Cross-Case Analysis

Six Technology Innovation Challenge Grants
from
Five Western Cluster Sites

September 2002

Study commissioned by:

ACT Now! - Advanced Curriculum through Technology
Aurora Project
Challenge 95: Community of 21st Century Learners for El Paso
Challenge 98: El Paso Partnership for Technology Integration
RETA - Regional Educational Technology Assistance Initiative
SATEC - San Antonio Technology in Education Coalition

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Introduction

In the spring of 2002, U.S. Department of Education, through coordination of the six TICG projects, contracted National Staff Development Council to conduct a cross-case study of five Western cluster sites with an emphasis on examining the role of professional development in technology innovation. This study allowed for comparisons of recurring patterns and themes that emerged across the different TICG projects. Being able to generalize across the different projects makes the findings more applicable to other situations (Gall, Gall, & Borg, 1999).

Purpose

The purpose of this cross-case study was to analyze the impact of the six Technology Innovation Challenge Grants. By viewing the different technology innovations in multiple contexts, those interested in the transformation of public schools, including educators, policy makers, and others, can better understand the role of professional development and what changes occur in teaching and learning that produces results for students and teachers.

Six TICG Projects from Five Western Cluster Sites

TICG Projects	Location	Year
Challenge 95: Community of 21st Century Learners for El Paso	El Paso, Texas	1995
ACT Now! - Advanced Curriculum through Technology	Chula Vista, California	1996
Aurora Project	Oklahoma	1997
SATEC - San Antonio Technology in Education Coalition	San Antonio, Texas	1997
Challenge 98: El Paso Partnership for Technology Integration	El Paso, Texas	1998
RETA - Regional Educational Technology Assistance Initiative	New Mexico	1998

Key Findings for the Four Evaluation Questions

Evaluation Question One

What impact has technology and professional development had on teaching and learning and the local community?

Key Findings

- Technology used as a tool to increase student achievement of curriculum standards.
- Technology facilitated raising staff and student expectations and increased the degree of meaningfulness for student learning.
- Using technology appropriately in classrooms revolutionized teaching.
- Professional development in using technology to address standards, to design and use constructivist strategies, and to manage classroom tasks transformed classroom practices.
- Technology made public education visible.

Conclusion

Student learning increased when technology was used as a tool to assist students in developing and asking good questions and exploring the world around them. Through effective professional development that focused on integrating technology into an integrated curriculum, teachers learned to use technology effectively. Parents and community partners not only facilitated successful implementation of the initiative and took ownership for all students in the community, they also discovered their own missions, redefined and renewed, and new and distinct roles in the community.

Evaluation Question Two

What theories of change drive technology-related innovations, implementation, and professional learning?

Key Findings

- Key leaders supported the shared vision.
- Stakeholders were involved in planning and implementation.
- Early adopters shared the vision and helped build capacity.
- Teachers gained confidence with increase in knowledge.
- Increase in knowledge led toward teaching renewal.
- Teachers engaged students in real world applications to increase student performance.

Conclusion

It was evident, through data analysis, that the predominant theory of change for professional development was a training model based on the transfer of training research (Joyce & Showers, 1982; NSDC, 2001). The training model included theory, demonstration, practice, feedback, and coaching or other forms of follow-up. Collaboration was evident through various partnerships focusing on a shared vision and building capacity through ongoing feedback and support. The intent was for teachers to participate in training sessions on the integration of technology into the curriculum and transfer that training to their classrooms to increase student performance.

Evaluation Question Three

What processes and structures have these projects developed and implemented that can contribute to the success of other federally funded projects or federal, state, or local initiatives?

Key Findings

- The thinking and attitudes of the superintendents and principals of participating schools toward the innovation influenced the application of new strategies by all in the organization.
- Project leaders supported, inspired, and facilitated effective implementation of the projects.
- Teacher leadership was essential to successful design of and implementation of the initiatives.
- Building and nurturing shared vision among stakeholders was a key responsibility of the leadership teams.
- Building capacity of teachers and principals to improve student performance through the use of technology, inquiry, and real world applications was the emphasis of all Challenge grants.
- Establishing communities of learners was essential to building capacity.
- Key to meeting the needs of the learners was a sense of the developmental nature of the work and flexibility.
- Collaboration facilitated problem solving and developed partnerships and alliances essential to attaining the shared vision and building capacity.
- Sustainability was essential to ensure achievement of the shared vision.

Conclusion

Through skilled, visionary leadership and a shared vision, learning communities emerged that engendered passion and commitment. Through listening to others, modifying strategies and authentically collaborating, creative ideas emerged as promising

practices. By committing to achieve the project's goals and collaborating with stakeholders, visionary project leaders built trust in the organization and increased the organization's efforts to achieve its goals.

Evaluation Question Four

What processes and structures contributed most to the projects' success and what barriers impeded them?

Key Findings

Helping Factors

- A shared vision was developed and supported by all stakeholders.
- Integration of technology with standards-based curriculum was a high priority and linked to district goals with commitment and support from leaders.
- Connections were made to other state and federal initiatives.
- The design and deliver of training for teachers focused on integration of technology with standards-based curriculum.
- Professional development was designed with selection of and training by quality trainers (i.e., Train-the-Trainer Model).
- Capacity was built for appropriate use of technology in the classroom.
- Adequate resources were provided, which included sufficient funds, technology infrastructure, and personnel.
- A culture of learning with technology in communities (parents, business partners, universities, city and state) was established.

Hindering Factors

- Slow and inadequate acquisition of equipment delayed the use of technology in the classrooms.
- Complexity of integrating curriculum increased demands on teachers.
- Complexity of learning to change and collaborate hindered changes in teaching practices.
- Impact evaluations were hampered by changes in evaluators and methodologies used.
- Time constraints for teachers inhibited opportunities to learn, assimilate, and transfer learning to the classrooms.
- Attrition and changing technology increased demand for technical support.
- Lack of early engagement of administrators inhibited implementation at some schools.
- Changes to learner-centered classrooms were diminished by inconsistent transfer of instructional approaches.

Conclusion

Consistent with the research literature and National Staff Development Council standards, factors across all sites that helped or hindered the success of technology integration in the classrooms were the presence or absence of (a) learning communities; (b) administrative and teacher leadership; (c) adequate resources, including funding for purchase and maintenance of equipment, (d) time for planning and collaborating, (e) instructional and technical support; (f) curriculum development, (g) design of a quality training model, including demonstration, practice, feedback, and coaching; and (h) evaluation.

Conclusion

The intent of this study was to find common patterns and themes that emerged across the six projects that identify characteristics of professional development programs that ensure high-quality learning for teachers and students. The results of this study can be used to further explore and better understand how technology impacts teaching and learning.

- Through skilled, visionary leadership and a shared vision, learning communities emerged that engendered passion and commitment. Through listening to others, modifying strategies and authentically collaborating, creative ideas emerged as promising practices. By committing to achieve the project's goals and collaborating with stakeholders, visionary project leaders built trust in the organization and increased the organization's efforts to achieve its goals.
- Through skillfully designed curriculum that integrated inquiry-based instruction, application to the real world, and technology, students engaged in meaningful ways, found interest and motivation for what they were learning, and increased their performance.
- Professional development fostered learning communities who intentionally used data to make decisions, engaged in curriculum planning, shared what they were learning with others, studied together, monitored student progress through the study of student work, and reflected on their own practice to increase student achievement.
- Authentic partnerships with parents and community facilitated the change of the culture of the community and shaped its commitment to high quality education for every child.

- Adequacy of resources, both financial and human, provided the time and quality of implementation needed for sustainability. Making connections to funds from other state and federal initiatives and in-district additional funds were all means of providing financial support that allowed for more equipment and human resources to implement the project as designed.
- Although not explicated stated, the predominant theory of change for professional development was a training model based on research. The professional development design included constructivist theory; demonstration through the use of modeling; practice that included hands-on experiences at participants' comfort level, participant feedback given to the trainers within a timely manner, usually through surveys; and ongoing support through mentoring, teaming, on-site training and assistance, and modeling in classrooms.
- Evaluation methodologies were both quantitative and qualitative. The measures included pre-post surveys, focus groups, interviews, and observations. The evaluation teams were often in flux because of changes in membership, changes in the guidelines for evaluations required by U.S. Department of Education for TICG projects, the time and effort required to develop valid and reliable measures to link professional development to student achievement, and the vast amounts of data collected from basically volunteers.

ACKNOWLEDGEMENTS

The evaluation team would like to thank those who shared openly and honestly their observations and interpretations of the events, outcomes, challenges and successes of their Challenge grants. Their commitment to their work and the passion they shared for students and their learning was evident in all their discussions. Without their thorough, honest sharing, this evaluation would not have been possible.

We would like to express a special thanks to all TICG project directors who coordinated the interviews and observations, arranged transportation, and provided written documents. Each was a gracious host who facilitated our learning.

INTRODUCTION

Learning is the center. Technology is the tool. Project leader

In 1995, the U. S. Department of Education began a grant program, Technology Innovation Challenge Grant (TICG), to promote innovative uses of educational technology. The overall purpose of the TICG program was to design uses of educational technology to improve teaching and learning.

Six projects from five of the Western cluster sites volunteered for this study as a way to expand understanding of how technology influences student learning. The grant required the inclusion of at least one local educational agency that had a high percentage of students living in poverty. Other members could include any of the following: university, regional educational agency, museums, libraries, software designers, school districts, state agencies.

The projects for the TICG program were to be designed to:

- develop standards-based curricula in a wide range of subjects;
- provide professional development for teachers;
- increase student access to technology and online resources;
- provide technology training and support for parents in low-income areas;
- devise techniques for assisting teachers in developing computer-based instruction;
- create strategies for accelerating the academic progress of at-risk children via technology; and
- develop new approaches to measuring the impact of educational technology on student learning (TICG, U. S. Department of Education, 2002).

In the spring of 2002, the U.S. Department of Education, through coordination of the six TICG projects, contracted the National Staff Development Council to conduct a cross-case study of five Western cluster sites with an emphasis on examining the role of professional development in technology innovation. This cross-case study allowed for

the comparison of recurring patterns and themes from across the different TICG projects. Being able to generalize across the different projects makes the findings more applicable to other situations (Gall, Gall, & Borg, 1999).

PURPOSE

The purpose of this cross-case study was to analyze the impact of the six Technology Innovation Challenge Grants. By viewing the different technology innovations in multiple contexts, those interested in the transformation of public schools, including educators, policy makers, and others, can better understand the role of professional development and what changes occur in teaching and learning that produces results for students and teachers.

EVALUATION QUESTIONS

The evaluation team established the following essential evaluation questions based on the goals of the Challenge grants:

1. What impact has technology and professional development had on teaching and learning and the local community?
2. What theories of change drive technology-related innovations, implementation, and professional learning?
3. What processes and structures have these projects developed and implemented that can contribute to the success of other federally funded projects as well as federal, state, or local initiatives?

4. What processes and structures contributed most to the projects' success and what barriers impeded them?

These questions guided all inquiries, interviews, and analysis of written documentation and other artifacts related to these Challenge grants.

OVERVIEW

> The world is in the midst of a communication revolution that will rival the industrial revolution in terms of impact and importance. . . . As technology becomes more prevalent in schools, expectations for improvements in education grow as well. Although technology is not a panacea for the challenges facing today's schools, when used appropriately it can be an effective tool for promoting practices shown to improve teaching and learning. Technology can be a powerful ally for citizens. An engaging curriculum, enhanced by technology, and taught by well-prepared teachers familiar with the modern workplace, is crucial for student since schools are the primary places in many students' lives where they will have access to technology (Gonzales, 2001, p. 211).

Kozma and Schank (1998) state that "the 21st century promises to make very different demands on our students and schools. . . . To meet these new demands, students will need to acquire a new set of skills. They will need to be able to use a variety of tools to search and sort vast amounts of information, generate new data, analyze them, interpret their meaning, and transform them into something new" (p. 4). A systemic change, such as changing student performance expectations, requires stakeholder participation around a shared need (Elmore, R. & McLaughlin, M., 1988; Fullan, 1991). The TICG sites viewed this shared need as narrowing the technology gap in preparation for the 21st century.

Receiving the federal funds for the TICG projects allowed the sites to be innovative in their approaches in addressing three main components, consistently found

in various other studies (Means & Olson, 1995; OTA, 1995), which affect adoption of educational technology. The components are access, teacher professional development, and school support. Hardware, software, and professional development share an interdependent relationship (Office of Technology Assessment, 1995). Siegel (1994) states that teacher professional development needs "to model how to use the technology in the teaching and learning process. The idea is not only to teach them [teachers]how to use the hardware and software, but how to integrate it seamlessly into the curriculum" (p. 34). All the grant sites implemented some type of professional development training model focused on the integration of technology with teaching and learning.

All grant participants acknowledged the importance of receiving the federal funds and worked diligently to accomplish the dreams and aspirations of their grants and to remain aligned to the goals of their TICG projects.

Site Demographics

ACT Now! – Advance Curriculum Through Technology (1996)

Sweetwater Union High School District, Chula Vista, CA, is the largest secondary district in California and serves 35,000 students in grades 7 – 12 and over 44,000 adult school students. Approximately 80% of the student body belongs to ethnic minority groups, and the largest single ethnic group (65%) is of Hispanic descent.

Aurora Project (1997)

The Aurora Project, in Oklahoma, comprises twenty-three public schools and three private schools. A majority of the original 190 Aurora teachers were from six public schools, one private school, and two consortiums from small rural schools,

Wheatland and Northwest. The project also included faculty from Southwestern Oklahoma State University and University of Oklahoma.

Challenge 95: Community of 21st Century Learners for El Paso (1995) and Challenge 98: El Paso Partnership for Technology Integration (1998)

El Paso represents the fifth poorest congressional district in the United States and is a bi-national community, with the City of Juarez, Mexico, just across the border. El Paso has a population of 650,000, approximately 75% being Hispanic, 135,000 students attend El Paso schools, with 85% of them eligible for free or reduced price school lunch. In 1992, only about one third of the Latino and African American students passed the Texas Assessment of Academic Skills (TAAS). In 2001, upwards of 90% of all students passed the TAAS.

RETA – Regional Educational Technology Assistance Initiative (1998)

The RETA program provides professional development opportunities for K-12 teachers in the 89 school districts of New Mexico. Technology curriculum integration is brought to the school sites located within designated regional resource centers.

SATEC – San Antonio Technology in Education Coalition (1997)

San Antonio Independent School District (SAISD) and North East Independent School District (NEISD) are two of the ten largest school districts in Texas. SAISD serves 58,000 students on 95 campuses and NEISD serves 46,000 students on 53 campuses.

Table 1 identifies each site, year the grant was awarded, a description of the TICG program, and a list of partners.

