showers, B. (1995). *Student achievement through staff development*. White Plains, NY: Longman.

Julian, D. (1997). The utilization of the logic model as a system level planning and evaluation device. *Evaluation and Program Planning, 20*(3), 251-257.

Julian, D., Jones, A., & Deyo, D. (1995). Open systems evaluation and the logic model: Program planning and evaluation tools. *Evaluation and Program Planning, 18*(4), 333-341.

Kanaya, T., Light, D., & Culp, K. (2005a). Factors influencing outcomes from a technology-focused professional development program. *Journal of Research on Technology in Education, 37*(2).

Kanaya, T., Light, D., & Culp, K. (2005b). Factors influencing outcomes from a technology-focused professional development program. *Journal of Research on Technology in Education, 37*(3), 313-329.

Kerrigan, J. (2002). Powerful software to enhance the elementary school mathematics program. *Teaching Children Mathematics, 8*(6), 364-370.

Killion, J. (2002). *Assessing impact: Evaluating staff development*. Oxford, OH: National Staff Development Council.

King, J. (1998). Understanding and practicing participatory evaluation. *New Directions for Evaluation, 80*, 57-67.

Knestis, K., Byrom, E., Matzen, N., Corn, J., & Thrift, B. (in preparation). *Developing schools' capacity for evaluating technology projects: Lessons learned from the North*

Carolina IMPACT schools (Unpublished manuscript). Greensboro, NC: SERVE Center at UNCG.

Knestis, K., Byrom, E., Matzen, N., Corn, J., & Thrift, B. (in press). *Factors influencing the capacity for applying project evaluation in schools: Lessons learned from Looking at North Carolina Education Technology (LANCET)*. Greensboro, NC: SERVE Center at UNCG.

Kocher, A., & Moore, B. (2001, April). *Assessing teacher technology skills.* Paper presented at the Annual Meeting of the American Educational Research Association, Seattle, WA.

Lambert, L. (2002). A framework for shared leadership. *Educational Leadership*, 37-40.

Land, S., & Hannafin, M. (2000). Student-centered learning environments. In D. Jonassen & S. Land (Eds.), *Theoretical Foundations of Learning Environments*. Mahwah, NJ: Lawrence Erlbaum Associates.

Landau, S., & Everitt, B. (2004). Principal component analysis and factor analysis. In *A handbook of statistical analyses using SPSS* (pp. 277-304). Boca Raton, FL: Chapman and Hall.

Lemke, C. (2002). *enGauge 21st century skills: Digital literacies for a digital age*. Naperville, IL: North Central Regional Educational Lab.

Lemke, C., Wainer, A., & Haning, N. (2006). *National trends: Enhancing education through technology, NCLB Title II D - Year three in review*. Los Angeles: Metiri Group.

Liberman, A., & Miller, L. (1999). *Teachers: Transforming their world and their work*. New York: Teachers College Press.

Linn, R., & Miller, M. (2005). *Measurement and assessment in teaching* (9th ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Loucks-Horsely, S., Love, N., Stiles, K., Mundry, S., & Hewson, P. (2003). *Designing professional development for teachers of science and mathematics* (2nd ed.). Thousand Oaks, CA: Corwin Press.

Marzano, R., Waters, T., & McNulty, B. (2005). *School leadership that works*. Aurora, CO: McREL.

McArdle, J., & Nesselroade, J. (1994). Structuring data to study development and change. In S. Cohen & H. Reese (Eds.), *Lifespan developmental psychology: Methodological innovations*. Hillside, NJ: Lawrence Erlbaum Associates.

McKenzie, J. (2002). The true cost of ownership. *MultiMedia Schools, 9*(6).

McKillip, J. (1987). *Need analysis: Tools for human services and education* (Vol. 10). Newbury Park, CA: Sage.

McLaughlin, M., & Talbert, J. (1993). *Contexts that matter for teaching and learning*. Palo Alto, CA: Stanford University.

McNabb, M., Hawkes, M., & Rouk, U. (1999). *Critical issues in evaluating the effectiveness of technology.* Paper presented at the Secretary's Conference on Educational Technology: Evaluating the Effectiveness of Technology., Washington, DC.

Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance. *Psychometrica, 58*(4), 525-543.

Merriam, S., Caffarella, R., & Baumgartner, L. (2007). *Learning in adulthood* (3rd ed.). San Francisco: Jossey Bass.

Milken Exchange. (1998). *Technology in American schools: Seven dimensions for gauging progress.* Santa Monica, CA: Milken Family Foundation.

Milken Exchange. (1999). *Transforming learning through technology: Policy roadmaps for the nation's governors.* Santa Monica, CA: Milken Family Foundation.

Miller, M. (1995). Coefficient alpha: A basic introduction from the perspectives of classical test theory and structural equation modeling. *Structural Equation Modeling, 2*(3), 255-273.

National Business Education Alliance. (2006). The LoTi connection.   Retrieved June 6, 2007, from http://www.loticonnection.com/

National Center for Educational Statistics. (2004). *Digest of Education Statistics*.

National Staff Development Council. (2001). Standards of staff development (Revised Edition). from http://www.nsdc.org/standards/index.cfm

NCRTEC. (1997). Learning with technology profile tool.   Retrieved June 30, 2007, from http://www.ncrtec.org/capacity/profile/profwww.htm

Newmann, F., King, B., & Youngs, P. (2001). *Professional development that addresses school capacity.* Paper presented at the American Educational Research Association, Seattle, WA.

Newmann, F., Smith, B., Allensworth, E., & Bryk, A. (2001). *School instructional program coherence: Benefits and challenges*. Chicago: Consortium on Chicago School Research.

North Carolina Department of Public Instruction. (2003a). The IMPACT Grant Project. from http://tps.dpi.state.nc.us/eett/

North Carolina Department of Public Instruction. (2003b). Looking at North Carolina's educational technology (LANCET). from http://www.ncwiseowl.org/impact/LANCET/

North Carolina Department of Public Instruction. (2007). Annual media and technology report. Retrieved December, 20, 2007, from http://tps.dpi.state.nc.us/amtr2007/

North Central Regional Educational Laboratory. (2000). enGauge: A framework for effective technology use. Retrieved June 4, 2007, from http://www.ncrel.org/engauge/

November, A., Costello, M., & Huske, L. (1998). Developing a school or district technology plan. *North Central Regional Educational Laboratory Pathways Critical Issue*.

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection*. Washington, DC: U.S. Government Printing Office.

Osborne, J. E. (2008). *Best practices in quantitative methods*. Thousand Oaks, CA: Sage Publishing.

Otterbourg, S. (1998). *Using technology to strengthen employee and family involvement in education*. Washington, DC: Partnership for Family Involvement in Education; U.S. Department of Education.

Papanastasiou, E., Zemblyas, M., & Vrasidas, C. (2003). Can computer use hurt science achievement? *Journal of Science Education and Technology, 12*(3), 325-332.

Partnership for 21st Century Skills. (2006a). Framework for 21st century learning overview. Retrieved November 1, 2006, from http://www.21stcenturyskills.org/documents/Frameworkflyer092806.pdf

Partnership for 21st Century Skills. (2006b). Professional development for the 21st century. Retrieved November 1, 2006, from http://www.21stcenturyskills.org/documents/ProfDev.pdf

Patton, M. Q. (1994). Developmental evaluation. *Evaluation Practice, 15*(3), 311-319.

Patton, M. Q. (1997). *Utilization-focused evaluation: The new century text* (3rd ed.). Beverly Hills, CA: Sage.

Pendersen, S., & Liu, M. (2003). Teachers' beliefs about issues in the implementation of a student-centered learning environment. *Educational Technology Research and Development, 51*(2), 57-76.

Penuel, W., Kim, D., Michalchik, V., Lewis, S., Means, B., Murhpy, R., et al. (2002). *Using technology to enhance connections between home and school: A research synthesis*. Washington, DC: Planning and Evaluation Service, U.S. Department of Education.

Pett, M., Lackey, N., & Sullivan, J. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*. Thousand Oaks, CA: Sage.

Powell, J., Aeby, V., & Carpenter-Aeby, T. (2003). A comparison of student outcomes with and without teacher facilitated computer-based instruction. *Computers & Education, 40*(2), 183-191.

Public Schools of North Carolina. (2005). *IMPACT: Guidelines for North Carolina Media and Technology Programs*. Raleigh, NC.

Reilly, R. (1999). The technology coordinator: Curriculum leader or electronic janitor? *MultiMedia Schools, 6*(3), 38-41.

Ringstaff, C., & Kelley, L. (2002). *The learning return on our educational technology investment*. San Francisco: WestEd.