Table 1. Program Description of Each Site Including Award Year and Partners

Site	Fiscal Year Awarded	Program Description	Partners
Challenge 95: Community of 21st Century Learners for El Paso	1995	The 1995 Technology Innovation Challenge Grant, awarded to Socorro ISD, the University of Texas at El Paso and the El Paso Collaborative for Academic Excellence, is a major component in the El Paso community's efforts to revitalize public education. The three major priorities of the project are to: 1) provide connectivity to at least ten Partner Schools, 2) develop a cadre of 120 classroom teachers who are capable of serving as technology and curriculum integration change agents in their respective schools, and 3) educate low income minority parents in the use of educational technology. [Online] www.challenge.utep.edu	▪ Socorro ISD ▪ El Paso ISD ▪ Ysleta ISD ▪ El Paso Collaborative for Academic Excellence ▪ University of Texas at El Paso
ACT Now! Advanced Curriculum Through Technology	1996	The ACT Now! program provides technology skills and classroom integration training to teachers along with classrooms, computers and Internet connectivity. Participants develops and implements hundreds of technology-enhanced units and lessons for the Web. [Online] www.suhsd.k12.ca.us/actnow	▪ Sweetwater HS District ▪ San Diego State University ▪ Qualcomm ▪ Pacific Bell ▪ Proxima ▪ National City Public Library's Computer Center ▪ Saint Rose of Lima Private ▪ John Otis Elementary ▪ Lincoln Acres Elementary ▪ Southwestern Community College ▪ CA Digital HS Program

Table 1. Program Description (continued)

Site	Fiscal Year Award	Program Description	Types of Partners
Aurora Project	1997	This project has centered on the development of the ALCA Community server which serves as a server for web, project, e-Learning, data, resource, and collaboration. [Online] www.alcaweb.org/cgibin/WebObjects/ALCA	▪ Bishop McGuinness HS ▪ Enid Public Schools ▪ Fairview Public Schools ▪ Frontier Public Schools ▪ Jenks Public Schools ▪ Hugo Public Schools ▪ Pioneer Distance Learning Consortium ▪ Pryor Public Schools ▪ Southwestern OK State University ▪ Southwest Education Development Laboratory ▪ OK Department of Career and Technology Education ▪ OK Climatological Survey ▪ OK Conservation Commission ▪ OK Department of Commerce ▪ OK Water Resource Board ▪ OK OneNet ▪ Argus Project ▪ Gamma Stream ▪ Apple Computer ▪ Environmental Systems Research Institute Inc. ▪ OK Historical Society ▪ OK Alliance for Geography Education ▪ Northwestern OK State University ▪ OK State University ▪ Dept. of Environmental Education

Table 1. Program Description (continued)

Site	Fiscal Year Awarded	Program Description	Types of Partners
San Antonio Technology in Education Coalition (SATEC)	1997	The SATEC Program provides the resources to improve the mathematical skills of middle and high school students by incorporating the latest technological innovations into the classroom instruction. This is accomplished by using the technology to help the students make the connection between abstract mathematical concepts and concrete, real-world experiences. SATEC seeks to have a seamless integration of technology into the curriculum and instruction. [Online] www.satec.saisd.net	▪ San Antonio ISD ▪ North East ISD ▪ Archdiocese of San Antonio ▪ University of Texas at San Antonio
Challenge 98: El Paso Partnership for Technology Integration	1998	Challenge 98 - El Paso Partnership for Technology Integration, a K-16 project, includes: teacher capacity building through staff development and master's degree, leadership support, parent engagement, dissemination, university faculty development, and pre-service teacher preparation. [Online] www.challenge.utep.edu	▪ Region 19 Education Service Center ▪ El Paso Collaborative for Academic Excellence ▪ University of Texas at El Paso
Regional Educational Technology Assistance Initiative (RETA)	1998	RETA is a statewide partnership that helps New Mexico educators and administrators integrate technology is in the classroom. [Online] www.reta.nmsu.edu)	▪ New Mexico State University ▪ Gadsden ISD ▪ State Department of Education ▪ New Mexico K-12 schools ▪ New Mexico Bureau of Indian Affairs Schools and Private Schools ▪ New Mexico Council on Technology in Education ▪ Regional Resource Centers at Institutes of Higher Education

Table 2 identifies the number of teachers and schools involved in the TICG professional development programs. This is an approximate number of teachers, schools, and districts participating in professional development training on the integration of technology. These data do not indicate that teachers have necessarily changed their practice based on their participation.

Table 2. Number Involved in TICG Professional Development Programs

TICG Project	Number of Teachers, Schools, and Districts Involved
Challenge 95: Community of 21st Century Learners	• 41 schools involved directly with 106 teachers participating in master's degree (12 courses). • 17 teachers received endorsements (4 courses) and 50 teachers received endorsement in compressed program (2 courses). • 1,000 teachers involved indirectly through mentoring
ACT Now!	• 1270 teachers (80% of teachers in district) participated. • 30 schools had teachers who participated.
Aurora Project	• 164 pre-service teachers have been involved in the project. • 407 teachers have been involved in the project. • 46 administrators have been involved in the project.
SATEC	• 78 teachers using SATEC math • 27 middle schools and high schools have SATEC math classrooms
Challenge 98: El Paso Partnership for Technology Integration	• 100 urban and rural schools involved with 500 teachers participating in 120 hours of staff development. • 200 teachers participated in a master's degree program in technology integration. • 200 parent educators were involved in the project. • Over 3,000 teachers were involved indirectly through mentoring.
RETA	• Teachers from 76 of the state's 89 districts have participated in the RETA program. • Teachers from 3 Bureau of Indian Affairs (BIA) schools have participated.

METHODOLOGY

The purpose of the cross-case study was to analyze the impact of the six TICG projects at five Western cluster sites. A qualitative, case-study approach was used to investigate the development, implementation, and impact of the six projects. Data were

collected and analyzed from documents/artifacts, focus groups, structured interviews, and observations.

On-Site Visitation

Multiple perspectives were sought throughout data collection and analysis within and across all five sites. The two-member team, from National Staff Development Council, conducted three-day site visits between April 15 and June 15, 2002. The site visits allowed the team to conduct individual interviews and focus groups and to observe in selected classrooms and schools. Most interviews and focus groups were conducted with both team members present.

Participants

The projector director at each site was contacted by letter in April, 2002 to gain consent for participation in the study. A three-day visit, conducted by a two-member team from the National Staff Development Council, was scheduled for each site. The project director worked with the lead evaluator, who provided a sample template, to establish a schedule and guidelines for the site visit interviews and focus groups (see Appendix A).

The participants included project director, classroom teachers, administrators, trainers/instructors, staff developers, university faculty, technology staff, partners, parents, students, facilitators, and other pertinent informants. Table 3 lists the number of participants interviewed according to position and site.

Table 3. Number of Participants Interviewed on Site

	El Paso Challenge 95	ACT Now!	Aurora Project	SATEC	El Paso Challenge 98	RETA
Curriculum Coordinators and Specialists				4		7
Classroom Teachers	19	9	15	7	12	
Project Director	1	1	1	1	3	1
Former Participants		4		2		
School Administrator	1	2	3	5	3	
Staff Development				4		
Technology Staff		5	2			4
Trainers/Instructors		6			4	22
District Administrator	1	1			1	
Evaluation Team					5	
Master's Degree Faculty	1				3	
Parents					11	
Partners			14		2	
Coordinators/Peer Facilitators			9			
Students			7	53	25	
Board Member	1					

Several sites requested contacting some teachers via e-mail to get their perspectives. Others provided names and phone numbers to conduct phone interviews with selected individuals. Contact was made to selected individuals with limited responses.

After the site visits were completed, the evaluation team met as a group one day with an evaluator from each site to gain additional perspectives of the TICG projects.

Data Collection

The plan and structure for the data collection was designed to ensure that information could be systematically gathered and synthesized across all six projects. By using multiple investigators, multiple sources of data, and multiple methods to confirm the emerging findings, the reliability and internal validity was strengthened

(Merriam, 1998).

The evaluation questions were developed by reviewing the goals of all the TICG projects. The goals reflected the shared vision at each site. Although the specific goals differed slightly across sites, there were some commonalities. The completed list of goals was sent to the project directors for cross- verification.

After the overarching evaluation questions were developed, the interview, focus group, and classroom observation protocols were designed (see Appendix B).

Table 4 identifies the commonalities of project goals across all sites.

Table 4. Commonalities of Goals Across Sites

SITES	Challenge 95	ACT Now!	Aurora Project	SATEC	Challenge 98	RETA
Year Grant Awarded	**1995**	**1996**	**1997**	**1997**	**1998**	**1998**
GOALS						
Curriculum Development		**X**	**X**	**X**	**X**	**X**
Technology Infrastructure	**X**	**X**	**X**	**X**	**X**	
Partnerships (with universities, businesses, parents, community)	**X**	**X**	**X**		**X**	**X**
Professional Development (for in-service teachers, administrators, pre-service teachers, parents)	**X**	**X**	**X**	**X**	**X**	**X**
Student Achievement	**X**	**X**	**X**	**X**	**X**	
Technical Support	**X**	**X**	**X**		**X**	**X**

Before, during, and following each site visit numerous written materials were collected. These included, but were not limited to, the grant proposals, yearly performance reports, evaluations, newsletters, technology plans, training materials, training schedules, PowerPoint presentation handouts, student achievement data, survey results from students/parents/teachers/administrators, and videos. All sites maintained websites so the evaluators were able to search the Web sites and download any pertinent information, such as goals, evaluation reports, curriculum samples and lessons, and professional development opportunities.

The triangulation of data (i.e., interviews, written documents, observations) allowed for cross-validation among the different data sources (McMillan & Schumacher, 1997).

Data Analysis

The cross-case study required first a within-case analysis of each TICG project and then a cross-case analysis (Merriam, 1988, 1998; Yin, 1994; Miles & Huberman, 1994; Patton, 1990). Each evaluator independently read interview transcripts, notes from field observations, and documents. By coding and comparing, common categories that answered the research questions were identified. Then the two evaluators met to cross-check their findings and organized the data in a matrix for cross-case analysis.

In organizing data, Patton (1990) identifies two main sources: "1) the questions that were generated during the conceptual phase of the study and 2) analysis, insights, and interpretations that emerged during data collection" (p. 378). A review of the literature used during data analysis helped to clarify and gain a deeper understanding of what was related to and differentiated from the recurring categories.

Limitations of the Cross-Case Study

There were several limitations to the cross-case study. One limitation inherent in this study was the time frame for the study. Scheduling a three-day site visit at the end of a school year limited the availability of some informants and classrooms for observations.

Although a template for selection of respondents was provided to guide the project directors in preparing for the on-site data collection by the two-member team, the agenda, classroom and school visits, and individuals interviewed were the design and selection of the project directors. Data gathered provided limitations due to possible bias of informants as well as the thoroughness and objectivity of the selected documents and artifacts.

Another limitation was the availability of relatively little student performance data. While those interviewed shared that they used rubrics, portfolios, projects, and action research to evaluate their efforts and student work, no such data were available to the evaluators from those assessment strategies to analyze the impact of the projects on student achievement.

The generalizability of the findings was a limitation because only six TICG projects located within one region, Western cluster, were investigated. These six projects represented only 6% of the 100 projects that have been funded over the past six years.

FINDINGS

These challenge grants have narrowed the technology gap. Otherwise, demographic reality would have control. Project leader

The cross-case study focused on 1) the impact of technology and professional development on teaching and learning, 2) the theories of change, 3) processes and structures developed and implemented, and 4) helping and hindering factors. The findings for this report are presented in four sections. Each section represents one of the four evaluation questions and includes a review of literature, key findings from cross-case analysis with evidence presented from documents and responses from informants, and a conclusion. Though quotes from specific sites are used within each section, they are only intended to reflect the attitudes and beliefs of people in all of the sites studied. Careful attention has been made to maintain confidentiality and not specifically identify any persons who have been quoted from interview responses. All direct quotes are presented in italicized print.

FIRST EVALUATION QUESTION: What impact has technology and professional development had on teaching and learning and the community?

Review of Literature

Technology and its Impact on Learning

- Educational technology is a valuable tool to increase student performance on educational standards, particularly when the use of technology is combined with other efforts such as standards-based approaches, alternative assessment of student learning, parental and community involvement, frequent exploration and inquiry, and frequent

feedback and teacher expertise (CEO Forum, 2001; Antifaiff, 2002; International Society for Technology in Education, 2002; Mann and Shafer, 1997).

- Teacher expertise is the most critical factor in increasing student performance. Nothing impacts student success on standards-based curriculum more than a competent, reflective teacher in the classroom who interacts effectively with students, facilitates their learning experiences, and uses curriculum and curriculum materials effectively (Cohen and Ball, 1999).
- Students learn best when they play an active role in their own learning. These students use higher level thinking skills. We can no longer expect students to memorize and absorb a static set of facts, because those facts soon become obsolete. The sheer amount of information available grows ever more rapidly and what students need to know changes as quickly. Students "construct" their own knowledge as they must learn how to investigate, classify, evaluate, and communicate information. Technology can be tools to facilitate these processes (Gonzales, 2001, p. 218).
- One of the major challenges in the use of technology and the Internet is to develop systems for separating the valuable from the useless. Using tools that assist teachers in evaluating Web sites for accuracy and reliability, the Internet is a great place for students to begin to search for pertinent current data and information, find different sides to issues, and discover information often hard to find in traditional instructional materials (Benton Foundation, 2001). Even if teachers are eager to use the resources, they are challenged to find the ones useful to their curriculum. It can take hours of time.

- New tools are essential for assessing technology assisted student learning (Glatthorn, 1998; Wiggins, 1993, 2001). Authentic assessment tools, such as analytical scales and rubrics, are essential to measure student progress on various skills learned through the use of technology and the Internet (Benton Foundation, 2001).
- Numerous studies have failed to provide conclusive evidence that student achievement on standardized tests scores has gone up when technology and networking are integrated. While some studies show evidence in increased achievement, many reflect that it is difficult to isolate the impact of technology from other change initiatives going on in the school (Benton Foundation, 2001).
- Standardized tests measure student mastery on discrete skills and factual knowledge. Many analysts believe they do not adequately gauge whether students are acquiring higher order skills such as ability to solve complex problems, think analytically, synthesize information, and communicate effectively (Benton Foundation, 2001).

Professional Development that Impacts Student Learning

- The National Staff Development Council (NSDC) has developed a resource guide that includes twelve standards for staff development to help schools and districts in designing and implementing high quality staff development. These standards include: context standards (learning communities, leadership, resources), process standards (data-driven, evaluation, research-based, design, learning, collaboration), and content standards (equity, quality teaching, family involvement) (NSDC, 2001).
- Along with the NSDC Standards are the National Educational Technology Standards (NETS), which all classroom teachers should meet. These standards include: technology operations and concepts; planning and designing learning environment and

experiences; teaching, learning, and the curriculum; assessment and evaluation; productivity and professional practice; and social, ethical, legal, and human issues (ISTE, 2000).

- Even though educators have developed a long term understanding that professional development increases student performance, inadequate training is perhaps the biggest reason technology fails to be used appropriately (Mann and Shafer, 1997).
- The United States Office of Technology Assessment (OTA, 1995) stated that in the process of acquiring hardware and software for students to use, the most valuable part of the education equation, the teacher, is often left out of the formula for implementation. Only 20 percent of teachers feel "very prepared" to integrate technology into their teaching. In addition, OTA recommends that funding of professional development for use of technology in the classroom should be approximately 30 percent of a district's technology budget. National Staff Development Council recommends 10 percent of a district's budget be allocated for professional development (NSDC, 2001).
- Teachers say the greatest challenge is developing lesson plans that incorporate use of technology and resources over the Internet. According to a report sponsored by the Department of Education, *Using Technology to Support Educational Reform* (1993), teachers are nearly unanimous in concluding that in early stages of technology implementation, their jobs are much harder. Despite this information, most schools cut corners on training and professional development.

- Teachers are more likely to use what they are learning about technology in their classrooms if they receive curriculum integration training rather than basic skills training in the use of technology (Jerald and Orlofsky, 1999).
- While traditional training could help teachers make better use of technology, teachers can learn better and at lower cost from each other (Benton Foundation, 2001). Teachers are more likely to learn when they are in non-threatening environments. They must have ample opportunities to discuss and collaborate with their peers and instructors (Gonzales, 2001; NSDC, 2001; Fullan, 1993).
- Teachers learn best in learning communities with goals that are aligned with the goals of the school and district. A highly effective professional development strategy is teachers teaching teachers. This strategy is particularly effective because of the rapport it establishes among teachers. Learning communities allow teachers to network and share ideas. Communities of learners open up classrooms and provide teachers who are often isolated from each other the opportunity to learn from each other (NSDC, 2001; Gonzales, 2001; DeFour, 1998; Hord, 1997).

The Design of Curriculum

- Using technology to achieve the curriculum standards and benchmarks increases student achievement on higher level reasoning skills and problem solving. Students learn how to manage their own learning and be more reflective about what they are learning and the impact of that on the world around them (Jonassen, 2000).
- Students will learn strategies to access information that increases knowledge, inquiry, and depth of investigation. Effective communication and interpersonal skills will improve as well (Dewey, 1927; Tyler, 1949; Wiggins, 1993; Caine & Caine, 1991,

1994). Curriculum designed to explore and inquire, such as WebQuests, take down the walls between the classroom and the outside world. Children are exploring complex, real-world issues, challenged to analyze current, raw data and expected to communicate their learnings to others (Gonzales, 2001; Quinn & Valentina, 2002; WebQuest Taskononmy, 2002).

- A founding principle of these curriculum strategies is that through constructing their own meaning around authentic issues, students will acquire the sophisticated thinking skills needed to live and work in the 21st century (Marzano, 2001; English, 1992, 2001; Wiggins, 1998; Resnick, 1984; Strong, Silver, & Perini, 2001; Bass, 2002).
- "Instead of absorbing an established body of knowledge delivered to them by teachers, [students] are developing skills to seek and analyze and convey information. They are addressing real world concerns in an interdisciplinary way. Instead of studying in isolation, they are working in teams. Instead of regurgitating what they have learned back to their teacher, they are communicating to a much wider audience" (Benton Foundation, 2001).

Instruction

- Constructivist classroom theory emerged from Piaget's basic principles: learning is an active process, and learning should be whole, authentic, and real. Meaning is constructed as children interact in meaningful ways with the world around them. Technology, in particular, multimedia, offers a vast array of such opportunities. (Piaget, 1970; Vygotsky 1978; Bruner, 1962, 1990; Dewey, 1907; Brooks & Brooks, 1999; Wells, 1994, 2002).

- Collaborative learning increases student performance (Johnson, Johnson, & Holubec, 1993; Sharan & Sharan, 1992; Slavin, 1990).
- The brain research suggests that if people work together, they learn exponentially. In addition, the more students are engaged in making connections to what they already know, find meaning in what they are learning, and determine that this new learning is useful to them in their daily world, the more effort they will give to learn what is needed (Hart, 1983; Wolfe, 2001).

Equity

- One major challenge for the nation is access for children living in poverty. In 1995, 60% of central city schools who serve predominantly children in poverty had insufficient phone lines, electrical writing, or electrical power compared with 47% of rural and small towns. Though this statistic may have changed with the use of E-rate funds to support infrastructure, the challenges for school districts in communities lacking resources is the immense needs for funds for infrastructure (Benton Foundation, 2002).
- Not only is access an equity issue for America's children living in poverty, use of computers is as well. Unless disadvantaged students are introduced to more challenging uses of computers, they may be consigned to a new technology underclass (Pillar, 1992).
- When parents and community partners engage in educating children, schools become more successful with all students (New American Schools, 2001).
- Public engagement is a willingness on the part of the community citizenship to invest not only their financial resources, but also the time and energy needed to support a

system of quality public education that is accessible to all of America's children (Voke, 2002).

- Essential characteristics of public engagements are:

    1. All constituencies were purposefully, intently engaged in the public discussion about the purpose of public schools.
    2. They sought meaningful long term improvement in schools. The dialogue moved forward to action to improve student learning.
    3. They attempted to establish common ground and broad consensus.
    4. They featured an atmosphere of candor and trust (Voke, 2002, p. 5).

Key Findings

Technology is not the center; the center is learning! Proejct leader

A major emphasis in the grant initiatives was the use of technology as a tool to increase the performance of students on content standards in the curriculum. The following themes emerged across sites:

- **Technology used as a tool** to increase student achievement of curriculum standards.
    - Interviews and review of grant applications and evaluations indicated that **student achievement** was the focus of TICG efforts. Respondents believed that student achievement, on standard measures, increased when teachers integrated technology into a standards-driven curriculum and inquiry instructional strategies. Standards-based approaches to instruction increased student performance. When schools and teaching staff were very clear about what was to be learned, students performed at a much higher level. When curriculum standards were explored in terms of their real world applications and students developed inquiry strategies to address problems that led them to conceptual understanding of the standards, performance was higher. Using

technology, to engage students in real life experiences and in using current data, increased student interest.

- Technology facilitated **raising staff and student expectations** and increased the degree of meaningfulness for student learning.
    - Students living in poverty have access to the world through technology, and this access **narrowed the technology gap** between those who had the resources of technology in the home and those who did not.
    - Leadership teams, teachers, principals, and parents believed that students with **special needs or varied learning styles** were more successful with the use of technology.
    - **Student engagement** led to excitement and involvement in meaningful learning experiences.
- Using technology appropriately in classrooms revolutionized teaching.
    - Through **inquiry, collaboration, and sharing** students entered into meaningful work that mirrors real-world experiences.
    - Students and teachers enjoyed the use of technology and engaged in what they were learning more **intently and with greater depth and meaning.**
    - Teachers' use of technology facilitated **constructivist classrooms, inquiry approaches to teaching, collaboration, and student sharing.**
- **Professional development** in using technology to address standards, to design and use constructivist strategies, and to manage classroom tasks **transformed classroom practices.**
    - **Developing curriculum** was a transformative staff development practice.

- **The Trainer of Trainer model** built capacity among the teaching staff.
- **Modeling** and providing **immediate support and feedback** in training increased the likelihood that teachers would use the strategies in their classrooms.
- **Ongoing support at the school** assisted teachers in problem solving and implementing effective use of technology in the classroom.
- **Holding teachers accountable** for what they were learning increased the likelihood lessons developed during professional development sessions would be used with students in the classroom.
- Sharing lessons, data, student performance, and work samples over time assisted teaching teams to **learn from each other** and to be **reflective in their practice**.
- Technology assisted school staff in easily **managing tasks** that generally consumed immense amounts of time; such as grade recording, publishing homework assignments for students and parents, sharing progress, and managing attendance.

- Technology made **public education visible**.
  - **Parents** understood the value of their child's education and engaged as partners with educators to ensure the success of their children in school.
  - **Community organizations** partnering in the TICG projects perceived their role as vital in the education of the community's youth and essential to their survival.

- **Community partners** developed a deeper understanding of the critical ways they supported education and the distinct roles they played.
- **Higher education and regional service centers served as key catalysts and critical liaisons** linking K-16 education, parents, community, and political entities to the education of the community's school-aged children.

Technology used as a tool to increase student achievement of curriculum standards.

Though one of the major emphasis in all of the Challenge grants was to raise the performance of students on meeting state standards and to increase the performance of students on the state tests, little evidence was found in terms of quantitative data to demonstrate the impact of technology on student achievement. Several reasons contributed to lack of quantitative student performance data. At times, leadership teams were delayed in implementation of the initiatives due to increased amount of time needed for building shared vision and designing the innovation. Consequently, progress in having the technology in the classroom was delayed. Teachers were late in receiving equipment, buildings were not wired, and software and components were not always compatible with the equipment. In some cases, the software was not sufficiently developed for classroom use.

In addition to these barriers, there was a belief by many individuals interviewed that state assessment tools were inadequate and even inappropriate for determining the impact of technology on student performance. Respondents indicated that new strategies in assessing the impact of technology on student achievement were needed.

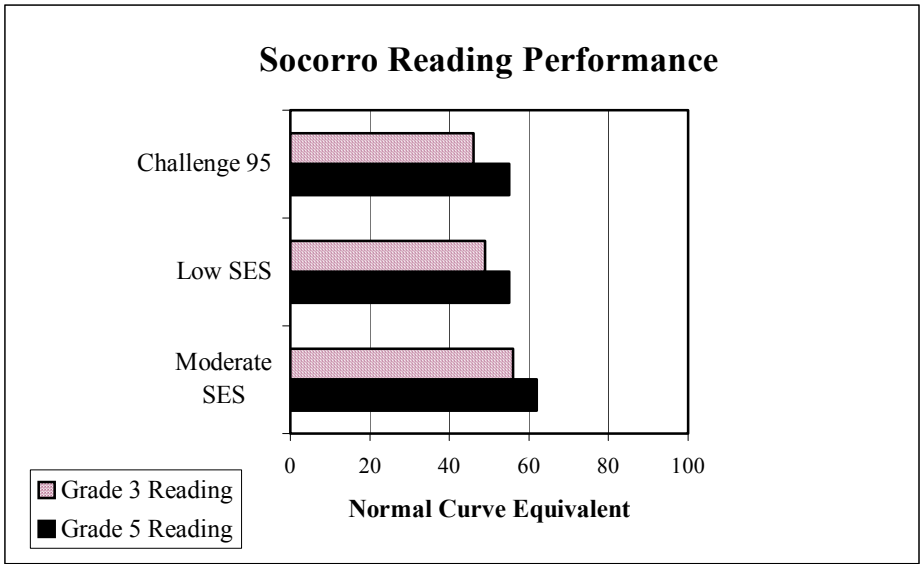
In the March 2001 evaluation of the Challenge 95 grant, the evaluators noted the findings on student performance on the Texas Assessment of Academic Skills (TAAS). The study followed the progress of third graders from ten schools in two districts, Socorro ISD and Ysleta ISD, and made comparisons on math and reading TAAS scores. Table 5 below indicates the three comparison groups for the Socorro study based on two demographic indicators: 1) economically disadvantaged status and 2) minority classification.

Table 5. Socorro Study Comparison Group Demographics

Comparison Group	Challenge 95	Low SES	Moderate SES
Economically Disadvantaged	94%	93%	46%
Minority	98%	98%	80%

The findings from the first Challenge 95 study of student performance indicated that all three comparison groups showed improvement in reading scores; however, Challenge 95 students did not significantly score higher than Low SES students (see Figure 1).

Figure 1. Longitudinal Socorro Study, Reading Performance



The findings for mathematics indicated that Challenge 95 students made more progress than Low SES students. A statistically significant higher rate of growth occurred for Challenge 95 than for Moderate SES students and the achievement gap narrowed between the two groups by 1997 (see Figure 2) (Gantner, 2001, pp. 4-5).

Figure 2. Longitudinal Socorro Study, Mathematics Performance

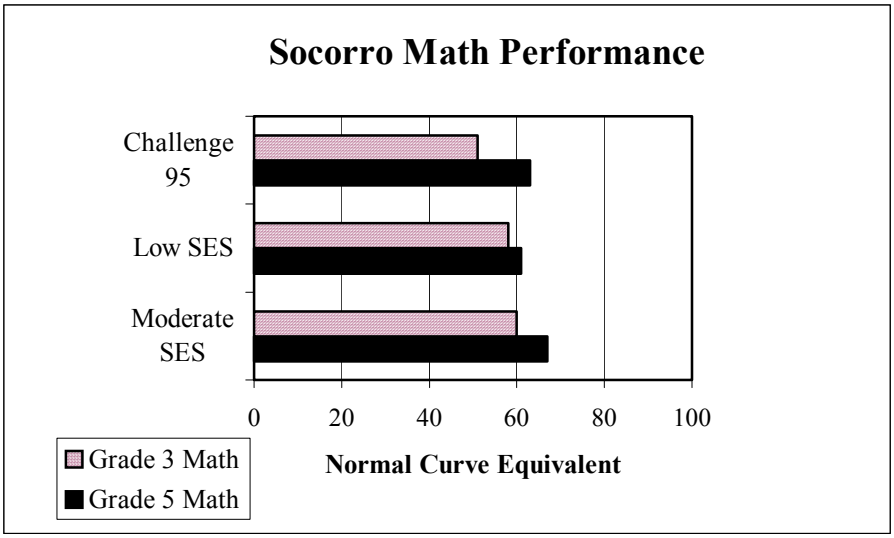


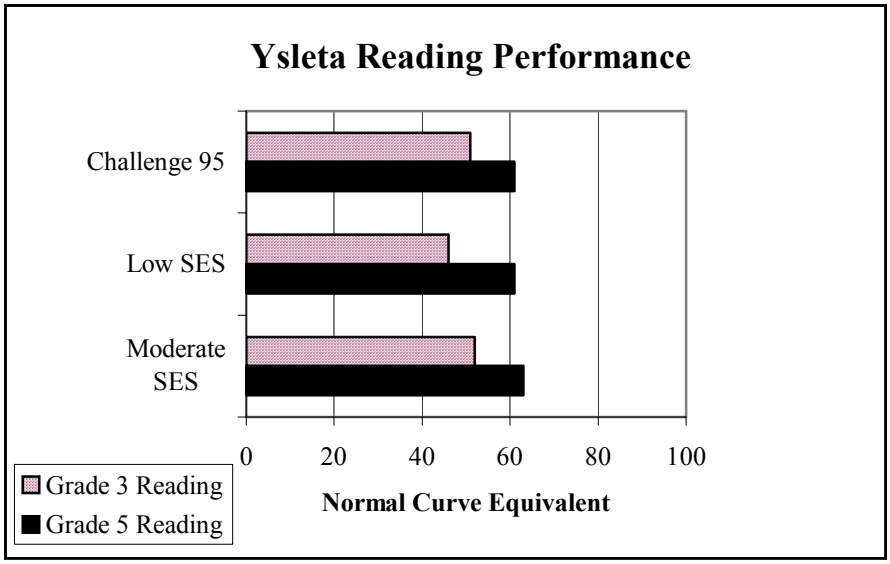
Table 6 below indicates the three comparison groups for the Ysleta study based on two demographic indicators: 1) economically disadvantaged status and 2) minority classification.