Rogers, E. (2003). *Diffusion of innovations* (5th ed. Vol. 5th). New York: The Free Press.

Royse, D., Thyer, B., Padgett, D., & Logan, T. K. (2006). *Program evaluation* (4th ed.). Belmont, CA: Thompson.

Sands, S., & Buchholz, E. S. (1997). The underutilization of computers to assist in the remediation of dyslexia. *International Journal of Instructional Media, 24*(2), 153-175.

Schacter, J. (1999). *The impact of education technology on student achievement*. Santa Monica, CA: Milken Exchange on Education Technology.

Scriven, M. (1967). The methodology of evaluation. In R. W. Tyler & R. M. Gagne (Eds.), *Perspectives in Curriculum Evaluation* (pp. 39-83). Chicago: Rand McNally.

Shadish, W., Cook, T., & Campbell, D. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Boston: Houghton Mifflin Company.

Shannon, D. M., Johnson, T. E., Searcy, S., & Lott, A. (2002). Using electronic surveys: Advice from survey professionals. *Practical Assessment, Research & Evaluation, 8*(1).

Shelly, G., Cashman, T., Gunter, R., & Gunter, G. (2002). *Integrating technology into the classroom* (2nd ed.). Boston: Thompson Learning.

Solomon, D. J. (2001). Conducting web-based surveys. *Practical Assessment, Research & Evaluation, 7*(19).

Sparks, G. (1983). Synthesis of research on staff development for effective teaching. *Educational Leadership, 41*(3), 65-72.

Speck, M., & Knipe, C. (2001). *Why can't we get it right? Professional development in our schools*. Thousand Oaks, CA: Corwin Press, Inc.

State Educational Technology Directors Association. (2004). SETDA examples of data-based decision making. Retrieved June 21, 2007, from http://setda.org/web/guest/datadrivendecisionmaking

Stein, S., & Gewirtzman, L. (2003). *Principal training on the ground: Ensuring highly qualified leadership*. Portsmouth, NH: Heinemann.

Texas Education Agency. (2001). *Texas STaR Chart: A tool for planning and assessing school technology and readiness aligned with the Texas long-range plan for technology.* Austin, TX: Author.

Texas Education Agency. (2002). Texas STaR chart. Retrieved June 4, 2007, from http://starchart.esc12.net/default.html

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications.* Washington, DC: American Psychological Association.

Tiene, D., & Luft, P. (2001). Teaching in a technology-rich classroom. *Educational Technology, 41*(4), 21-31.

U.S. Department of Education. (2002a). *Enhancing Education Through Technology*.

U.S. Department of Education. (2002b). *No Child Left Behind (NCLB)*.

U.S. Department of Education. (2004). *Toward a new gold age in American education: National education technology plan*. Washington, DC: author.

Utah Education Network. (1999). Utah technology awareness project rubrics. Retrieved June 16, 2007, from http://www.uen.org/cgi-bin/websql/utahlink/UTAPdomains.hts

W.K. Kellogg Foundation. (1998). *Evaluation handbook*. Kalamazoo, MI: Author.

Wandersman, A. (1999). Framing the evaluation of health and human service programs in community settings: Assessing progress. *New Directions for Evaluation, 83*, 95-102.

Wandersman, A., Imm, P., Chinman, M. J., & Kaftarian, S. J. (2000). Getting to outcomes: A results-based approach to accountability. *Evaluation and Program Planning, 23*, 389-395.

Waters, T., Marzano, R., & McNulty, B. (2003). *Balanced leadership: What 30 years of research tells us about the effect of leadership on student achievement*. Aurora, CO: McREL.

Wenger, E., McDermott, R., & Synder, W. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Boston: Harvard Business School Press.

Weston, T. (2004). Formative evaluation for implementation: Evaluating educational technology applications and lessons. *American Journal of Evaluation, 25*(1), 51-64.

Worthen, B., Sanders, J., & Fitzpatrick, J. (2004). *Program evaluation: Alternative approaches and practical guidelines* (3rd ed.). New York: Addison, Wesley, Longman.

APPENDICIES

Appendix A

School Technology Needs Assessment *(STNA) 3.0*

The School Technology Needs Assessment *(STNA, say "Stenna") is intended to help school-level decision makers—administrators, technology facilitators, media coordinators, or technology committee members—collect data to plan and improve uses of technology in teaching and learning activities. The STNA is designed to be completed by teachers and other educators working directly with students, and should be administered to the entire staff of any school for which needs are being assessed. STNA results are not scored or reported for each individual respondent. Instead, each person's responses are combined with those of other educators in their building, and reported at the school level in terms of how many times each possible response is selected for each item. Pilot testing indicates that it should take approximately 25 minutes to complete the STNA.*

I. Supportive Environment for Technology Use

Selecting Responses – Section I

1. For each item, check the box below the response that best matches how much you agree with the statement - "Strongly Agree," "Agree," "Disagree," or "Strongly Disagree."
2. If you do not have enough information to form an opinion about the topic of an item, select "Do Not Know."
3. If you have enough information to form an opinion but are simply split between "Agree" and "Disagree," select "Neither Agree nor Disagree."

	"In my school…"	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know
Vision and Shared Leadership	1) A vision for technology has been developed through an effective collaboration among stakeholders, e.g., administrators, specialists, teachers, students, and community members.	☐	☐	☐	☐	☐	☐
	2) The vision for technology use has been effectively communicated to the community.	☐	☐	☐	☐	☐	☐
	3) Administrators model effective uses of technology.	☐	☐	☐	☐	☐	☐
	4) Administrators support changes in school-level systems, policies, and practices related to technology.	☐	☐	☐	☐	☐	☐

	5) Teachers who are innovators with technology receive **material incentives**, e.g., stipends, perks, waivers, special opportunities.	☐	☐	☐	☐	☐	☐
	6) Teachers who are innovators with technology receive **non-material incentives**, e.g., public recognition, special appreciation.	☐	☐	☐	☐	☐	☐
	7) When administrators are seeking or hiring teachers, they consider technology literacy and leadership for technology as criteria for selection.	☐	☐	☐	☐	☐	☐
Organizational Conditions	8) An effective long-range school technology plan is in place.	☐	☐	☐	☐	☐	☐
	9) The school technology plan is developed through an effective collaboration among stakeholders, e.g., administrators, specialists, teachers, students, and community members.	☐	☐	☐	☐	☐	☐
	10) The school technology plan is monitored and updated at least once a year.	☐	☐	☐	☐	☐	☐
	11) Teachers and other staff members support the school technology plan.	☐	☐	☐	☐	☐	☐
	12) The amount of money budgeted for technology resources is sufficient for implementing decisions arising from planning.	☐	☐	☐	☐	☐	☐
	13) The amount of money budgeted for technology resources is sufficient for continuously updating and replacing technology systems as they become outdated.	☐	☐	☐	☐	☐	☐
	14) Supplemental sources of funding are actively pursued to support technology, e.g., external grants, collaboration with community or parent groups, support from businesses.	☐	☐	☐	☐	☐	☐
	15) Multiple sources of data are used to evaluate the impact of technology initiatives on student outcomes.	☐	☐	☐	☐	☐	☐
	16) Technology is used to communicate and collaborate **with families** about school programs and student learning.	☐	☐	☐	☐	☐	☐
	17) Technology is used to communicate and collaborate **with the community** about school programs designed to enhance student learning.	☐	☐	☐	☐	☐	☐
ble Sche dulin	18) The media center can be flexibly scheduled to provide equitable access to resources and instruction.	☐	☐	☐	☐	☐	☐

	19) Computer labs can be flexibly scheduled for equitable access to resources and instruction. (Leave this item blank if your school has no computer labs.)	☐	☐	☐	☐	☐	☐
	20) Mobile computers can be flexibly scheduled to provide equitable access to resources and instruction. (Leave this item blank if your school has no mobile computers.)	☐	☐	☐	☐	☐	☐
Infrastructure	21) Teachers and students have sufficient computer hardware available for their use, e.g., computers, digital cameras, projection devices, scanners, printers.	☐	☐	☐	☐	☐	☐
	22) Electronic systems for communicating within the school are adequate, e.g., e-mail among teachers and staff, network drives to upload lesson plans and grades to the main office.	☐	☐	☐	☐	☐	☐
	23) Electronic systems for communicating with families and the community are adequate, e.g., e-mail, teacher, and/or school Web pages.	☐	☐	☐	☐	☐	☐
	24) Reliability and speed of external connections are sufficient, e.g., connections to the Internet, online databases, and other resources.	☐	☐	☐	☐	☐	☐
	25) Students with disabilities have appropriate and adequate access to adaptive and assistive devices.	☐	☐	☐	☐	☐	☐
Staff Support	26) Teachers have ready access to technical support, e.g., to troubleshoot hardware or software problems, maintain systems.	☐	☐	☐	☐	☐	☐
	27) Library media coordinator and/or media assistant positions are adequately staffed.	☐	☐	☐	☐	☐	☐
	28) Technology facilitator and/or technology assistant positions are adequately staffed.	☐	☐	☐	☐	☐	☐
Media and Software	29) Teachers and students have ready access to productivity software, e.g., graphic organizer, word processing, slide presentation, or drawing applications.	☐	☐	☐	☐	☐	☐
	30) Teachers have ready access to a cataloging system they can use for searching and locating teaching materials.	☐	☐	☐	☐	☐	☐
	31) Teachers and students have ready access to a good collection of print, multimedia, and electronic resources.	☐	☐	☐	☐	☐	☐