Table 6. Ysleta Study Comparison Group Demographics

Comparison Group	Challenge 95	Low SES	Moderate SES
Economically Disadvantaged	81%	83%	57%
Minority	100%	100%	80%

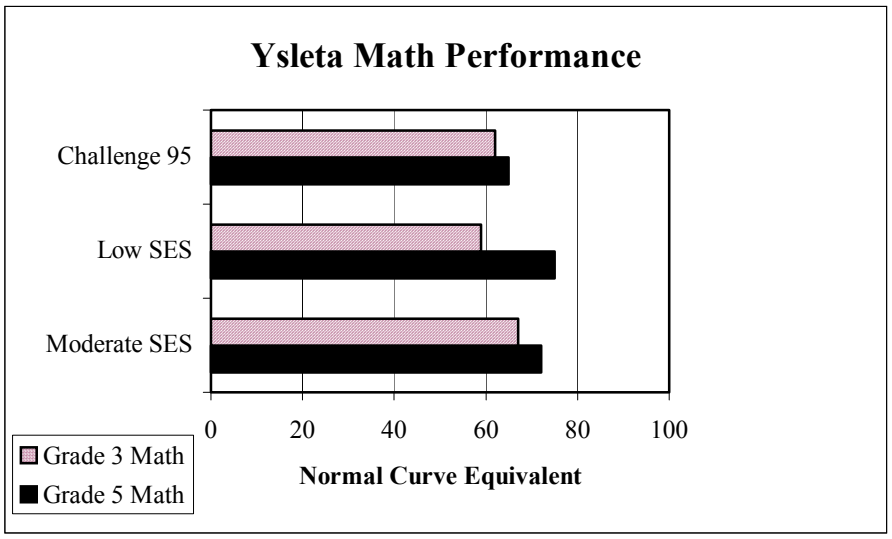
The Ysleta ISD findings were similar to the Socorro ISD findings; all three demographic groups made comparable growth in reading (see Figure 3).

Figure 3. Longitudinal Ysleta Study, Reading Performance



All three groups improved their math scores over the two-year period of the study (see Figure 4) (Gantner, 2001, pp. 5-6).

Figure 4. Longitudinal Ysleta Study, Mathematics Performance



The study did not conclude that this growth was solely due to Challenge 95, but more likely due to consistent implementation of a math program and other factors related to systemic change. However, the Challenge 95 evaluators continued to establish other impacts on student and staff learning. The Challenge 95 evaluators stated that these

changes included a focus on meaningful professional development, highly motivated student learners, decreased numbers of discipline and classroom management issues.

The following comments from across the sites reflect agreement with the findings from the Challenge 95 evaluation on student performance:

> *[TICG] made teacher professional development the cornerstone of its program, with impressive results. . . . quality programs can increase knowledge, reinvigorate teaching, and ultimately inspire changes in teaching practice.*
>
> *Several teachers noted that boys who were discipline problems in the regular classroom voluntarily stopped their disruptive behaviors when technology was integrated with classroom assignments.*
>
> *These students found the technologically enriched environment so fascinating that they no longer complained that 'school is boring.' More than one teacher reported that difficult classroom management issues became non-existent when they incorporated technology into their daily curriculum.*
>
> *They [teachers] watched with delight as students grew enthused about schooling through interacting with technologically integrated learning environments. This outcome, increased motivation for learning, is a powerful outcome.*

Another major issue in determining the impact of technology on students learning was the fact that many schools were implementing many innovations. Many of the schools and districts implementing the Challenge grant innovations were also implementing innovations in literacy, mathematics, and science. Achievement was going up in their schools on standardized measures; however, they were reluctant to attribute that growth only to the use of technology in their classrooms. One teacher said:

> *Our achievement has gone up based on our scores; but we are not sure of the contribution of this program. I know my students are learning skills faster and there are some things, such as rounding off, that I use to have to spend time on that I not longer spend time on.*

Therefore, the evaluations conducted on the grants often focused on attitudes of teachers, parents, and students toward the use of technology and the affective impacts on student performance.

Several results shared are noteworthy. Published in an evaluation document of the SATEC curriculum and its impact on student learning, the following findings were significant:

- 41.7 percent of SATEC school students passed the state Algebra End of Course Exam as compared to 34.9% of non SATEC school students.
- After controlling for student gender, ethnic background, English proficiency and at risk index, SATEC school students were 1.5 times more likely to pass the Algebra End of Course Exam compared to non-SATEC school students.

At Ronald Reagan High School, a high school in Northeast ISD in San Antonio, and part of the SATEC Challenge Grant, teachers and staff gathered data on student performance on the Algebra I End of Course Tests for the State of Texas. The data included 7 classroom teachers, 4 using the SATEC curriculum and strategies (see Table 7). Those students in classrooms of teachers who were using SATEC curriculum significantly out scored those students who were not in SATEC curriculum.

Table 7. SATEC Teachers and End of Course Scores

Teacher	State End of Course (# passing/class total =Class Percentage)
SATEC Teachers	
Teacher A	66/76 = 87%
Teacher B	57/65 = 88%
Teacher C	47/58 = 81%
Teacher D	20/24 = 83%
Non SATEC Teachers	
Teacher E	40/70 = 57%
Teacher F	26/40 = 65%
Teacher G	78/125 = 62%

One individual stated:

Standardized test scores increase for students in standards-based, constructivist classrooms. A focus on higher level thinking increases student achievement.

Technology facilitated raising staff and student expectations and increased the degree of meaningfulness for student learning.

High Expectations. Students and staff believed that using technology in the classroom raised the expectations and the performances of students. According to key leaders in the ACT Now! innovation, technology raised expectations not only for students but also for staff. One leader said:

This project is most advantageous to the students. It does not matter whether students are low performing or high performing; all could do well and participate. It is great for students with low self esteem. Teachers also learned that there are other ways of doing things. They began to help students become knowledgeable about the real world through the application of technology.

In the SATEC Algebra program, students interviewed believed that they were learning significantly more algebra. One student shared that he had failed Algebra I twice, but this year he really understood algebra, and he attributed that change to the changes in the curriculum. He shared:

> *The curriculum has shifted from being textbook-driven to lab- or project-driven. Labs focus on real life experiences, shadows, sundials, bridges, basketball, and swings. It just makes sense to me!*

Several students indicated that they wanted even more challenges and problems to solve. They wanted to know more about how what they were learning fit into the real world. The question frequently asked: "How does this stuff apply?"

In a physics class in a school participating in the Aurora project, students shared that they had a better understanding of physics concepts. They said that the work was more challenging than for them than traditional classes, and that they used the technology to explore, discover, and share what they were learning with others.

High school students in an English as a Second Language class in El Paso ISD shared what they had learned about topics of interest to them, the rain forest or particular cultural aspects of their life in the United States. They were producing PowerPoint presentations to share with other students.

A student stated:

> *We learn more of what we are expected to learn. When we cannot figure it out, we have assistance on the Internet and the computer. We can go back over and review our work, and we can help each other.*

One SATEC teacher stated that she was a very traditional teacher but interested in innovation. She was helping to write the algebra curriculum. Approximately 40% of her students were passing the Algebra I End of Course Tests for the State of Texas. She

moved to a new school, used the SATEC curriculum and constructivist classroom processes and techniques throughout the school year, and she and her fellow teachers began to really understand the concepts of algebra. She stated her thoughts as: "Oh, that is what that means; oh, that is how that goes." She shared that she had developed conceptually; her own understanding grew. She saw a 40% jump in her students' passing rates.

Standards-Driven Curriculum and Student Learning. Many teachers, principals, and students interviewed believed that students were learning more in classrooms where constructivist strategies and technology were used to address standards. The curriculum strategies employed by all of the Challenge grants, such as WebQuests, ACT Online, Hot Lists, SATEC, Aurora's GeogWeb, and RETA New Mexico curriculum and Marco Polo, all had as their fundamental design problem-based, real life experiences for students. The students had to explore the world around them, used current data from the Internet, and solved problems around issues that matter to them. They focused on standards, engaged in higher levels of thinking, and explored issues that were of interest to them. Curricula that integrated this type of learning experience sought to connect student learning to concrete experiences with appropriate integration of technology. Such tools as curriculum-interfaced probes, image analysis software, spreadsheets, PowerPoint, Internet searches, and simulation activities were used in these curricula experiences to engage students in exploration and inquiry. Students worked collaboratively with each other and in teams to solve real-world problems.

Teachers and administrators reported that these tools were dramatically changing the environment of teaching and learning, and they allowed teachers to introduce students

to concepts by permitting them to discover patterns on their own by collecting and analyzing live data and sharing what they learned with others. Students were developing deeper understandings of these curriculum concepts and saw what learning in meaningful ways. According to grant participants, the previous focus on drilling students on skills, one-on-one interaction with the teacher, desks in rows, and using technology as a reward or enhancement to direct instruction has shifted to a focus on concepts and connections to the real world. One respondent stated:

> *In the mid 80's, we were in the cellar. We have been recognized in the last few years by the State because of student performance on TAAS (Texas Assessment of Academic Skills). Gaps between the rich and the poor have been significantly changed, and we believe that technology has impacted these results.*

A middle school student stated:

> *What we have to learn gets easier every day. The technology is easier to use every day. The computers help us make graphs and do it much easier. We do not have to erase and measure. The computer provides us opportunities to discuss and explore.*

Teachers also reported that students were more skilled in areas of writing, language, and mastery of multiple skills. They also developed problem solving skills and began to emerge as key leaders in assisting others. Several teachers stated:

> *Technology encourages independent learning and problem solving*.

> *Student empowerment contributes greatly to student success. Older students especially are energized by their ability to play leadership roles in the classroom.*

When students were asked if they liked to use technology in the classroom, all students raised their hands and their faces brightened up. Several students had options to move to other classes to alleviate problems in their schedules and they refused. They felt that technology made learning easier. Several students responded:

The computers give multiple examples and show different ways of doing things. Furthermore, there are more opportunities to explore things you are really interested in.

Instruction with the computers allows more time to work with groups and to collaborate. You can stay more focused on what you are learning. When teachers are talking at you, you lose focus sometimes. You learn more, faster because the computer works faster.

One teacher reported:

Inquiry approaches, use of technology to access the world around them, to see real world applications and how it relates to them, and presenting their findings in a professional way increases the quality of student work and their own motivation and self-efficacy.

Equity. One of the major concerns of all Challenge grant leadership teams, students, parents, and staff was equal access to technology for students living in poverty. All shared their strong passion for and belief that students living in poverty must have access to the world through technology. The grant provided access and that access has narrowed the gap between those in the United States who have the resources to have technology in the home and those who do not. One respondent stated:

When [TICG project] came to us, we were excited about the possibilities for our students with the use of the Internet. Many of our students had not even ridden on an elevator or been to a library other than the school library. The Internet has broadened the horizon for what they can learn, see, and do. It has brought the world into the classroom, where doors open for them.

Meeting Varied Learning Styles and Special Needs of Students. According to many teachers interviewed, students with special needs or varied learning styles are more successful with the use of technology. Teachers shared how technology allows students' talents and interests to develop. In addition, teachers believed that technology provides students, who sometimes have not been highly successful in school, a way to share what

they know with others and to be more successful on the curriculum standards.

Several teachers commented:

Technology, if used appropriately, can really do wonderful things for students, especially students with special needs.

I could tell you story after story of students in English as a Second Language, students at risk who were not really engaged who have emerged as successful students because of the use of technology in the classroom. By integrating technology teachers turned them around and engaged them in the project. Students who have low self-esteem were turned around. For students to have that empowerment is amazing.

Technology has been the salvation for the special needs students. In a general education classroom, I see all levels, and those kids with lower [academic] skills and not so great social skills shine in the computer lab, especially if you given them a lead position.

Student Engagement. Both students and teachers reported that they enjoyed the use of technology and engaged more intently in classroom work. Their learning was in greater depth. Students were more on task and more focused on what they were learning. They had greater opportunities to find meaning and application to what they were learning. In addition, they were more eager to share what they were learning.

Teachers reported:

The use of constructivist teaching strategies has fundamentally restructured social interactions and learning. In turn this new social interaction fostered between students and educators is an important first step in the establishment of a learning community.

I had students produce presentations in Hyperstudio. As students were working on the projects, I found students who were not excited about learning really doing research and working together; their work was far superior to anything they had done before. At the end I invited parents and administrators to come see the presentations. These students typically did not participate. Their final projects were outstanding. Parents and administrators were amazed. Other teachers wanted to see what I was doing. Mentoring began naturally.

It is amazing to me what they can do because they really enjoy it! You can have a kid who never does anything in class really going to town!

Those interviewed believed that students using technology were likelier to be engaged in learning, less likely to be discipline problems, more likely to attend school, staying focused, and producing high quality work.

Using technology appropriately in classrooms revolutionized teaching.

Make it real! Get everyone!

Standards-Driven Curriculum in Constructivist Classrooms. A major approach to instruction in all of the Challenge grants was inquiry. One individual stated:

> *Students cannot learn to think critically, analyze information, make logical arguments, explain natural phenomena, or work as part of a team unless they are often permitted and encouraged to do so. When students connect their learning to concrete experiences, they develop a foundation for understanding more complex ideas.*

Students in Challenge classrooms shared with each other and worked in teams on curriculum projects that they were creating. In curriculum experiences and strategies used, such as WebQuests, Aurora's GeogWeb, Act Online, RETA, SATEC, students engaged in real world issues that were meaningful to them. They developed deep understandings of concepts and proficiency in higher order skills and standards. One teacher shared that she and her students found mathematics everywhere in the world; planes taking off, contagious diseases, and in tooth decay. She told a story of students using motion detectors and heat sensors to make predictions about the world around them. She shared that on one occasion students were going on a field trip, and they were also going to have the opportunity to go on a roller coaster. The students took a motion picture camera and filmed the ride then they began to analyze the experience in mathematical terms. In another Algebra classroom, students were using technology to collect data about disease and were studying exponential decline and exponential growth.