	32) When educators are selecting resource media and software, they consider both the curriculum and the needs of learners.	☐	☐	☐	☐	☐	☐

II. Professional Development

Selecting Responses – Section II

1. For each item, check the box below the response that best matches how much you agree with the statement - "Strongly Agree," "Agree," "Disagree," or "Strongly Disagree."
2. If you do not have enough information to form an opinion about the topic of an item, select "Do Not Know."
3. If you have enough information to form an opinion but are simply split between "Agree" and "Disagree," select "Neither Agree nor Disagree."

"I would benefit from professional development on…"		Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know
Professional Development Needs: Instruction	1) Research-based practices I can use in my teaching.	☐	☐	☐	☐	☐	☐
	2) Identification, location, and evaluation of technology resources, e.g., websites, that I can use with my students.	☐	☐	☐	☐	☐	☐
	3) Performance-based student assessment of my students.	☐	☐	☐	☐	☐	☐
	4) The use of technology to collect and analyze student assessment data.	☐	☐	☐	☐	☐	☐
	5) Learner-centered teaching strategies that incorporate technology, e.g., project-based or cooperative learning.	☐	☐	☐	☐	☐	☐
	6) Online security and safety.	☐	☐	☐	☐	☐	☐
	7) The use of technology for differentiating instruction for students with special learning needs.	☐	☐	☐	☐	☐	☐
Professional Development Needs: Planning	8) Uses of technology to increase my professional productivity.	☐	☐	☐	☐	☐	☐
	9) Ways to use technology to communicate and collaborate with families about school programs and student learning.	☐	☐	☐	☐	☐	☐
	10) Ways to use technology to communicate and collaborate with other educators.	☐	☐	☐	☐	☐	☐

	11) Alignment of lesson plans to content standards and student technology standards.	☐	☐	☐	☐	☐	☐
	12) Use of research or action research projects to improve technology-enhanced classroom practices.	☐	☐	☐	☐	☐	☐
	13) Use of data for reflecting on my professional practices.	☐	☐	☐	☐	☐	☐
	14) Use of data to make decisions about the use of technology.	☐	☐	☐	☐	☐	☐
	15) Use of technology to participate in professional development activities, e.g. online workshops, hands-on training in a computer lab.	☐	☐	☐	☐	☐	☐
Professional Development Quality	16) Educators in charge of professional development use data from teachers' needs assessments to determine technology professional development topics and activities.	☐	☐	☐	☐	☐	☐
	17) Technology professional development is timely.	☐	☐	☐	☐	☐	☐
	18) Technology professional development is relevant.	☐	☐	☐	☐	☐	☐
	19) Technology professional development is ongoing.	☐	☐	☐	☐	☐	☐
	20) Teachers have an opportunity to evaluate technology professional development activities in which they participate.	☐	☐	☐	☐	☐	☐
	21) The impact of technology professional development is tracked using data on **classroom practice**.	☐	☐	☐	☐	☐	☐
	22) The impact of technology professional development is tracked using data on **student learning**.	☐	☐	☐	☐	☐	☐

III. Teaching and Learning

Selecting Responses – Section III

1. For each item, check the box below the response that comes closest to indicating how often you do the described activity - "Daily," Weekly," and so on.
2. If you do not have enough information to select a number response for an item, select "Do Not Know."

"In the settings where I work with children…"		Daily	Weekly	Monthly	Once per Grading Period	Never	Do Not Know
Instruction	1) I consult publications, online journals, or other resources to identify research-based practices I can use in teaching with technology.	☐	☐	☐	☐	☐	☐
	2) I identify, locate, and evaluate technology resources, e.g., websites.	☐	☐	☐	☐	☐	☐
	3) I apply performance-based student assessment to technology-enhanced lessons, e.g., student portfolios, student presentations.	☐	☐	☐	☐	☐	☐
	4) I use technology regularly to collect and analyze student assessment data.	☐	☐	☐	☐	☐	☐
	5) My lessons include technology-enhanced, learner-centered teaching strategies, e.g., project-based learning.	☐	☐	☐	☐	☐	☐
	6) I apply policies and practices to enhance online security and safety.	☐	☐	☐	☐	☐	☐
	7) I use technology to differentiate instruction for students with special learning needs.	☐	☐	☐	☐	☐	☐
Planning	8) I use technology to support and increase my professional productivity.	☐	☐	☐	☐	☐	☐
	9) I use technology to communicate and collaborate with families about school programs and student learning.	☐	☐	☐	☐	☐	☐
	10) I use technology to communicate and collaborate with other educators.	☐	☐	☐	☐	☐	☐
	11) My lesson plans refer to both content standards and student technology standards.	☐	☐	☐	☐	☐	☐

	12) I do research or action research projects to improve technology-enhanced classroom practices.	☐	☐	☐	☐	☐	☐
	13) I use multiple sources of data for reflecting on professional practice.	☐	☐	☐	☐	☐	☐
	14) I use multiple sources of data to make decisions about the use of technology.	☐	☐	☐	☐	☐	☐
	15) I use technology to participate in professional development activities, e.g. online workshops, hands-on training in a computer lab.	☐	☐	☐	☐	☐	☐
Information and Communication Technologies	1) Students use a variety of technologies, e.g., productivity, visualization, research, and communication tools.	☐	☐	☐	☐	☐	☐
	2) Students use technology during the school day to communicate and collaborate with others, beyond the classroom.	☐	☐	☐	☐	☐	☐
	3) Students use technology to access online resources and information as a part of classroom activities.	☐	☐	☐	☐	☐	☐
	4) Students use the same kinds of tools that professional researchers use, e.g., simulations, databases, satellite imagery.	☐	☐	☐	☐	☐	☐
	5) Students work on technology-enhanced projects that approach real-world applications of technology.	☐	☐	☐	☐	☐	☐
	6) Students use technology to help solve problems.	☐	☐	☐	☐	☐	☐
	7) Students use technology to support higher-order thinking, e.g., analysis, synthesis, and evaluation of ideas and information.	☐	☐	☐	☐	☐	☐
	8) Students use technology to create new ideas and representations of information.	☐	☐	☐	☐	☐	☐

IV. Impact of Technology

Selecting Responses – Section IV

1. For each item, check the box below the response that best matches how much you agree with the statement - “Strongly Agree," "Agree," "Disagree," or "Strongly Disagree.”
2. If you do not have enough information to form an opinion about the topic of an item, select “Do Not Know.”
3. If you have enough information to form an opinion but are simply split between “Agree” and “Disagree,” select “Neither Agree nor Disagree.”

“In the settings where I work with children…”		Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know
Teaching Practices	1) My teaching is more student-centered and interactive when technology is integrated into instruction.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
	2) My teaching practices emphasize teacher uses of technology skills to support instruction.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
	3) My teaching practices emphasize student uses of productivity applications, e.g., word processing, spreadsheet.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
	4) My teaching practices emphasize student uses of technology as an integral part of specific teaching strategies, e.g., project-based or cooperative learning.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
Student Outcomes	5) Technology has helped my students become more socially aware, confident, and positive about their future.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
	6) Technology has helped my students become independent learners and self-starters.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
	7) Technology has helped my students work more collaboratively.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
	8) Technology has increased my students’ engagement in their learning.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
	9) Technology has helped my students achieve greater academic success.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

VII. Professional Personal Profile

Selecting Responses – Section VII

Your responses to the following items are used only to further ongoing study of the reliability and validity of the STNA instrument. In order to preserve and ensure the confidentiality of your individual response, this demographic information will not be made available to your school.

<table>
<tr><td colspan="3">"You need to know about me…"</td></tr>
<tr><td rowspan="3">Professional Profile</td><td>1) I have ____ years of experience.</td><td>Please enter the closest whole number that represents the total number of years you have worked in positions similar to your current role, e.g. 8 or 23.</td></tr>
<tr><td>2) I am a…</td><td>❑ Teacher (including specialists, e.g., art, PE)
❑ Teaching assistant, aide, or similar
❑ Technology specialist
❑ Media specialist
❑ Administrator
❑ Other</td></tr>
<tr><td>3) I currently teach (check all that apply)…</td><td>❑ Pre-kindergarten students
❑ Kindergarten students
❑ 1st-grade students
❑ 2nd-grade students
❑ 3rd-grade students
❑ 4th-grade students
❑ 5th-grade students
❑ 6th-grade students
❑ 7th-grade students
❑ 8th-grade students
❑ 9th-grade students
❑ 10th-grade students
❑ 11th-grade students
❑ 12th-grade students</td></tr>
<tr><td rowspan="2">Demographic Information</td><td>4) I identify myself as (check all that apply)…</td><td>❑ American Indian or Alaska Native
❑ Asian
❑ Black or African American
❑ Native Hawaiian or Other Pacific Islander
❑ White
❑ Hispanic/Latino</td></tr>
<tr><td>5) I am…</td><td>❑ Female
❑ Male</td></tr>
</table>

	6) I have Internet access at home…	❑ No ❑ Yes, dial-up service ❑ Yes, broadband service

Appendix B

STNA Item Reference Matrices

Construct I. Supportive Environment for Technology Use

This construct primarily focuses on the level to which conditions are in place at the school to support effective technology use. These items ask if the right tools, resources, staff, opportunities, etc. are in place to enable teachers and other staff to successfully integrate technology (see Table B1).

Table B1

Reference Matrix for *Supportive Environment for Technology Use* Construct for STNA

Subconstruct	Item	Standard or Suggested Practice
Vision and Shared Leadership	1. A vision for technology has been developed through an effective collaboration among stakeholders, e.g., administrators, specialists, teachers, students, and community members.	▪ Educational leaders facilitate the shared development by all stakeholders of a vision for technology use and widely communicate that vision (International Society for Technology in Education, 2002). ▪ All stakeholders should be involved in creating the vision. The vision should be understood and committed to by the full range of stakeholders. School, district, and community leaders should be formally committed to implementing the vision(North Central Regional Educational Laboratory, 2000). ▪ The system should engage key stakeholders plus the broader community, in defining and clearly stating a compelling vision and expectations for technology in schools (Milken Exchange, 1998). ▪ The district and the schools should effectively communicate the vision to students, staff, and the community (North Central Regional Educational Laboratory, 2000). ▪ Advance a bold, forward-looking vision for tomorrow's schools. Build consensus around a compelling vision--tie it to economic growth. Create a sense of urgency about the vision among the community, private sector, and schools (Milken Exchange, 1998). ▪ Formal technology-related structures and processes should engage parents, community members, school faculty, and learners in meaningful exchanges, interactions, and partnerships that advance the vision (North Central Regional Educational Laboratory, 2000).
	2. The vision for technology use has been effectively communicated to the community.	▪ The district and the schools should effectively communicate the vision to students, staff, and the community (North Central Regional Educational Laboratory, 2000). ▪ Advance a bold, forward-looking vision for tomorrow's schools. Build consensus around a compelling vision--tie it to economic growth. Create a sense of urgency about the vision among the

		community, private sector, and schools (Milken Exchange, 1998). ▪ Key community stakeholders should be committed and involved in planning, implementing, and evaluating the system's use of learning technologies (Milken Exchange, 1998).
	3. Administrators model effective uses of technology.	▪ Administrators should model the effective use of technology; develop and support systemic change processes to maximize support for learning; and facilitate appropriate professional development processes (Milken Exchange, 1998). ▪ Administrators should be prepared to use technology effectively. They should be prepared to work with colleagues to guide their school system toward more effective uses of technology in teaching, learning, and managing (North Central Regional Educational Laboratory, 2000).
	4. Administrators support changes in school-level systems, policies, and practice related to technology.	▪ Administrators should be prepared to use technology effectively. They should be prepared to work with colleagues to guide their school system toward more effective uses of technology in teaching, learning, and managing (North Central Regional Educational Laboratory, 2000). ▪ Educational leaders foster and nurture a culture of responsible risk-taking and advocate policies promoting continuous innovation with technology (International Society for Technology in Education, 2002).
	5. Teachers who are innovators with technology receive incentives or rewards for their hard work (e.g., funding, perks, waivers, special opportunities).	▪ Innovation--with and without technology--should be supported, encouraged, and actively developed through policies and informal action. Policymakers should use funding, perks, waivers, and special opportunities to provide incentives for schools and educators to innovate (North Central Regional Educational Laboratory, 2000).
	6. Teachers who are innovators with technology receive **non-material incentives**, e.g., public recognition, special appreciation.	▪ Educational leaders foster and nurture a culture of responsible risk-taking and advocate policies promoting continuous innovation with technology (International Society for Technology in Education, 2002). ▪ The school culture should be one that encourages, enables, and rewards educators individually and collectively to improve the learning and teaching processes through the effective use of technology and communication networks (Milken Exchange, 1998). ▪ Multiple faculty incentives support technology integration and research (CEO Forum, 2000).

	7. When administrators are seeking or hiring teachers, they consider technology literacy and leadership for technology as criteria for selection.	▪ The school should seek college graduates with the highest standard of technology teaching expertise, who will become technology leaders in their schools (CEO Forum, 2000b).
Organizational Conditions	8. An effective long-range school technology plan is in place.	▪ Educational leaders maintain an inclusive and cohesive process to develop, implement, and monitor a dynamic, long-range, and systemic technology plan to achieve the vision (International Society for Technology in Education, 2002). ▪ The system should develop a comprehensive, long-term plan, with alignment between the plan for technology in schools and existent policies and practices (e.g., rules and regulations, fiscal priorities, operating practices, allocation of resources, investment in human capital and accountability) (Milken Exchange, 1998).
	9. The school technology plan is developed through an effective collaboration among stakeholders, e.g., administrators, specialists, teachers, students, and community members.	▪ Technology and media staff play an ongoing and active role throughout the planning and construction phases of renovated or repurposed facilities (i.e., space, design, and furniture considerations) that focus on accessibility, flexibility, and efficiency necessary to provide opportunities for teaching and learning as well as media and technology administrative needs (Public Schools of North Carolina, 2005). ▪ Form a media and technology advisory committee to include the media coordinator and the technology facilitator. The committee meets at least monthly to advocate for the technology and media programs within the school, assess needs and make decisions regarding budget allocations. A resource development plan is supported by an adequate yearly budget to maintain, update, and expand the school's resources. Short-term and long-term plans are developed for collection development and the integration of media and technology programs into the total school instructional program to enhance student learning (Public Schools of North Carolina, 2005).
	10. The school technology plan is monitored and updated at least once a year.	▪ Form a media and technology advisory committee to include the media coordinator and the technology facilitator. The committee meets at least monthly to advocate for the technology and media programs within the school, assess needs and make decisions regarding budget allocations. A resource development plan is supported by an adequate yearly budget to maintain, update, and expand the

		school's resources. Short-term and long-term plans are developed for collection development and the integration of media and technology programs into the total school instructional program to enhance student learning (Public Schools of North Carolina, 2005).
	11. Teachers and other staff members support the school technology plan.	▪ Technology and media staff play an ongoing and active role throughout the planning and construction phases of renovated or repurposed facilities (i.e., space, design, and furniture considerations) that focus on accessibility, flexibility, and efficiency necessary to provide opportunities for teaching and learning as well as media and technology administrative needs (Public Schools of North Carolina, 2005). ▪ Form a media and technology advisory committee to include the media coordinator and the technology facilitator. The committee meets at least monthly to advocate for the technology and media programs within the school, assess needs and make decisions regarding budget allocations. A resource development plan is supported by an adequate yearly budget to maintain, update, and expand the school's resources. Short-term and long-term plans are developed for collection development and the integration of media and technology programs into the total school instructional program to enhance student learning (Public Schools of North Carolina, 2005).
	12. The amount of money budgeted for technology resources is sufficient for implementing decisions arising from planning.	▪ Educational leaders allocate financial and human resources to ensure complete and sustained implementation of the technology plan (International Society for Technology in Education, 2002).
	13. The amount of money budgeted for technology resources is sufficient for continuously updating and replacing technology systems as they become outdated.	▪ Provide an adequate plan for growth and expansion that is supported by an adequate yearly budget to support the evolution of developments in state-of-the-art technology (Public Schools of North Carolina, 2005).
	14. Supplemental sources of funding are actively pursued to support technology (e.g., external grants, collaboration with community or parent groups, support from	▪ Building-level media and technology staff should secure additional funding by actively seeking out and writing grants, and soliciting funding from other sources such as PTA/PTOs, local community organizations, and businesses (Public Schools of North Carolina, 2005).