Students were making predictions about the data plus discussing with each other the meaning and concepts of the data. At the end of the class, the teacher was querying the students about their learnings. She asked, "Where do you find exponential decay in the world around you?"

The Aurora project engaged students in using professional tools to test water quality in conjunction with the Oklahoma Water Resources Board. Along with the state historians, student document history. By using the Geography Information System, they were learning more about themselves and others. The RETA curriculum allowed students to explore their state through readings, photography, and stories. Such curriculum experiences as Route 66, the sharing of the forced march of the Navajo in *The Long Walk*, and the story of the historic trail, El Camino Real de Tierra Adentro, allowed students to learn more about themselves through the lives and experiences of their ancestors. In the El Paso Challenge 98 project and ACT Now! curriculum, using WebQuests, Act Online, and Hot Lists, students were experiencing integrated curriculum through leading questions about the world. The activities helped students to deeply understand and experience the standards they were learning in meaningful, memorable ways.

In a second grade classroom, students were using the Internet to learn more about their favorite author. They were working in small groups. Some were at the computers and searching the Internet about the author's life; other students were generating questions that they would want to ask the author; some were in the corner reading books by the author to each other.

In other classrooms observed, students were sharing the PowerPoint presentations that they created with other class members, younger students, other teachers and parents. Classrooms were a buzz with strategies that were engaging everyone including the teacher in problem-posing, problem-solving, exploration around major issues or central themes, gathering and analyzing current data, and reflecting on what they were learning.

Collaboration. According to students and teachers, students worked collaboratively in the classroom. The majority of their time was spent working with other students in teams. Together, they explored the Internet, searched for current data, addressed major explorations, and took on different roles to achieve the goal of the project they were working on.

Professional development in the use of technology and constructivist strategies to address standards, to address standards, to design and use constructivist strategies, and to manage classroom tasks transformed classroom practices.

One respondent stated:

> *We cannot expect technology alone to impact student performance. Knowledgeable, well-trained teachers must participate in the development of rich curriculum that incorporates technology where it is appropriate to do so. Putting computers in the classroom of an unmotivated and untrained teacher may do more harm that good. It is certainly not cost effective.*

Curriculum Development as Professional Development. A primary goal of the Challenge grants was to develop the curriculum writing skills of staff members. Although the grant leadership teams found that teachers were not skilled writers of curriculum, they continued to maintain that focus. Some modified their strategies and provided teachers multiple ways to engage in writing curriculum. ACT Now! when faced with the fact that many teachers found writing WebQuests too challenging to develop in

the time allocated, provided teachers other types of scaffolding strategies that still met the goals of the project, such as Act Online and Hot Lists. SATEC utilized the skills of those who were originally identified as skilled curriculum developers and capitalized on their talents to complete their algebra project. The Aurora project actually hired curriculum experts to evaluate lessons submitted by teachers. These experts rated the quality of the lessons, based on the goals of the project and the lesson design, and made necessary changes. Grant leadership teams developed and provided rubrics and check lists to assist teachers in their work and to ensure that what was published and accessible for use in the classroom met the standards of the curriculum for the project.

Training and Trainer of Trainers Models. All of the Challenge grants focused on teacher training and the development of teacher leaders who could conduct training and mentor others. The primary goal of all the Challenge grants was to train teachers in the context of their curriculum content areas and assist them in integrating technology into their classroom.

The training established through the Challenge grants was a long term commitment on the part of teachers. RETA and ACT Now! developed training modules and expected teachers to commit to several sessions over time for training. The instructional periods for the RETA training modules included various formats, five Saturday workshops held over several months or five-day summer workshops. The ACT Now! training modules consisted of five modules, which were 4 hours in length and had to be taken in order. The fifth session of the series was designated as a celebration to view and discuss projects created by other teachers.

Others, such as RETA and El Paso, developed extensive training for coaches and lead teachers at schools. The El Paso Partnership for Technology Integration, Challenge 98 project, established school cadres of experts and spent time regularly training and supporting these leadership teams. RETA continuously developed the skills of their school-based leaders through summer training sessions and ongoing support throughout the school year. In the projects teacher trainers were continuously updated on technology and skills to make sure they were current. Teachers held conferences for others and developed mini-lessons to support teachers in their schools. There was a long-term commitment on the part of trainers and continuous support for those lead teachers. In the Community of 21st Century Learners for El Paso, Challenge 95 grant, the leadership team designed and established a master's degree program for teachers in instructional technology. These teaching students applied what they were learning in their college work to their classrooms. In most of the other grants, learning about technology generated interest among participants in advanced degrees, and many were participating in masters and doctorate degree programs because of the excitement and interest in integrating technology in the classroom.

Modeling. In the trainer of trainer models used in these grants, trainers believed that modeling for teachers how to use technology in their classroom was their most powerful instructional tool according to the trainers. Those who participated in training had the same perceptions. In written evaluation reports and interviews, it was apparent that the power of their training lay in modeling that trainers did for them. Modeling, they reported, helped them develop their own strategies for their classrooms. Through

modeling teachers were experiencing in the training what they are expected to do with their students.

Ongoing Support. Challenge grant leadership teams provided regular and ongoing support to meet the needs of those learning new uses of technology in the classroom. Some of that support was in the form of regular follow-up meetings. Some support was provided at the schools, such as At-the-Elbow and TechPreps.
ACT Now! provided support to teachers and staff through TechPreps, which were a series of hands-on computer workshops held at the schools during teachers' prep periods and facilitated by a TechPrep facilitator. The Aurora Project had At-the-Elbow support, which meant that a peer facilitator at the school site provided support to individuals or small groups of teachers.

A major strategy for ongoing support was the development of teacher leadership cadres or teams at the school. School teams supported, trained, and mentored teachers who had no experience with technology or who had received training, but needed assistance.

Accountability. Also significant was a sense of accountability. Teachers who participated in Challenge grants had to produce and share lessons reflective of what they were learning. With others involved in the grant, they had to design WebQuests, Act Online, algebra lessons, or projects for their students to do in the classroom. Teachers were expected to teach what they were learning to other teachers in their schools. Many of the projects were presented at conferences and celebrations were held to allow an opportunity for teachers to share and demonstrate their learning. Some teachers hosted regular training sessions at their own schools for teacher teams. WebQuests and other

lessons were accessible through the Internet and servers for all participating. Sharing lessons, data, student performance, and work samples over time assisted teacher teams in producing higher quality work and being reflective in their practice.

Management of Tasks. Another strategy employed by Challenge grant leadership teams was to use technology to assist school staff members in managing tasks that generally consumed immense amounts of time, such as grade recording, publishing homework assignments for students and parents, sharing progress, and managing attendance. In addition, first class e-mail systems were installed in districts, and staff members were expected to use the system. Many principals and central administrators began to send all memoranda and communication through e-mail. In addition, some teachers established Web sites for parents and students to access homework assignments and grades. One teacher shared that her high school students were actually upset with her for providing their parents with access to their grades and attendance records.

Technology makes public education visible.

Community collaboration was essential!

One of the major areas of emphasis of the Challenge grants was collaboration with the community to engage everyone in the effort of increasing student performance. According to those interviewed, parents, as the single most important influence in their child's life, helped support and guide their children's learning. In addition, schools experienced positive results by involving members of the community. In these grants, business partners and involvement with higher education and regional service centers positively impacted the outcome of the grant efforts.

Parent Education and Engagement. Though all the grants acknowledged the importance of the role parents played in the education of their children, the El Paso Challenge 95 project focused in particular on this relationship and developed a true partnership with their parents. One of the major areas of emphasis in the Challenge 95: Community of 21st Century of Learners for El Paso grant was the development of parent education centers in participating schools. In these centers, parents led the activities and served as liaisons for parents, teachers, and administrators. During interviews and in annual evaluations of the grants, parents believed that to ensure success for students, parents had to be educated on the use of technology, the curriculum, and expectations for students. Through the parent centers, parents became more vigilant about monitoring their children's progress in school and developed skills in advocating for their children.

Several of the Challenge grants reported that parents knew more about what their children were doing in school. Parents knew what to expect from teachers and were encouraging their children to be success. In turn, they were encouraged by the efforts of the schools in meeting their children's needs. Schools and the education of their children were major areas of focus for these parents. Parents also reported that school has become a part of daily life. Parents knew that education was important to their children and that an education was essential for a successful future in the world. Respondents stated:

> *Parents have new standards and higher expectations.*
>
> *Parent centers help parents know how to set examples for their children. They believed that if their children saw them working hard and trying to learn new things, they would try harder as well.*

According to staff and parents, students' attitudes changed when parents were engaged in their education and the work of the school. Parents reported that, at first, their

children were embarrassed and concerned about why their parents were in the school. That attitude changed. Teachers and parents also noted that children's behavior changed when parents were in the schools. Parents believed that their children were proud and happy to see them in school. They thought that their children developed confidence as learners when they saw their parents learning in school as well. Parents stated:

> *At one middle school in our district, a student began to come into the school and change her clothes, different clothing and black lipstick. When a friend of the child's mother started volunteering in the school, that behavior stopped.*
>
> *Before I started coming to school, I took my child to a counselor. I thought the poor kid had a problem. They told me he had very low self-esteem. So I came in and talked to his teacher. She told me, 'He is like a shadow back there!' And I started getting involved and coming to his class. He was in Pre-K. He was always under the table. And then he started calling to me. 'Momma, do you think you could help me?' And so it started. We started putting his work up in the hallway, and he like it a lot. He grew so much. Now he is a very self-confident little boy!*

Since the opening of the parent centers, parents indicated that they feel welcomed in their schools and have come to see themselves as important in their children's education. They also mentioned that they felt that their voices were heard and their opinions were important. They all believed that the opening of the parent centers showed a true interest on the part of the schools to integrate parents into the learning environment and to reach out to the community.

Parents said that their own relationships with teachers, principals, and their own family members have changed as a result of the new open communication encouraged by the parent center activities and training. Through the activities of the parent center, parent skills were developed. Parents became confident learners, achieved G.E.D.'s, learned English, and prepared to become U.S. citizens. As parents developed their skills,

they were more confident and skilled at helping at school and with their own students at home.

As they began volunteering and helping their students at school, teachers' perceptions of their role changed as well. With new skills, parents took on new roles. Instead of making copies, teachers were using parents to reinforce reading and math skills; helped with discipline, shared themselves, their careers and interests, and substituted. Respondents stated:

> *We worked in the parent centers and developed the skills and confidence of parents. If parents needed classes in nutrition, we provided it. If they wanted to learn English, we taught it; we produced videos on what parents ought to see in the classroom, what students had to do to pass TAAS, how to go to the library and check out books, and how parents can help their children read.*
>
> *Parents were developing skills in reading and could see what they needed to do to help their children. They were developing plans for reading to their children; now they have a lot to offer them and feel comfortable.*
>
> *When my 22 and 26 year olds were in school, I never questioned the teachers or their methods of teaching. It was almost forbidden. Now as my 6th grade students is going through school, if I do not see what I think I should see in his learning, I will set up a conference with the teacher to find out what the problem is. Sometimes in our own upbringing, we are taught to not question the teachers. Even now, many parents do not know how to approach teachers, and they do not know why their child isn't doing well until it is too late. Times are changing. Parents are not holding back from asking questions of their teachers. They know what they are talking about and now have the confidence to ask questions about their child's learning.*

One strategy employed related to parents accessing e-mail systems that allowed them to stay in touch with their children's teachers and to access student assignments, grades, teacher interest and resources, and the standards expected of their children. Other strategies used by grant leadership teams were take-home computer systems and mobile computer labs for migrant children and parents. Partnerships with parents were a key area of focus for Challenge grants. One individual stated:

We want to make sure that parents understand their role in helping children be ready for college and to ensure that they are ultimately prepared for life.

Community Partnerships. The Challenge grants leadership teams were committed to developing a culture of community responsibility for student learning. Partners helped develop curriculum, showcased student work, and trained teachers on the use of technology and software. They sponsored training and hosted symposiums. Proxima Corp hosted the ACT Now! WebQuest Symposium. One hundred teachers attended. It was so successful the first year that it was repeated two more times. Cox hosted the ACT Now! Multimedia Academy. RETA partnered with Museums of New Mexico, KNME Public TV, Marco Polo, the New Mexico Coalition of School Administrators, K-12 schools, Tech Share, and Star Schools Project.

One of the highlights of the RETA project was its commitment to and skill in developing political alliances to support the education of children and their work to shape legislation that impacted technology use in schools. Their fifth goal related to sustainability focused on partnerships with the state legislature and education department.

Comments by site leaders were:

We found that if we were going to sustain our efforts we needed strategic partnerships. We partnered with the state department of education and worked closely with them. This partnership was mutually beneficial. For example, we are much more set up with technology and they were hosting state technology conferences. We did on line registration for them; we in turn received money from them for various things; we have their support and backing.

If this grant was going to be successful, we needed someone who was a part of the grant who could affect policy. We have made other strategic partnerships as well: coalition of school administrators, principals and superintendents, Gates state grant. We have partnerships with the museum to develop the curriculum. All of these coalitions and partnerships have lead to fulfilling the goals of [TICG project] and leading the sustainability.

These collaborators led a united effort to use the E-rate funds, to assist districts receiving state funds every year for technology literacy staff development, and to plan the state's infrastructure. Site leader stated:

> *We worked closely with the state and planned the infrastructure of the state. They have come to us to do surveys of the schools; we have provided the information and advice to get technology in the right place. We worked together on setting up a state strategy for distributing funding to districts. The funds were being distributed on a per pupil basis. Some districts were receiving very few funds because of their size. We set up an equity distribution to make sure that a minimum was received by all districts.*

Oklahoma developed a large list of collaborators: the Department of Commerce, the Historical Society, Climatologically Survey, Geographic Information Systems Council, Corp of Engineers, and the Oklahoma Water Resource Board. The Challenge 98: El Paso Partnership for Technology Integration project was a collaborative with two other major initiatives impacting public schools: a major literacy initiative and principal and teacher effectiveness. This approach was designed to coordinate action, among major educational initiatives in the city and surrounding areas, to help people make connections and accelerate their learning.

These partnerships were true partnerships. Not only did educators benefit from the relationships, partners found their role in the schools and communities redefined and their mission refocused. Through the Aurora project the Historical Society partners discussed new possibilities for enhancing their own work in the community. One community partner stated:

> *The Historical Society participated in the [TICG] project because we were eager to make teachers aware of the new exhibits, living history programs, identifying a larger community of experts for teachers and others to access who are involved in the community's social sciences, ethnic and culture center, and veteran's lives. The project helped us define and document our activities. We think this broadened the community and helps us achieve the goals of the legislature.*

University and Regional Center Partnerships. The leadership in the Challenge grants also recognized the significance of university and service center partnerships. In the El Paso partnership and the RETA project, University of Texas at El Paso and New Mexico State University, were a focal point for leadership, teacher and principal development, and partnership development. In the Challenge 98: El Paso Partnership for Technology Integration project, the regional service center collaborated with the university professors to provide services, not available through the grant itself, to smaller school districts. In the RETA project, the regional resource centers supported schools in different regions of the state. These regional centers played a significant role in establishing plans for implementation in their region, developing collaborative strategies, training teachers, and actively disseminating what was learned thus furthering the goals of the grant.