	businesses).	
	15. Multiple sources of data are used to evaluate the impact of technology programs.	▪ Educational leaders use technology to plan and implement comprehensive systems of effective assessment and evaluation (International Society for Technology in Education, 2002). ▪ Collaborative planning, evaluation, and instruction shows specific links between information literacy and content, and is a team effort between the technology facilitator, media coordinator, teachers, support personnel, pre-service interns, administrators, and students (Public Schools of North Carolina, 2005).
	16. Technology is used to communicate and collaborate with families about school programs and student learning. 17. Technology is used to communicate and collaborate with the community about school programs designed to enhance student learning.	▪ The telecommunications infrastructure should provide appropriate, robust communication from every learning setting. That access should extend beyond the school day and outside the school facility (North Central Regional Educational Laboratory, 2000). ▪ Teachers use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning (International Society for Technology in Education, 2000b). ▪ Mechanisms should be in place for ongoing communication among partners and the broader community for the purposes of celebrating successes, building awareness, monitoring progress, and encouraging wider participation (Milken Exchange, 1998). ▪ Create a communication plan to keep all stakeholders regularly informed of technology learning goals and progress toward those goals, and to engage all stakeholders in the process of continuous improvement (Milken Exchange, 1998).
Flexible Scheduling	18. The media center can be flexibly scheduled to provide equitable access to resources and instruction. 19. Computer labs can be flexibly scheduled for equitable access to resources and instruction. 20. Mobile computers can be flexibly scheduled to provide equitable access to resources and instruction.	▪ Building-level media and technology programs provide flexibly scheduled programs that provide equal and open access to resources and instruction that integrate with classroom goals and objectives at point of need (Public Schools of North Carolina, 2005).
Infrastructure	21. Teachers and students have sufficient computer hardware available for their	▪ Educational leaders implement procedures to drive continuous improvements of technology systems and to support technology replacement cycles

	use, e.g., computers, digital cameras, projection devices, scanners, printers.	(International Society for Technology in Education, 2002). ▪ Schools should have an installed base of modern technology equipment (computers, calculators, digital cameras, projection devices, scanners, printers, etc.) to support the learning, communication, and administrative goals of the education system (Milken Exchange, 1998). ▪ Educational leaders develop, implement, and monitor policies and guidelines to ensure compatibility of technologies (International Society for Technology in Education, 2002). ▪ Provide access to state-of-the-art technology and resources on local and wide area networks (Public Schools of North Carolina, 2005).
	22. Electronic systems for communicating within the school are adequate, e.g., e-mail among teachers and staff, network drives to upload lesson plans and grades to the main office.	▪ The telecommunications infrastructure should provide appropriate, robust communication from every learning setting. That access should extend beyond the school day and outside the school facility (North Central Regional Educational Laboratory, 2000). ▪ Building-level media and technology staff continuously publicize the contributions and resources of media and technology programs through a broad range of vehicles such as Web pages, newsletters, board presentations, displays, and special events (Public Schools of North Carolina, 2005).
	23. Electronic systems for communicating with families and the community are adequate, e.g., e-mail, teacher, and/or school Web pages.	
	24. Reliability and speed of external connections are sufficient, e.g., connections to the Internet, online databases, and other resources.	▪ Provide access to state-of-the-art technology and resources on local and wide area networks (Public Schools of North Carolina, 2005). ▪ Provide an infrastructure and connectivity that meet current state technology plan and information resources management standards (Public Schools of North Carolina, 2005). ▪ The connectivity should be adequate to support current and rapidly growing demands created by the learning, communication, and administrative requirements of the education system (Milken Exchange, 1998). ▪ System level professional staff is provided to facilitate the standardization of resources and hardware (Public Schools of North Carolina, 2005). ▪ System level professional staff is provided to facilitate the planning for and overseeing of LEA infrastructure and connectivity (Public Schools of North Carolina, 2005).
	25. Students with disabilities have	▪ Educators are aware of disability issues and are well-trained in accommodations, including assistive

	appropriate and adequate access to adaptive and assistive devices.	technologies (North Central Regional Educational Laboratory, 2000). ▪ Equitable access to resources and facilities that meet minimum requirements of federal ADA and special education laws is provided for identified students and others with special needs(Public Schools of North Carolina, 2005).
Staff Support	26. Adequate access to technical support is available (e.g., to troubleshoot hardware or software problems, maintain systems).	▪ School facilities should support connectivity and intensive technology use for learning. Consideration of such use should guide all facilities renovation and new construction (North Central Regional Educational Laboratory, 2000). ▪ Provide online support systems for educators to promote collegiality, access to resources, and continuous growth (Milken Exchange, 1999). ▪ The school and/or district should provide adequate and timely support for hardware, software, and instructional application (North Central Regional Educational Laboratory, 2000). ▪ Adequate technical support should provide timely, expert troubleshooting, technical assistance, ongoing maintenance, operation, and upgrades (Milken Exchange, 1998). ▪ Tech support available 24/7 (CEO Forum, 2000). ▪ System level professional staff is provided to facilitate the standardization of resources and hardware (Public Schools of North Carolina, 2005). ▪ System level professional staff is provided to facilitate the planning for and overseeing of LEA infrastructure and connectivity (Public Schools of North Carolina, 2005).
	27. Library media coordinator and/or media assistant positions are adequately staffed.	▪ Building-level media and technology staff continuously foster interpersonal relationships with students and staff to encourage collaboration, communication, and the sharing of ideas and strategies that support the total instructional program (Public Schools of North Carolina, 2005). ▪ The recommended *minimum* staffing for schools with an average daily membership of 1-500 includes: 1 full-time library media coordinator, 1 full-time technology facilitator, 1/2 media assistant and 1/2 technology assistant (Public Schools of North Carolina, 2005). ▪ The recommended *minimum* staffing for schools with an average daily membership of 501-1000 includes: 1 full-time library media coordinator, 1 full-time technology facilitator, 1 full-time media assistant, and 1 full-time technology assistant (Public Schools of North Carolina, 2005).

		▪ The recommended *minimum* staffing for schools with an average daily membership of 1001-1500 includes: 2 full-time library media coordinators, 2 full-time technology facilitators, 1 1/2 media assistants, and 1 1/2 full-time technology assistants (Public Schools of North Carolina, 2005). ▪ The recommended *minimum* staffing for schools with an average daily membership of 1501-2000 includes: 2 full-time library media coordinators, 2 full-time technology facilitators, 2 full-time media assistants, and 2 full-time technology assistants (Public Schools of North Carolina, 2005).
	28. Technology facilitator and/or technology assistant positions are adequately staffed.	▪ The recommended *minimum* staffing for schools with an average daily membership of 1-500 includes: 1 full-time library media coordinator, 1 full-time technology facilitator, 1/2 media assistant and 1/2 technology assistant (Public Schools of North Carolina, 2005). ▪ The recommended *minimum* staffing for schools with an average daily membership of 501-1000 includes: 1 full-time library media coordinator, 1 full-time technology facilitator, 1 full-time media assistant, and 1 full-time technology assistant (Public Schools of North Carolina, 2005). ▪ The recommended *minimum* staffing for schools with an average daily membership of 1001-1500 includes: 2 full-time library media coordinators, 2 full-time technology facilitators, 1 1/2 media assistants, and 1 1/2 full-time technology assistants (Public Schools of North Carolina, 2005). ▪ The recommended *minimum* staffing for schools with an average daily membership of 1501-2000 includes: 2 full-time library media coordinators, 2 full-time technology facilitators, 2 full-time media assistants, and 2 full-time technology assistants (Public Schools of North Carolina, 2005).
Media and Software	29. Teachers and students have ready access to productivity software, e.g., graphic organizer, word processing, slide presentation, or drawing applications.	▪ Materials are provided to support student representation of their own ideas (e.g., productivity tools such as Inspiration, MS Word, Powerpoint, spreadsheets, Web page software, and technology such as video and digital cameras (Apple Computer Inc., 1995) ▪ Teachers and learners should have sufficient access to productivity tools, online services, media-based instructional materials, and primary sources of data in settings that enrich their learning goals (Milken Exchange, 1998).
	30. Teachers have ready access to a cataloging	▪ Provide an organized collection of resources, including technology-based materials and

	system they can use for searching and locating teaching materials.	equipment, accessible through a district-wide Union catalog and circulated through an automated system. Establish *annual* procedures for adding new materials and equipment to an accurate, automated inventory and for discarding outdated and worn items (Public Schools of North Carolina, 2005).
	31. Teachers and students have ready access to a good collection of print, multimedia, and electronic resources.	▪ Provide a balance of print, multimedia, and electronic resources, based on local board-approved selection policies that support the state curriculum and the needs of the student population (Public Schools of North Carolina, 2005). ▪ Building-level media and technology programs provide barrier-free access to the library media center's facility and its collection as well as access to building-level, national, state, and district-wide electronic resources, before, during, and after the instructional day to support learning (Public Schools of North Carolina, 2005).
	32. When educators are selecting resource media and software, they consider both the curriculum and the needs of learners.	▪ Provide a diverse collection that supports teaching and learning, students' personal interests, diverse learning styles, multicultural backgrounds, and physical challenges (assistive/adaptive devices, etc.) (Public Schools of North Carolina, 2005). ▪ Resources are selected and acquired by formally assessing needs (e.g., curriculum mapping) and following building-level selection policy based on the local board-approved model and established criteria for various media formats (Public Schools of North Carolina, 2005). ▪ Provide a diverse collection that supports teaching and learning, students' personal interests, diverse learning styles, multicultural backgrounds, and physical challenges (assistive/adaptive devices, etc.) (Public Schools of North Carolina, 2005). ▪ Equipment and digital resources should be strategically deployed and sufficient to meet the needs of learners and educators (North Central Regional Educational Laboratory, 2000).

Construct II. Professional Development

The "Professional Development" construct is organized into two sections where respondents indicate level of need for specific professional development opportunities and quality of past professional development experiences. Items addressing potential professional development needs address the use of technology for both instruction and planning. These items align with items in the following section of STNA related to how often teachers use technology for both instruction and planning. Comparing response rates for these items across constructs can inform future professional development planning. The Professional Development Quality section provides an general description of the quality of the current professional development program at the school level (see Table B2).

Table B2

Reference Matrix for *Professional Development* Construct for STNA

Subconstruct	Item	Standard or Suggested Practice
Instruction	1. I would benefit from professional development on research-based practices I can use in my teaching.	▪ Staff development that improves the learning of all students prepares educators to apply research to decision making (National Staff Development Council, 2001). ▪ Quality Teaching. Staff development that improves the learning of all students deepens educators' content knowledge, provides them with research-based instructional strategies to assist students in meeting rigorous academic standards, and prepares them to use the various types of classroom assessments appropriately (National Staff Development Council, 2001). ▪ Educational leaders advocate for research-based effective practices in use of technology (International Society for Technology in Education, 2002). ▪ The vision for technology use should be grounded in sound research on how people think and learn and how technology influences and adds value to these processes (North Central Regional

Subconstruct	Item	Standard or Suggested Practice
		Educational Laboratory, 2000).
	2. I would benefit from professional development on identification, location, and evaluation of technology resources, e.g., websites, that I can use with my students.	▪ Teachers identify and locate technology resources and evaluate them for accuracy and suitability (International Society for Technology in Education, 2000b). ▪ Staff development that improves the learning of all students prepares educators to understand and appreciate all students, create safe, orderly, and supportive learning environments, and hold high expectations for their academic achievement (National Staff Development Council, 2001).
	3. I would benefit from professional development on performance-based student assessment of my students.	▪ Successful professional development programs are focused on promoting effective student assessment (North Central Regional Educational Laboratory, 2000) ▪ Teachers apply technology in assessing student learning of subject matter using a variety of assessment techniques (International Society for Technology in Education, 2000b). ▪ Traditional assessment is often norm-referenced and multiple-guess, while assessments in constructivist classrooms are more criterion-referenced and based on performance portfolios that illustrate what students can create with technology (Apple Computer Inc., 1995). ▪ Develop new student performance measures to reliably assess the impact of technology on learning (Milken Exchange, 1999). ▪ Use technology to provide more sensitive and cost-effective testing options (Milken Exchange, 1999). ▪ Educators should be prepared to apply technology in support of the assessment process. They should be prepared to apply new forms of assessment to the products of technology-supported learning (North Central Regional Educational Laboratory, 2000).
	4. I would benefit from professional development on the use of technology to collect and analyze student assessment data.	▪ Successful professional development programs are focused on promoting effective student assessment (North Central Regional Educational Laboratory, 2000) ▪ Staff development that improves the learning of all students deepens educators' content knowledge, provides them with research-based instructional strategies to assist students in meeting rigorous academic standards, and prepares them to use the various types of classroom assessments appropriately (National Staff Development

Subconstruct	Item	Standard or Suggested Practice
		Council, 2001). ▪ Teachers apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity (International Society for Technology in Education, 2000b).
	5. I would benefit from professional development on learner-centered teaching strategies that incorporate technology, e.g., project-based or cooperative learning.	▪ Teachers use technology to support learner-centered strategies that address the diverse needs of students (International Society for Technology in Education, 2000b). ▪ Technology provides opportunities for students to use an inquiry-based, collaborative approach to solve meaningful problems (Apple Computer Inc., 1995). ▪ Technology provides opportunities for teachers to change their approach to teaching and learning from curriculum centered to learner-centered, from individual tasks to collaborative work, from passive to active learning (Apple Computer Inc., 1995). ▪ Teachers' fluency with technology should translate into unique and relevant learning opportunities for students (Milken Exchange, 1998). ▪ Educators should be prepared to use a variety of technology-supported strategies for teaching and learning to meet the needs of students (NCREL, 2000).
	6. I would benefit from professional development on online security and safety.	▪ Staff development that improves the learning of all students prepares educators to understand and appreciate all students, create safe, orderly, and supportive learning environments, and hold high expectations for their academic achievement (National Staff Development Council, 2001). ▪ Teachers promote safe and healthy use of technology resources (International Society for Technology in Education, 2000b).
	7. I would benefit from professional development on the use of technology for differentiating instruction for students with special learning needs.	▪ Staff development that improves the learning of all students prepares educators to understand and appreciate all students, create safe, orderly and supportive learning environments, and hold high expectations for their academic achievement (National Staff Development Council, 2001). ▪ *No Child Left Behind* calls for professional development that instructs in methods of teaching children with special needs (Public Schools of North Carolina, 2005). ▪ Teachers design developmentally appropriate

Subconstruct	Item	Standard or Suggested Practice
		learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners (International Society for Technology in Education, 2000b). ▪ Teachers use technology to support learner-centered strategies that address the diverse needs of students (International Society for Technology in Education, 2000b).
Planning	8. I would benefit from professional development on the uses of technology to increase my professional productivity.	▪ Ensuring high quality professional development means providing resources to support teachers as they implement new strategies in their classrooms (Public Schools of North Carolina, 2005). ▪ Teachers use technology to enhance their productivity and professional practice (International Society for Technology in Education, 2000b)
	9. I would benefit from professional development on ways to use technology to communicate and collaborate with families about school programs and student learning.	▪ Staff development that improves the learning of all students provides educators with knowledge and skills to involve families and other stakeholders appropriately (National Staff Development Council, 2001). ▪ Teachers use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning (International Society for Technology in Education, 2000b). ▪ Mechanisms should be in place for ongoing communication among partners and the broader community for the purposes of celebrating successes, building awareness, monitoring progress, and encouraging wider participation (Milken Exchange, 1998).
	10. I would benefit from professional development on ways to use technology to communicate and collaborate with other educators.	▪ Teachers use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning (International Society for Technology in Education, 2000b). ▪ Educators should use technology and communication networks to advance their own professional practice and collegial interactions (Milken Exchange, 1998).
	11. I would benefit from professional development on alignment of lesson plans to content standards and student technology standards.	▪ Teachers facilitate technology-enhanced experiences that address content standards and student technology standards (International Society for Technology in Education, 2000b). ▪ Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning (International Society