Conclusion

Student learning increased when technology was used as a tool to assist students in developing and asking good questions and exploring the world around them. Through effective professional development that focused on integrating technology into an integrated curriculum, teachers learned to use technology effectively. Parents and community partners not only facilitated successful implementation of the initiative and took ownership for all students in the community, they also discovered their own missions, redefined and renewed, and new and distinct roles in the community.

Table 8 identifies across sites the influence technology and professional development has had on teaching, learning, and the community

Table 8. Influence of Technology and Professional Development on Teaching and Learning

Findings Across Sites	Challenge 95	ACT Now!	Aurora Project	SATEC	Challenge 98	RETA
Technology Used as Tool to Increase Student Achievement	X	X	X	X	X	X
Technology Facilitated Raising Staff and Student Expectations	X	X	X	X	X	X
Using Technology Appropriately Revolutionalized Teaching	X	X	X	X	X	X
Professional Development in Using Technology Transformed Classroom Practices	X	X	X	X	X	X
Technology Made Public Education Visible	X	X	X		X	X

SECOND EVALUATION QUESTION: What theories of change drive technology-related innovations, implementation, and professional learning?

Review of Literature

- Weiss (1998) identifies theories of change as both implementation theory and program theory. Implementation theory is defined as the program activities and program theory is defined as the mechanisms of change. The implementation theory is based on the delivery of the program activities. The program theory is based on a set of assumptions upon which stakeholders build their program plan and explains the casual

links between the program's inputs and outputs. The assumptions are about what change the program is seeking, what influences the change, and what needs to happen for the change to occur (Goldings, 2001). The program theory emphasizes the cognitive, affective, social, and cultural responses to the program activities (Weiss, 1998; Wholey, 1994, 1987).

- A theory of change approach to planning, implementing, and evaluating a complex initiative identifies a series of actions linking the resources and activities to the desired outcomes. The series of actions define the relationship between the program's goals and objectives; its resources (inputs) and activities; and how the program is expected to work (Killion, 2002; Patton, 1997; Swanson & Holton, 1997). Patton adapted Bennett's model (1982, 1979) to clarify the components that guide a series of actions:
    - Inputs (resources) must be assembled to get the program started.
    - Activities are undertaken with available resources.
    - Program participants (clients, students, beneficiaries) engage in program activities.
    - Participants react to what they experience.
    - As a result of what they experience, changes in knowledge, attitudes, and skills occur (if the program is effective).
    - Behavior and practice changes follow knowledge and attitude change.
    - Overall impacts result, both intended and unintended (Patton, 1997, pp.233-234).
- McLaughlin and Mitra (2000) identify the theory of action as a supportive community of practice, a committed and supportive principal, and a compatible school district. The context of the district plays a vital role in sustaining reform practices.
- Issues surrounding educational technology and reform are complex. Bodilly & Mitchell (1997) note that "objectives and activities of educational technology projects often evolve as teachers learn to use the new technology in more sophisticated ways, as technology changes and as schools have to change" (p. 19).

- Implementing an innovation, which is multidimensional, requires three components: "1) the possible use of new or revised *materials* (instructional resources such as curriculum materials or technologies), 2) the possible use of new *teaching approaches* (i.e., new teaching strategies or activities), and 3) the possible alteration of *beliefs* (e.g., pedagogical assumptions and theories underlying particular new policies or programs)" (Fullan, 2001, p. 39). Materials, teaching approaches, and beliefs represent the means to achieving the designated program goals.
- Fullan (1999) notes that it is important "to examine change efforts in terms of their theories of education, i.e. what pedagogical assumptions and associated components are essential to the model, and their theories of change or action, i.e. what strategies are formed to guide and support implementation" (p. 20). The context, such as readiness for change or capacity to change, is a variable that needs to be included in a program's theory of change or action. It is important to be explicit about the assumptions concerning how the program's activities will impact the desired outcomes. Insights about change can be gained by enhancing what the best approaches are for implementing the program.
- A credible change agent, such as an administrator, often facilitates the diffusion of any innovation by serving as a liaison between the adopters of the innovation and the stakeholders who want to see the change occur (Dalton, 1989). The administrator can act as the change agent by facilitating the changes needed in the beliefs, attitudes, and practices of the teachers relating to the integration of technology (Dooley, 1999).

- Often what affects the implementation of a program is the diverse ways in which individuals react to change. Rogers (1995) identifies five categories relevant to how open individuals are to an innovation and change:
    - Innovators tend to be risk-takers, able to deal with uncertainty, and have access to financial resources.
    - Early adopters tend to serve as role models for their colleagues and are often influential based on respect from their colleagues.
    - Early majority tend to interact frequently with peers and are willing to adopt new ideas but within their own time frame.
    - Late majority tend to approach new ideas with some skepticism and don't tend to adopt new ideas until there is some pressure from peers.
    - Resisters tend to be more isolated and reluctant to try something new unless they are sure they won't fail.
- Institutionalizing and sustaining change requires "attending to a whole infrastructure for change, including curriculum resources, coalitions and alignments of agencies and policies, professional development and capacity-building processes, and procedures for monitoring and feedback" (Hargreaves, Earl, Moore, & Manning, 2001, p. 158). Complex changes, such as technology integration with standards-based curriculum, require a considerable amount of professional learning.

> Learning to change is intellectually demanding, and teachers need lots of time, inside and outside of the school day, to think through complex curriculum changes individually and with their colleagues. They need advice and support from skilled principals and other support persons to steer them through the process of making sense of new approaches. And they need emotional support from colleagues, leaders, administrators, and parents as they try to realign their teaching to deliver the kinds of learning that students really need (Hargreaves et al., p. 196).

- *First Things First*, a model for creating conditions and capacity for community-wide reform, identified these critical elements as early outcomes of their "theory of change":
    - awareness and knowledge of the reform among district and school staff;
    - a sense of urgency to change;
    - commitment to the initiative by stakeholders;
    - a sense of readiness to do the work; and
    - a belief that the reform is possible (Gambone & Associates, 2002, p. 11).

Key Findings

Common themes from the cross-case analysis emerged that identified the theories of change that drove these technology-related innovations. The common themes were:

- Key leaders supported the shared vision.
- Stakeholders were involved in planning and implementation.
- Early adopters shared the vision and helped build capacity.
- Teachers gained confidence with increase in knowledge.
- Increase in knowledge led toward teaching renewal.
- Teachers engaged students in real world applications to increase student performance.

Each of the sites began with one or more key leaders who had a vision and was persistent in writing and receiving a Technology Innovative Challenge Grant. The grant writers considered current conditions, needs, academic concerns, and resources. The inputs (resources) to get the program started included both financial and human resources. The federal funds from the grants provided the much needed finances for the infrastructure and professional development opportunities. The human resources included teachers, administrators, university faculty, and business partners.

Key Leaders Supported the Shared Vision. Key leaders were often known as the change agents or innovators. They were the ones that tended to have access to the financial resources and served as gatekeepers for an innovation. The project directors included university professors and former classroom teachers who frequently leaders. The project directors for Challenge 98 consisted of three project directors, two directors from the University of Texas at El Paso (UTEP) and one director from Region 19, who originally was a classroom teacher and participated in Challenge 95. The current ACT Now! project director was a classroom teacher when he first participated in ACT Now!. Several comments clarify the importance of having the key leader share and support the vision of the grant. Some respondents stated the importance of the principal as a key leader.

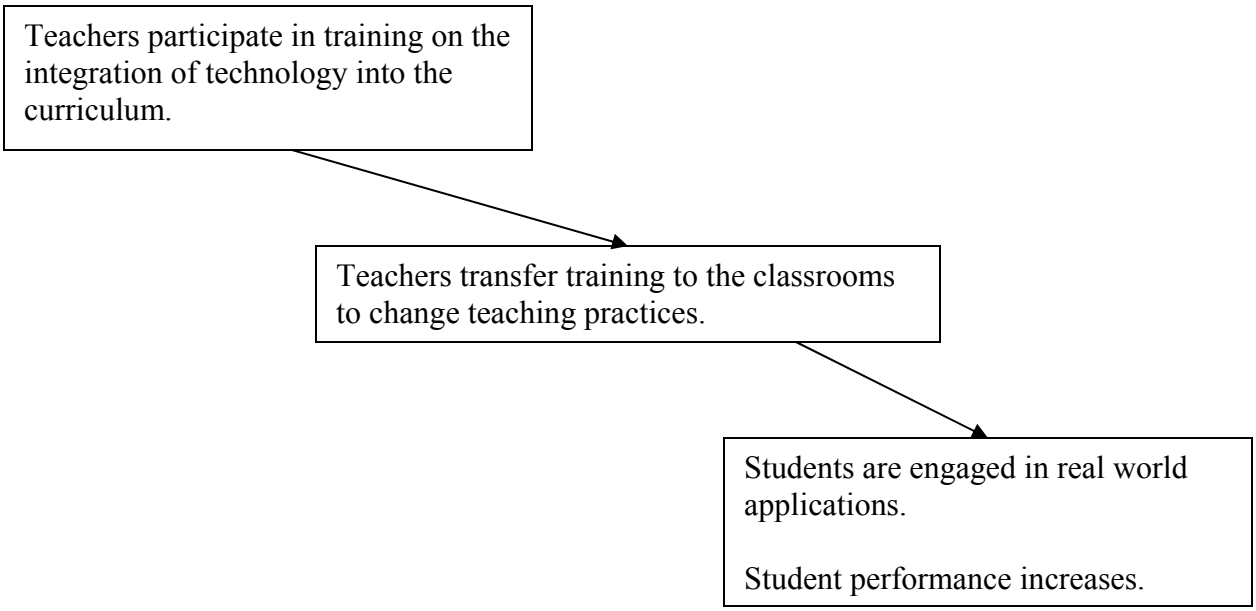
> *In regard to teaching I think the principal's role is to have a clear vision with a team of teachers as to what it means to integrate technology into instruction. It is very important for the leader to have a vision of what it means to have technology in the school, to have a core group of teachers that share that vision and create that vision and give input as to the training and to constantly readjust because they come upon stumbling blocks and it's difficult because the teachers have so much to do, the time is so limited and the curriculum is so vast*.

> *The principal has to share the vision. There are subtle ways to kill a program. Teachers know when something is important. They hear it in a faculty meeting; they hear teachers talk about it. The principal has to have the vision and support it. The district has to share the vision and support it also.*

The key leaders in the Aurora Project made up the Aurora Board, which provided oversight to the project. The duties of the board members included recruiting and training teachers to become curriculum developers, provided technology and support to the teachers, and oversaw day to day operations of the project. Peer facilitators, also known as lead teachers, developed from within this core trained group to assist others in their own districts.

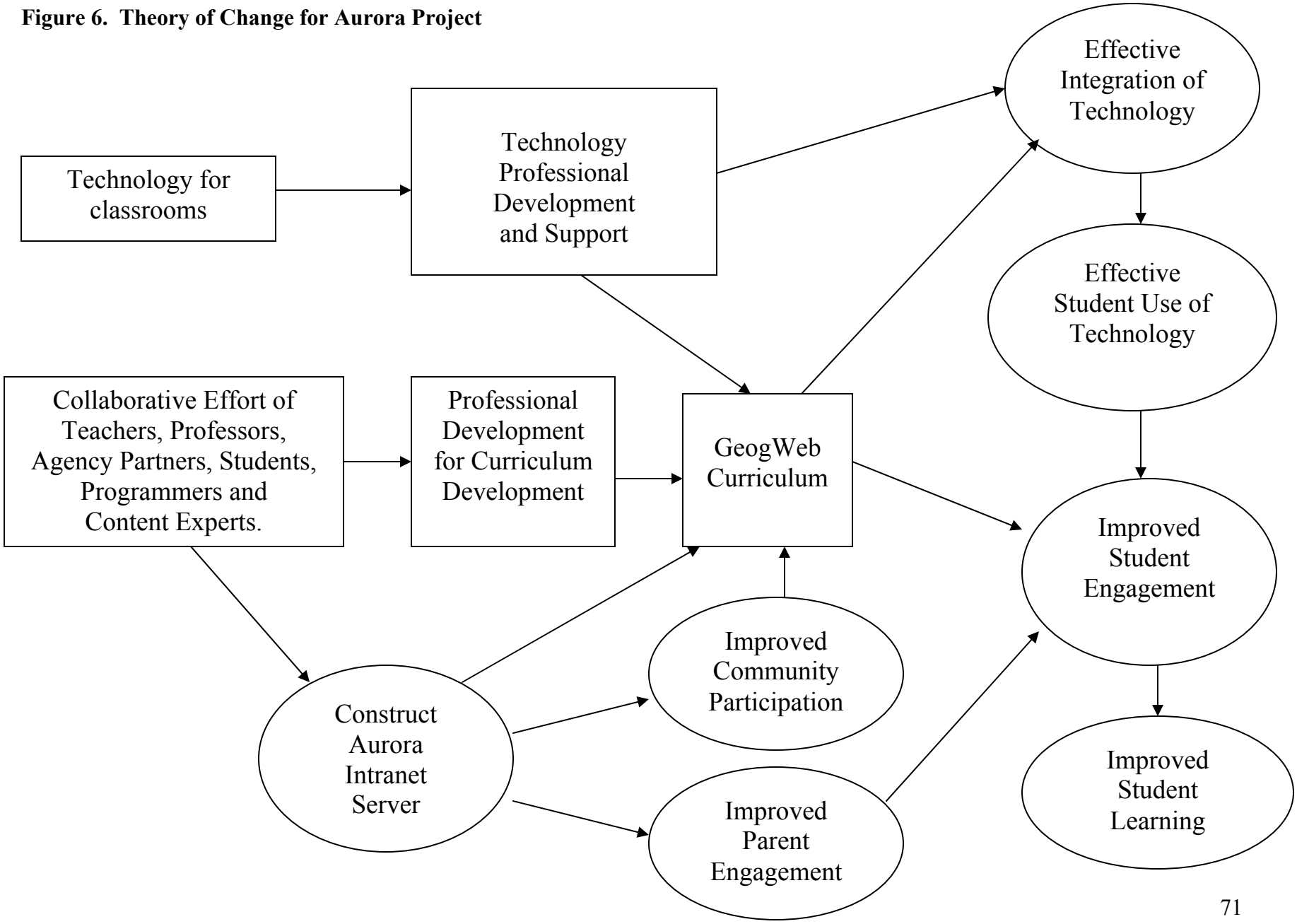
The training model that was used by all TICG projects was based explicitly on this simple program's theory of change for professional development. The theory of change identified what the program is and how it will increase student achievement. Figure 5 identifies the program's theory of change as adapted from "A Simple Theory of Change for Staff Development" (Killion, 2002, p. 56). The theory of change identifies

Figure 5. Theory of Change for Professional Development



A theory of change, exhibited in a conceptual map for the Aurora Project, depicted deployment of technology, training of teachers in the use of technology, collaborative efforts by stakeholders, growth of GeogWeb curriculum and the Aurora Intranet server. Figure 6 illustrates the theory of change for the Aurora Project.

Figure 6. Theory of Change for Aurora Project



Stakeholders Were Involved in Planning and Implementation. One requirement of the Challenge grant was to develop partnerships. These partnerships were part of a continuous effort of planning and problem solving related to not only staying focused on the intent of the grants, but also making necessary changes based on the needs of the teachers. Feedback from training sessions, input and feedback from teachers and administrators, and reflections of the training teams about their work were openly discussed and changes in the implementation activities were made.

One technology coordinator from ACT Now! had insight from both perspectives as she was a representative of the private sector who was later hired by the school system to help implement and monitor what had originally been planned. She stated:

> *Certainly from my point of view . . . I worked with [the project] from the private partnership role. They recruited private partners to make it more community based. Then they identified the number of schools. In a series of waves, all teachers could participate.*

Evaluation and planning documents from El Paso identified the multiple partners involved over the years as stakeholders with this project which focused on a systemic reform effort.

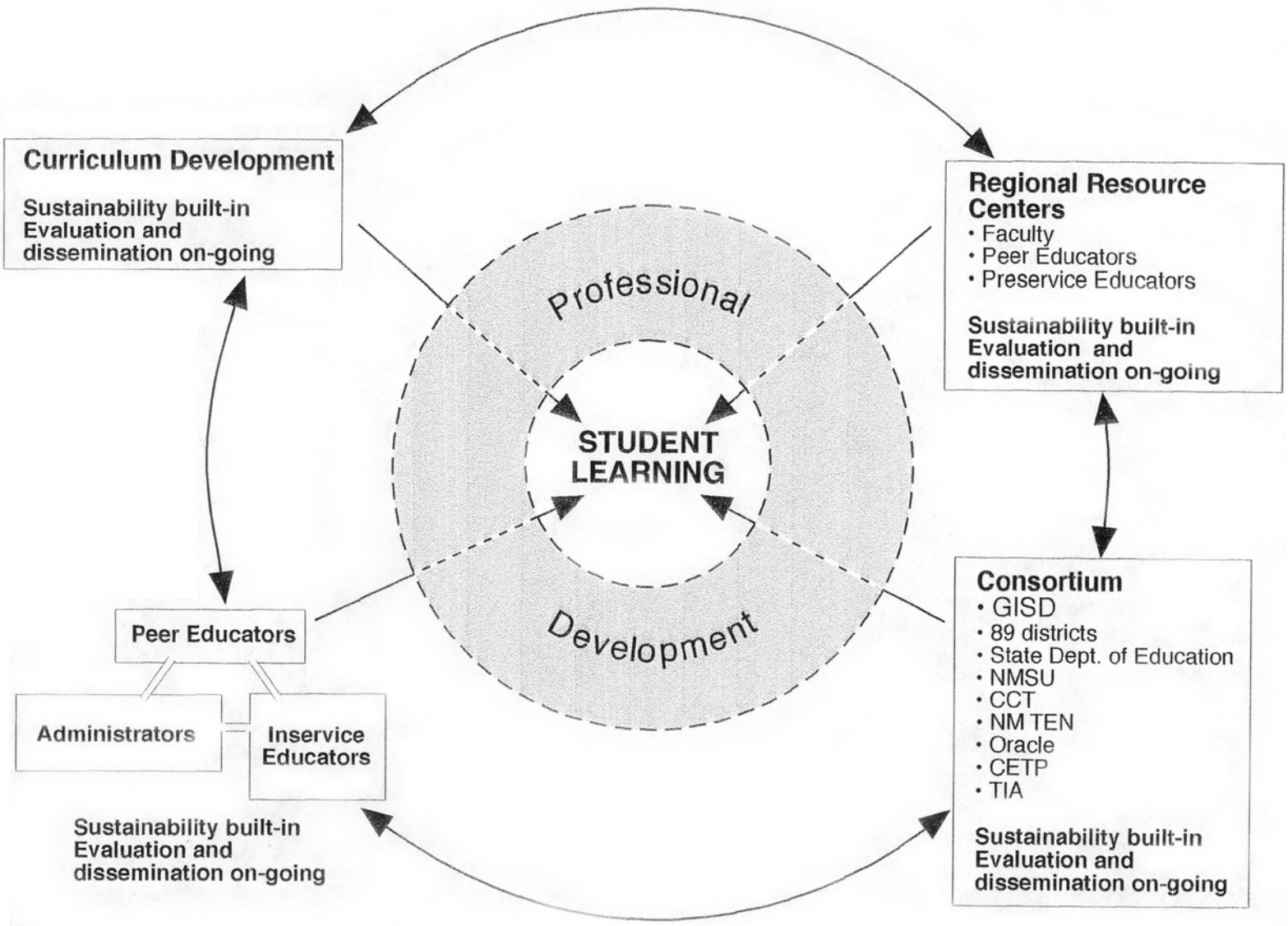
> *This 10 year-old K-16 partnership includes the superintendents of El Paso's three largest school districts (135,000 students), the University of Texas at El Paso, El Paso Community College, Texas Region 19 Education Service Center, which works intensively with 9 small rural school districts (20,000 students), the business community, the major grass roots community organization, and El Paso's Mayor and County Judge.* (p. 2)

The Aurora Project involved partners early on through a vision building process. These partners were identified as resource providers and included member(s) from the Oklahoma Geographic Information Systems Council, Oklahoma Climatological Survey

and the Oklahoma Historical Society. This group worked on ways to disseminate information both internally and externally.

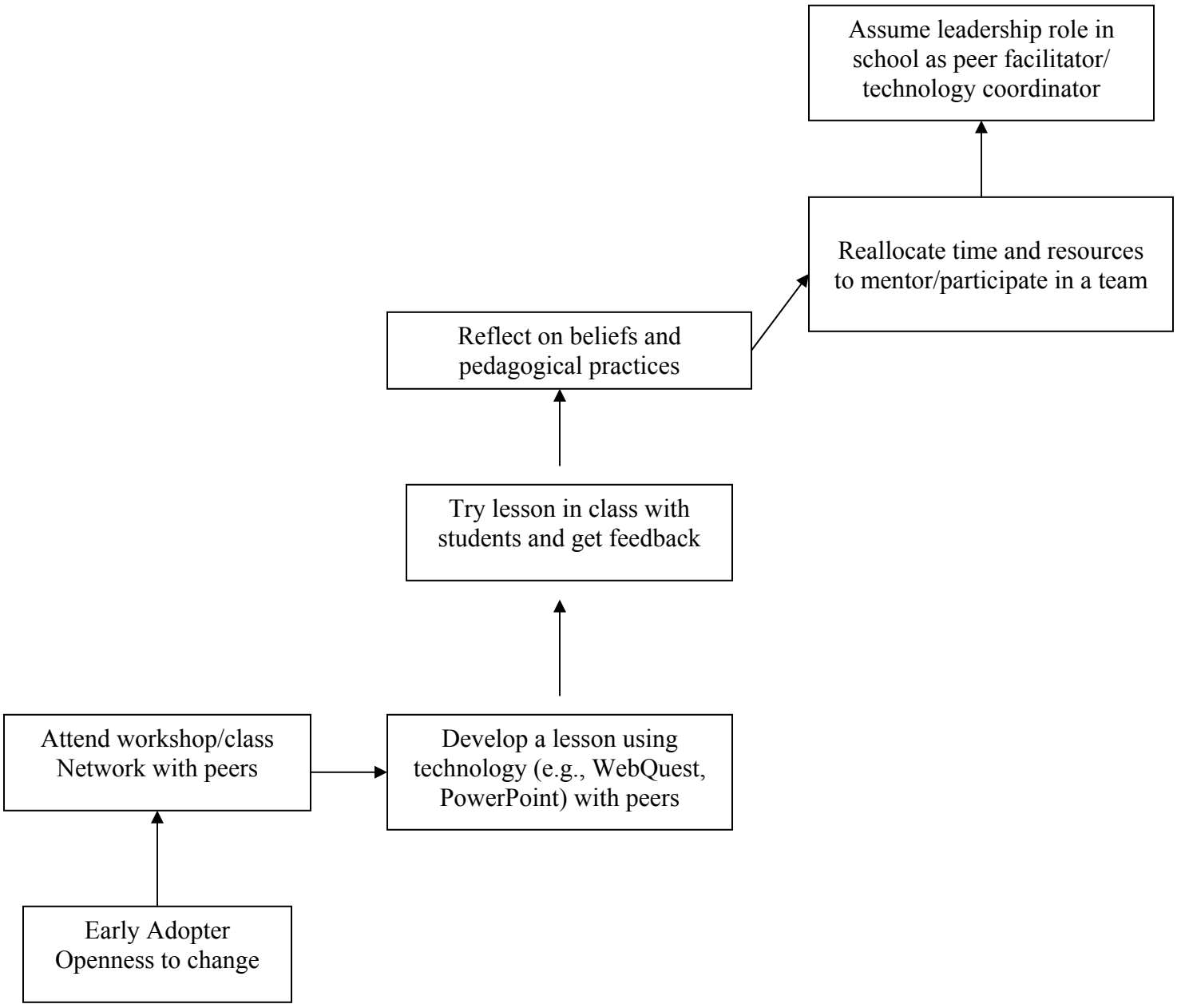
The RETA project designed their theory of change with a focus on professional development. Seven Resource Centers in New Mexico provided training for faculty, peer educators, pre-service educators, and administrators. Support for sustainability and ongoing dissemination came from the consortium, which included 89 school districts, State Department of Education, New Mexico State University, and others. The training modules focused on integrating curriculum, learning new software, and technology skills. Figure 7 replicates the theory of change for the Regional Educational Technology Assistance (RETA) Initiative.

Figure 7. Theory of Change for RETA



Early Adopters Shared the Vision and Helped Build Capacity. Rogers (1995) identified early adopters as the individuals who tend to serve as role models for their colleagues and are influential because they are respected by others. In cross-case analysis of the sites, certain regional resource centers, districts, or schools were targeted to be involved in the project. Then teachers volunteered or were recruited to be involved during the early stages of the project. Often these groups or individuals demonstrated characteristics of early adopters, such as being open to change, a risk taker, and willing to try new ideas. Figure 8 shows an individual teacher's theory of change.

Figure 8. Theory of Change for Early Adopters



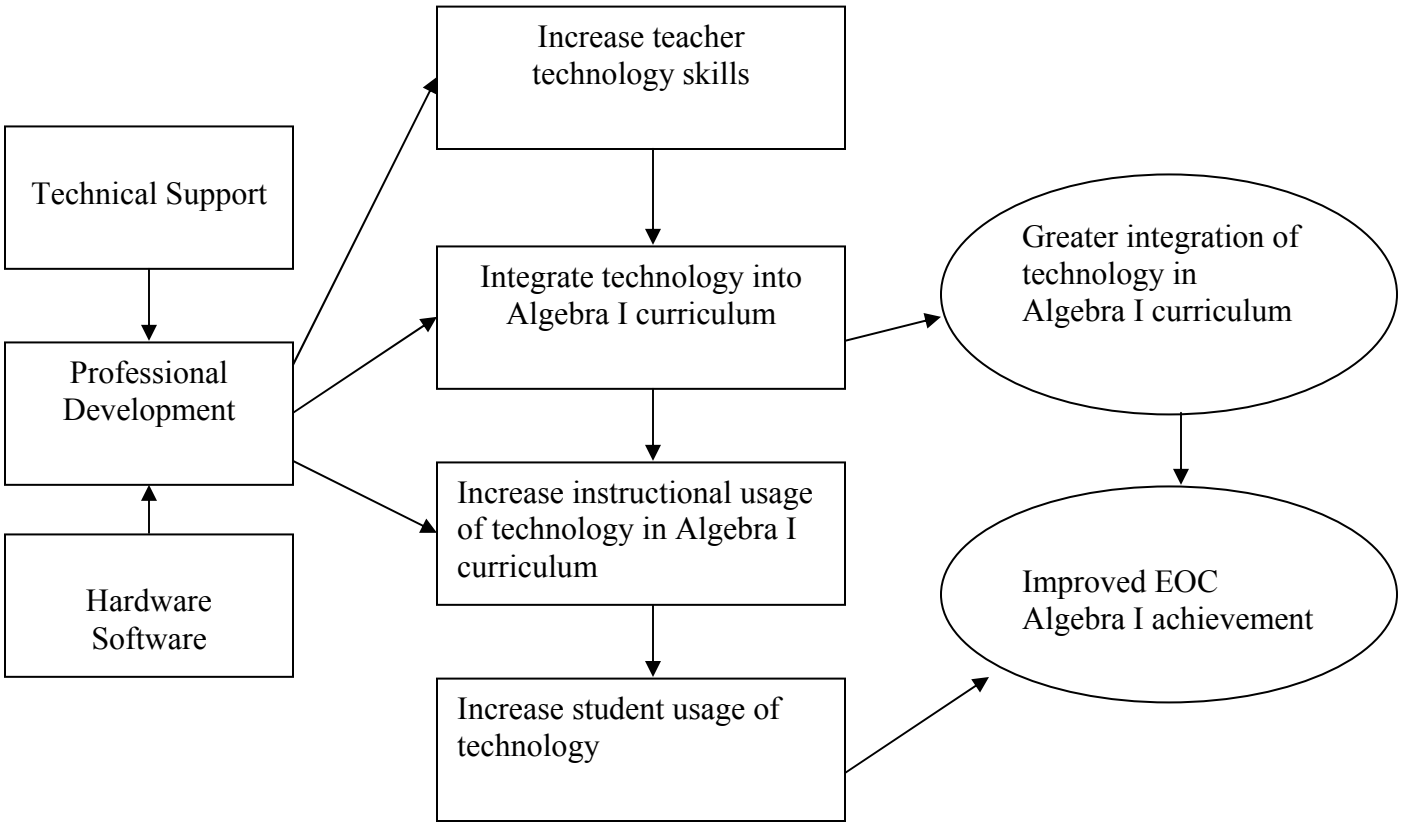
The SATEC project began with a cohort of 12 teachers who were given released time to work individually and collectively to produce Algebra I lessons integrating technology. The vision for SATEC was "to connect student learning to concrete

experiences through the seamless integration of technology into curriculum and instruction." One participant described how the early adopters shared the vision and planned how to build capacity at the school site.