Subconstruct	Item	Standard or Suggested Practice
		for Technology in Education, 2000b). ▪ *No Child Left Behind* calls for professional development that is aligned with state content standards and assessments (Public Schools of North Carolina, 2005)
	12. I would benefit from professional development on use of research or action research projects to improve technology-enhanced classroom practices.	▪ Educators should be skilled in designing teaching strategies and learning environments that maximize the impact that technology has on learning (North Central Regional Educational Laboratory, 2000). ▪ Technology use should be based on both high-impact, research-based practice and field-based, best practices shown to add value to learning (North Central Regional Educational Laboratory, 2000). ▪ Collaborative efforts are based on the best available models of instruction, collaboration, and cooperative learning to develop strong instructional partnerships that lead to student development of critical thinking and problem-solving skills (Public Schools of North Carolina, 2005). ▪ Fund research to document the impact of technology on student learning under varied conditions (Milken Exchange, 1999).
	13. I would benefit from professional development on use of data for reflecting on my professional practices.	▪ Teacher development with the most impact provides opportunities to experiment and reflect on new experiences. Personal reflection, while participating in a group discussion or writing in a personal journal, helps teachers to question their own beliefs and to begin the process of change (Apple Computer Inc., 1995). ▪ Teachers continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning (International Society for Technology in Education, 2002).
	14. I would benefit from professional development on use of data to make decisions about the use of technology.	▪ Teachers apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity (International Society for Technology in Education, 2002) ▪ Create a well-designed data collection plan, including appropriate indicators of key implementation and outcome objectives. Analyze multiple measures to regularly assess progress toward goals (Milken Exchange, 1998). ▪ Data-driven decision making. Use results to inform all levels of planning and decision-making (Milken

Subconstruct	Item	Standard or Suggested Practice
		Exchange, 1998).
	15. I would benefit from professional development on use of technology to participate in professional development activities, e.g. online workshops, hands-on training in a computer lab.	▪ Educators should be prepared to use technology to increase professional productivity and gain enriched access to professional resources (North Central Regional Educational Laboratory, 2000). ▪ Teachers use technology resources to engage in ongoing professional development and lifelong learning (International Society for Technology in Education, 2000b).
Professional Development Quality	16. Educators in charge of professional development use data from teachers' needs assessments to determine technology professional development topics and activities.	▪ The staff development program is planned, delivered, and evaluated collaboratively by a committee with representatives from a variety of roles including the technology facilitator, media coordinator, teachers, administrators, students, IHE faculty, and support personnel. Staff development participants are involved in the evaluation process (Public Schools of North Carolina, 2005).
	17. Technology professional development is timely.	▪ Successful professional development programs are directed by participants' interests, questions, and needs (North Central Regional Educational Laboratory, 2000). ▪ Ensuring high quality professional development means creating an ongoing calendar of professional development opportunities tailored to meet assessed professional development needs (Public Schools of North Carolina, 2005).
	18. Technology professional development is relevant.	▪ Staff development offerings correlate to technology competencies for educators and meet licensure and renewal requirements (Public Schools of North Carolina, 2005). ▪ Providing that professional development is relevant to the classroom setting and reflective of test data (Public Schools of North Carolina, 2005) ▪ The school and district should provide comprehensive professional growth opportunities for teachers, administrators, and other staff that build their capacity to advance the vision (North Central Regional Educational Laboratory, 2000). .
	19. Technology professional development is ongoing.	▪ *No Child Left Behind* calls for professional development that is sustained, intensive, and classroom-focused (Public Schools of North Carolina, 2005). ▪ Skillful leaders establish policies and organizational structures that support ongoing professional learning and continuous improvement (National Staff Development Council, 2001).

Subconstruct	Item	Standard or Suggested Practice
	20. Teachers have an opportunity to evaluate technology professional development activities in which they participate.	▪ The staff development program is planned, delivered, and evaluated collaboratively by a committee with representatives from a variety of roles including the technology facilitator, media coordinator, teachers, administrators, students, IHE faculty, and support personnel. Staff development participants are involved in the evaluation process (Public Schools of North Carolina, 2005).
	21. The impact of technology professional development is tracked using data on classroom practice.	▪ Staff development that improves the learning of all students uses multiple sources of information to guide improvement and demonstrate its impact (National Staff Development Council, 2001). ▪ *No Child Left Behind* calls for professional development that is regularly evaluated for impact on increased teacher effectiveness and improved student academic achievement (Public Schools of North Carolina, 2005). ▪ Successful professional development programs are guided by quality evaluation (North Central Regional Educational Laboratory, 2000)
	22. The impact of technology professional development is tracked using data on student learning.	▪ The effectiveness of professional development should be linked to student performance (North Central Regional Educational Laboratory, 2000). ▪ Assess the impact of professional development programs based on classroom practice and student learning (Milken Exchange, 1999). ▪ Staff development that improves the learning of all students uses disaggregated student data to determine adult learning priorities, monitor progress, and help sustain continuous improvement (National Staff Development Council, 2001).

Construct III. Teaching and Learning

The items included in the “Teaching and Learning” construct examine school staff’s current use of technology for instruction and planning practices. Items included here also examine how information and communication technologies are used by students in the classroom. Items 1-15 in the Instruction and Planning sections align with items 1-15 in the

Instruction and Planning sections from the Professional Development Construct (see Table B3).

Table B3

Reference Matrix for *Teaching and Learning* Construct for STNA

Subconstruct	Item	Standard or Suggested Practice
Instructional	1. I consult publications, online journals, or other resources to identify research-based practices in teaching with technology.	▪ Teachers apply current research on teaching and learning with technology when planning learning environments and experiences (International Society for Technology in Education, 2000b).
	2. I identify, locate, and evaluate technology resources (e.g., websites).	▪ Teachers identify and locate technology resources and evaluate them for accuracy and suitability (International Society for Technology in Education, 2000b)
	3. I apply performance-based student assessment to technology-enhanced lessons (e.g., student portfolios, student presentations).	▪ Teachers apply technology in assessing student learning of subject matter using a variety of assessment techniques (International Society for Technology in Education, 2000b). ▪ Traditional assessment is often norm-referenced and multiple-guess, while assessments in constructivist classrooms are more criterion-referenced and based on performance portfolios that illustrate what students can create with technology (Apple Computer Inc., 1995). ▪ Develop new student performance measures to reliably assess the impact of technology on learning (Milken Exchange, 1999). ▪ Use technology to provide more sensitive and cost-effective testing options (Milken Exchange, 1999). ▪ Educators should be prepared to apply technology in support of the assessment process. They should be prepared to apply new forms of assessment to the products of technology-supported learning (North Central Regional Educational Laboratory, 2000).
	4. I use technology to collect and analyze student assessment data.	▪ Educators should be prepared to apply technology in support of the assessment process. They should be prepared to apply new forms of assessment to the products of technology-supported learning (North Central

Subconstruct	Item	Standard or Suggested Practice
		Regional Educational Laboratory, 2000). ▪ Teachers use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning (International Society for Technology in Education, 2000b). ▪ Use assessment results to allocate resources, refine implementation strategies, identify promising practices, and support continuous improvement (Milken Exchange, 1998). ▪ Educators should be prepared to use a variety of technology-supported strategies for teaching and learning to meet the needs of students (North Central Regional Educational Laboratory, 2000).
	5. My lessons include technology-enhanced, learner-centered teaching strategies (e.g., project-based learning).	▪ Teachers' fluency with technology should translate into unique and relevant learning opportunities for students (Milken Exchange, 1998). ▪ Teachers use technology to support learner-centered strategies that address the diverse needs of students (International Society for Technology in Education, 2000b). ▪ Teachers design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners (International Society for Technology in Education, 2000b).
	6. I apply policies and practices to enhance online security and safety.	▪ Teachers promote safe and healthy use of technology resources (International Society for Technology in Education, 2000b).
	7. I use technology to differentiate instruction for students with special learning needs.	▪ Teachers use technology to support learner-centered strategies that address the diverse needs of students (International Society for Technology in Education, 2000b). ▪ Teachers design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners (International Society for Technology in Education, 2000b)
Planning	8. I use technology to support and increase teacher productivity.	▪ Educators should be prepared to use technology to increase professional productivity and gain enriched access to professional resources (North Central Regional

Subconstruct	Item	Standard or Suggested Practice
		Educational Laboratory, 2000). ▪ Teachers apply technology to increase productivity (International Society for Technology in Education, 2000b).
	9. I use technology to communicate and collaborate with families about school programs and student learning.	▪ Teachers use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning (International Society for Technology in Education, 2000b).
	10. I use technology to communicate and collaborate with other educators.	▪ Teachers use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning (International Society for Technology in Education, 2000b). ▪ Educators should use technology and communication networks to advance their own professional practice and collegial interactions (Milken Exchange, 1998).
	11. My lesson plans refer to both content standards and student technology standards.	▪ Revise academic learning standards for students to reflect technology (Milken Exchange, 1999). ▪ Teachers facilitate technology-enhanced experiences that address content standards and student technology standards (International Society for Technology in Education, 2000b). ▪ Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning (International Society for Technology in Education, 2000b).
	12. I do research or action research projects to improve technology-enhanced classroom practices.	▪ Teachers apply current research on teaching and learning with technology when planning learning environments and experiences (International Society for Technology in Education, 2000b). ▪ Educators should be skilled in designing teaching strategies and learning environments that maximize the impact that technology has on learning (North Central Regional Educational Laboratory, 2000). ▪ Teachers plan strategies to manage student learning in a technology-enhanced environment (International Society for Technology in Education, 2000b). ▪ Educational leaders advocate for research-based effective practices in use of technology (International Society for Technology in

Subconstruct	Item	Standard or Suggested Practice
		Education, 2002). ▪ Fund research to document the impact of technology on student learning under varied conditions (Milken Exchange, 1999).
	13. I use multiple sources of data for reflecting on professional practice.	▪ Teachers continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning (International Society for Technology in Education, 2002).
	14. I use multiple sources of data to make decisions about the use of technology.	▪ Teachers apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity (International Society for Technology in Education, 2002). ▪ Create a well-designed data collection plan, including appropriate indicators of key implementation and outcome objectives. Analyze multiple measures to regularly assess progress toward goals (Milken Exchange, 1998). ▪ Data-driven decision making. Use results to inform all levels of planning and decision-making (Milken Exchange, 1998). ▪ Building-level media and technology staff continuously monitor planning processes and results, prioritizing, and adapting long and short-term goals and strategies based on feedback and input. They utilize qualitative and quantitative measures to document and evaluate how media and technology resources and program initiatives meet the needs of students and teachers (Public Schools of North Carolina, 2005).
	15. I use technology to participate in professional development activities, e.g. online workshops, hands-on training in a computer lab.	▪ Educators should be prepared to use technology to increase professional productivity and gain enriched access to professional resources (North Central Regional Educational Laboratory, 2000). ▪ Teachers use technology resources to engage in ongoing professional development and lifelong learning (International Society for Technology in Education, 2000b).
Information and Communication Technologies	16. Students use a variety of technologies, e.g., productivity, visualization, research, and	▪ Students use technology routinely and appropriately (Apple Computer Inc., 1995). ▪ Students should have opportunities to use a range of technologies (e.g., learning,

Subconstruct	Item	Standard or Suggested Practice
	communication tools.	productivity, visualization, research, and communication tools) to support their learning (North Central Regional Educational Laboratory, 2000). ▪ Students explore and represent information dynamically and in many forms (Apple Computer Inc., 1995).
	17. Students use technology during the school day to communicate and collaborate with others, beyond the classroom.	▪ Students communicate effectively about complex processes (Apple Computer Inc., 1995). ▪ Students use technology to communicate and to aid in collaborative work (Apple Computer Inc., 1995). ▪ Students expand their access to "experts" beyond their instructor, to include online experts, online sources of information, etc. (Apple Computer Inc., 1995). ▪ Students rely less on seat work and more on communication, collaboration, accessing information, and expressing their own ideas (Apple Computer Inc., 1995). ▪ Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences (International Society for Technology in Education, 2000a). ▪ Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences (International Society for Technology in Education, 2000a).
	18. Students use technology to access online resources and information as a part of classroom activities.	▪ Students use technology to locate, evaluate, and collect information from a variety of sources (International Society for Technology in Education, 2000a). ▪ Students utilize the same kinds of tools that are used by professional researchers, including databases, satellite photos, simulations, etc. (Apple Computer Inc., 1995).
	19. Students use the same kinds of tools that professional researchers use, e.g., simulations, databases, satellite imagery.	▪ Students utilize the same kinds of tools that are used by professional researchers, including databases, satellite photos, simulations, etc. (Apple Computer Inc., 1995). ▪ Increasing relevancy. Learners should use contemporary technologies, communication networks, and associated learning contexts to engage in relevant, real-life applications of academic concepts. Their work should parallel the way in which professionals in the

Subconstruct	Item	Standard or Suggested Practice
		workforce use technology (Milken Exchange, 1998).
	20. Students work on technology-enhanced projects that approach real-world applications of technology.	▪ Students should work on substantive projects, addressing issues that have meaning, reaching out beyond the classroom to real-world practice (North Central Regional Educational Laboratory, 2000). ▪ Teachers apply technology to develop students' higher-order skills and creativity (International Society for Technology in Education, 2000b). ▪ Building-level media and technology staff continuously plan with teachers to help students become independent learners who can solve problems, think critically, and evaluate information from a wide variety of resources (Public Schools of North Carolina, 2005).
	21. Students use technology to help solve problems.	▪ Building-level media and technology staff continuously plan with teachers to help students become independent learners who can solve problems, think critically, and evaluate information from a wide variety of resources (Public Schools of North Carolina, 2005). ▪ Students use technology resources for solving problems and making informed decisions (International Society for Technology in Education, 2000a).
	22. Students use technology to support higher-order thinking, e.g., analysis, synthesis, and evaluation of ideas and information.	▪ Building-level media and technology staff continuously plan with teachers to help students become independent learners who can solve problems, think critically, and evaluate information from a wide variety of resources (Public Schools of North Carolina, 2005). ▪ Developing higher-level proficiencies. Student use of technology should make it increasingly possible for the learner to engage in learning practices that lead to new ways of thinking, understanding, constructing knowledge, and communicating results (Milken Exchange, 1998)
	23. Students use technology to create new ideas and representations of information.	▪ Educators should establish a learning context and physical environment that require and enable students and student teams' use of contemporary tools to research issues, solve problems, and communicate results (Milken Exchange, 1998). ▪ Students use technology tools to enhance

Subconstruct	Item	Standard or Suggested Practice
		learning, increase productivity, and promote creativity (International Society for Technology in Education, 2000a).

Construct IV. Impact of Technology

The items included in the "Impact of Technology" construct examine school staff's perception of the impact of technology on teaching practices and student outcomes (see Table B4).

Table B4

Reference Matrix for *Impact of Technology* Construct for STNA

Subconstruct	Item	Standard or Suggested Practice
Teaching Practices	1. My teaching is more student-centered and interactive when technology is integrated into instruction.	▪ Shifts naturally occur in classrooms from teacher-centered and didactic to more learner-centered and interactive (Apple Computer Inc., 1995). ▪ Over time, teachers report their interaction with students is different with less lecture and more mentoring (Apple Computer Inc., 1995).
	2. My teaching practices emphasize teacher uses of technology skills to support instruction. (adoption)	▪ Adoption of technology by teachers takes time and is represented by different stages: entry (learning the basics), adoption (using technology to support traditional instruction), adaptation (integrating new technologies into classroom practice with an emphasis on student productivity with word processors, spreadsheets, etc.), appropriation (focus on cooperative, project-based, and interdisciplinary work), and invention (discovering new uses for technology and designing projects that use multiple technologies) (Apple Computer Inc., 1995).
	3. My teaching practices emphasize student uses of productivity applications, e.g., word processing, spreadsheet. (adaptation)	▪ Adoption of technology by teachers takes time and is represented by different stages: entry (learning the basics), adoption (using technology to support traditional instruction), adaptation (integrating new technologies into classroom practice with an emphasis on student productivity with word processors, spreadsheets, etc.), appropriation (focus on cooperative, project-based, and interdisciplinary work), and invention (discovering new uses for technology and designing projects that use multiple technologies) (Apple Computer Inc., 1995).

Subconstruct	Item	Standard or Suggested Practice
	4. My teaching practices emphasize student uses of technology as an integral part of specific teaching strategies, e.g., project-based or cooperative learning. (appropriation)	▪ Adoption of technology by teachers takes time and is represented by different stages: entry (learning the basics), adoption (using technology to support traditional instruction), adaptation (integrating new technologies into classroom practice with an emphasis on student productivity with word processors, spreadsheets, etc.), appropriation (focus on cooperative, project-based, and interdisciplinary work), and invention (discovering new uses for technology and designing projects that use multiple technologies) (Apple Computer Inc., 1995).
Student Impact	5. Technology has helped my students become more socially aware, confident, and positive about their future.	▪ Students become socially aware and more confident (Apple Computer Inc., 1995). ▪ Students developed a positive orientation to the future (Apple Computer Inc., 1995).
	6. Technology has helped students become independent learners and self-starters.	▪ Students become independent learners and self starters(Apple Computer Inc., 1995).
	7. Technology has helped students work more collaboratively.	▪ Students worked well collaboratively (Apple Computer Inc., 1995).
	8. Technology has increased students' engagement in their learning.	▪ Students' behavior and attendance improved (Apple Computer Inc., 1995). ▪ Students' attitude toward themselves and learning improved (Apple Computer Inc., 1995).
	9. Technology has helped students achieve greater academic success.	▪ Student performance improved – test scores, writing, completed lessons more quickly (Apple Computer Inc., 1995).