> *When the grant was originally pursued, there was a test bed of 7 schools. What they were going to do was use the teachers each year to write curriculum for each grade level – go up and then down. The idea was to move up a grade and then down a grade. They would use the teachers to write curriculum and give then release time.*

Figure 9 identifies the theory of change in a logic map format show how SATEC intended to integrate technology into the curriculum through professional development efforts.

Figure 9. SATEC Logic Map



The underlying assumptions for SATEC were:

- By providing hardware and software to teachers with technical support through professional development activities, teachers would increase their technology skills, integrate technology into Algebra I curriculum, and increase instructional usage of technology in Algebra I curriculum.
- When teachers increased their use of instructional technology in their classrooms, students would increase their use of technology.
- Greater integration of technology into Algebra I curriculum would lead to improved achievement scores on the Algebra I End of Course Tests for the State of Texas.
- Students increased use of technology would lead to improved achievement scores on Algebra I End of Course Tests for the State of Texas.

Often administrators played an active role in selecting the early adopters and identifying the expectations for these teachers. The intent was to build capacity at the school site. One principal stated:

> *On my campus I had a hand in who got involved. I wanted teachers of teachers to go into partnership and relate to other teachers. You have to use your resources and use the right people to carry the instruction. I recommended teachers who are involved in this project. They were going into a partnership with other teachers. There are resisters but they partner as a support group to integrate in the classes of resisters.*

Teachers that were at the forefront early on were either already interested and/or using technology or were curious about what benefits their involvement would have for them as classroom teachers as well as for their students. A report for ACT Now! stated:

> *"Early adopters" include teachers who are presenting challenging technology-enriched lessons that link to District and state curriculum standards. ACT Now!*

> *training is contributing to development of "21st Century teachers" who facilitate students' use of technology, share expertise with their colleagues, and use technology tools to develop curriculum, present instruction, and manage their classrooms.* (pp. 72-73)

Many of the early adopters became leaders at their schools and in their districts, or were offered other job opportunities. Some of these leadership roles were as trainers, instructors, or technology coordinators/directors. Table 9 identifies the process during the early stages of implementation when a certain population was targeted; participants were recruited; and a variety of training opportunities were provided.

Table 9. Targeted Population and Professional Development Training for Early Adopters

	Challenge 95	ACT Now!	Aurora Project	SATEC	Challenge 98	RETA
Targeted Population	El Paso area schools (14 schools)	Region One schools (4 schools)	▪ Pioneer Distance Learning Consortium ▪ 5 public schools ▪ 1 parochial school ▪ Southwestern Oklahoma State University	▪ SAISD ▪ NEISD ▪ Diocese Schools (7 schools)	El Paso area schools El Paso area schools and rural schools	Regional Resource Centers (5 sites)
Early Adopters as Participants	Master's degree Cohort (15 – 20 teachers)	Teacher Training Quality Assurance Team (TTQAT) (25 teachers)	▪ 1 site coordinator ▪ Peer facilitators (5 teachers at each site)	First cohort (12 teachers)	Team of 7 teachers per school (2 Master's degree and 5 JETS)	RETA instructors (cluster groups)
Professional Development Training **(Train-the-Trainer Model)**	Master's degree ▪ 4 technology and 4 general ed. classes ▪ Mentoring ▪ Action research ▪ 2 electives ▪ Endorsement	▪ 24 hrs. of core classes ▪ 16 hrs. electives 40 hrs. for teachers	Training at school site	▪ Peer study groups ▪ Choice for workshops	Master's degree courses JETS content Mentoring Action research	Summer Institute for instructor Saturday workshops (5) for teachers

Teachers Gained Confidence with Increase in Knowledge. Teachers in the El Paso area schools had the opportunity to work toward their master's degree or an endorsement in instructional technology. The teachers reflected on their experiences as a member of a cohort. In an exit evaluation report for El Paso, this quote was consistent with similar information gathered during interviews and observations:

> *[As a result of Challenge, I have developed] more of an awareness of the new technology around me. I have also continued to develop my professional awareness in educational theory. It has been challenging, frustrating, nerve-racking, but more importantly, a necessity. I feel extremely confident and prepared to meet the needs of a classroom.* (p. 10)

Other interviews and documents clarified how the teachers' knowledge about technology and opportunities to learn and practice increased their confidence.

> *[You] know you have succeeded when teachers use it and students have succeeded. In classrooms where teachers are more willing, the teachers use the materials and ideas and are more likely to move to conceptual teaching instead of traditional teaching*.

One evaluation report for RETA provided several anecdotal comments that illustrated how teachers' confidence grew as their knowledge and skills increased.

> *Teachers were less intimidated, enjoyed the sessions and look forward to the 2000-2001 school for more technology integration instruction (see anecdotes below).*
>
> - *It opens up a whole new resource for teaching. . . .*
> - *I learned that becoming competent in using our new technology would be most beneficial to students.*
> - *After these classes I was less intimated and more confident with the computer. . . .*
> - *I feel confident/more adequate utilizing the computer in my classroom. I'm purchasing my own home/personal computer.*
> - *Rather than utilizing the classroom computer as a "management" tool, I can now utilize websites to advance and support my students' learning* (p. 9).

Another report indicated:

> *Over the course of the year a common theme continued to emerge among interviewed instructors and their participants. This theme focused on the increased level of confidence that many teachers report as a result of their experience with RETA workshops. They report an increased sense of confidence in trouble shooting technical problems, experimenting with new technologies, and experiencing an increase in their general sense of confidence in taking on leadership roles within their schools and districts. These data have been corroborated by past survey data.* (p. 103)

One respondent stated the importance of professional development:

> *Professional development program is one that provides not only instruction but side-by-side support. I believe we had that. It is sequenced in such a way that the leaps are not so great that the gaps are not intimidating. Professional development allows you the opportunity to revisit parts if you need it*.

One individual stated how the project allowed for capacity building by building more teacher confidence so that they could do training in the use of technology.

> *Benefits - more than anything else is the training of local teachers . . . not talking about computer literacy. The bulk of our teachers are trainers . . . we had a lot of extra equipment and training. Most of our people are at the level of training. They could train with a number of computer applications without [project]. They have become the gurus of our town. It has branched beyond our town. Teachers of teachers – good teachers.*

Increase in Knowledge Led Toward Teaching Renewal. As teachers gained knowledge in content area, pedagogy, and technology applications, they were often given leadership roles at their schools. They provided training for their colleagues. One teacher identified herself as a self-directed learner and sought opportunities for sharing and learning. The teacher stated:

> *Teachers have been released from their classrooms to come and observe in my classroom. Professionally, I go looking for others to help. The math coordinator has been a great resource to ask. I attended a conference on the use of the NTCM standards. I grow professionally with every lesson I teach. As a facilitator when I do workshops, I am constantly learning*.

Consistently from the interviews and through content analysis of written documents and evaluations, teachers found that continuous renewal came from: the hands-on opportunities for learning overtime, interactions with colleagues within and outside of their school/district, and application in the classroom with ongoing technical support. A project status report stated:

> *Teachers interviewed reported that the [TICG project] workshops provided a unique opportunity for them to expand their professional expertise and broaden their experiences with regard to classroom practice while allowing them to remain in the classroom as full-time teachers. Many of these teachers indicated that they saw [TICG project] as an alternative to "teacher burnout." The program offered them an opportunity to work with and learn from colleagues, focus in a hands-on environment and for an extended period of time on pedagogical and practical issues that are involved in teaching children through integrating technology. These teachers enjoyed the possibility of engaging in professionally enriching activities such as curriculum planning, participation on technology committees at local and district level, and providing professional development for peers on both a small and local scale and also on a much large scale to educators in other districts. (p. 103)*

One respondent commented:

> *Original concept was teachers going to voluntarily take 40 hours of training from us and then get a computer and Internet connection. It was "to die for" them. Sixteen hours were for technology tools – Excel, PowerPoint. Twenty-four hours were on how to use them. Original concept was that every person would learn WebQuest. (name) helped us design Train the Trainer model – what makes a good WebQuest and how to teach it.*

Teachers Engaged Students in Real-World Applications to Increase Student Performance. Numerous teachers interviewed reported that their students were highly engaged in the use of technology. It provided an opportunity for all students to be engaged in the learning process and to succeed.

> *Today students are involved in technology. All technology lends itself to project-based learning and integrating all content areas. PowerPoint is not a stand alone. Students see it as a tool. In my classroom they [student] work together as a pair. It is helping us with the curriculum in the classroom. With the curriculum*

it [technology] makes it meaningful to the students. When all kids come into the lab, teachers will say this is a special education student. They are all engaged in their learning. You pair them up and they go at their own pace.

Conclusion

It was evident, through data analysis, that the predominant theory of change for professional development was a training model based on the transfer of training research (Joyce & Showers, 1982; NSDC, 2001). The training model included theory, demonstration, practice, feedback, and coaching or other forms of follow-up. Collaboration was evident through various partnerships focusing on a shared vision and building capacity through ongoing feedback and support. The intent was for teachers to participate in training sessions on the integration of technology into the curriculum and transfer that training to their classrooms to increase student performance.

THIRD EVALUATION QUESTION: What processes and structures have these projects developed and implemented that can contribute to the success of other federally funded projects or federal, state, or local initiatives?

Review of Literature

Current literature on successful implementation of any initiative emphasizes leadership, building capacity, shared vision, learning communities, flexibility, collaboration, and sustainability.

- Key to the success of any project is the leadership and vision of those involved in the program design, their dreams and aspirations, and the goals for the project or initiative. Processes and systems, that authentically engage and support key leaders in new innovations, facilitate successful implementation. Leaders guide the vision and establish strong organizational principles. In the tumultuous world of today, leaders

must shape their organization through vision and concepts. They can never lead with elaborate rules and structures (Wheatley, 1992).

- Principals are key leaders in their schools in developing and nurturing a culture of high performance for students and teachers (Lambert, 1998). In a recent publication by the National Association of Elementary School Principals (2001), principals who are effective:
    - Lead schools in a way that places students and adult learning at the center.
    - Set high expectations and standards for academic and social development of all students and the performance of adults.
    - Demand content and instruction that ensure student achievement of agreed-upon academic standards.
    - Create a culture of continuous learning for adults tied to student learning and other school goals.
    - Use multiple sources of data as diagnostic tools to assess, identify, and apply instructional improvement.
    - Actively engage the community to create responsibility for student and school success (NAESP, 2001, p. 2).
- Just as critical to school success as principal leadership is teacher leadership. As researchers are studying successful schools, teacher leadership is emerging as a key element. When teachers have key leadership roles, their awareness of their professional worth is raised. They see themselves as key leaders in influencing others in improving educational practice and raising student performance. In addition, a focus on teacher leadership promotes a community of leaders and learners in the school (Katzenmeyer & Molter, 1996). Systems that focus on the development of teacher leadership have a greater probability of the innovation being implemented (Darling-Hammond, 1997).
- In successful efforts the leaders stay the course and hold the vision constant. They are the keepers of the dreams. Leaders, who have a long term vision and commitment to

it, motivate others to change their actions in significant ways. In addition, the leadership of the organization actually anchors the new expectations, behaviors and vision, into the new culture (Kotter, 1996). Leaders understand that to ensure persistent, ambitious, and continuous movement toward the new dream, they must become facilitators, moral architects, mentors, stewards, relationship builders, teachers, and models to the values required of all stakeholders: trust, authenticity, courage, commitment, and partnership (Rolls, 1995).

- A clear vision is shared by all engaged in the endeavor and such a vision engenders passion (Kanter, 1995). "People with a common purpose can learn to nourish a sense of commitment in a group or organization by developing shared images of the future they seek to create and the principles and guiding practices by which they hope to get there" (Senge, 1999, p. 7). "When there is a genuine vision, people excel and learn, not because they are told to, but because they want to. . . .The practice of shared vision involves the skills of unearthing shared "pictures of the future" that foster genuine commitment and enrollment rather than compliance" (Senge, 1990, p. 9). "The solution to the change process is not one larger-than-life individual who charms thousands into being obedient followers. Modern organizations are far too complex to be transformed by a single giant. Many people need to help with the leadership" (Kotter, 1996). While creating the vision is critical, ensuring that the vision passionately permeates the entire organization is key to its being meaningful. "The field must reach all corners of the organization, seeking out every employee, every recess of the organization" (Wheatley, 1992, p. 55).

- Leaders host continuous conversations about the vision, monitor progress to foster common commitment, and lead celebrations (Balwin, 1998; Kegan, 2001, Kotter, 1996). According to Pascale in his book, *Surfing the Edge of Chaos*, leaders will be defined in the future by how artistically, creatively, and systematically they can convene powerful conversations and generate creative, purposeful, and reflective practices in teaching and learning for all. According to Senge in his book, *The Fifth Discipline* (1990), the discipline of team learning is dialogue and conversation. Celebrations of small successes and quick wins motivate staff to continue to strive toward their goals (Kotter, 1996).
- There is a mood of ambition, a sense of urgency for change, celebration of success, persistence through barriers, and hope for the future. Increasing urgency demands that leaders remove excess, set high standards both formally in planning processes and day to day in actions, establish new measures for success, increase performance feedback, reward honest talk, and disperse information to all about the successes and the challenges they are facing (Kotter, 2001).
- Leadership, while developing in others the creative tension between the vision and the truth, also engenders a sense of hope in the organization that the team can shape its own future successfully (Kotter, 1996; Senge, 1999).
- Learning and reflective practice are norms. The starting point, for organizations that are striving to achieve new visions, is to focus on what new behaviors are needed. Therefore, the process of learning begins with the reawakening of curiosity and inquiry (Lambert et al., 1995). "Corporation that intends to become a learning organization must create the conditions in the organization that lead to what Deming

termed “profound knowledge”—the acquisition of new knowledge and competence, as well as the ability to transfer that understanding to others so that they come to have the same level of knowledge together with the ability to pass it on to others” (Thompson, 1995, p. 95). The NSDC standards share the same philosophy. Schools that are most successful use data to make decisions; establish strategies at the school for learning, such as study groups, action research, peer observations, sharing ideas, and evaluating students’ work; and collaborate to increase the performance of all students and staff.

- Collaboration leads to exponential growth and generative learning. The development and releasing of creativity, energy, and power in the organization are dependent on the relationships of those in the organization. When individuals collaborate and share, their own learning accelerates. “When teams are truly learning, not only are they producing extraordinary results but the individual members are growing more rapidly than could have occurred otherwise” (Senge, 1990, p. 10). “We will need to become savvy about how to build relationships and how to nurture growing, evolving things. All of us will need better skills in listening, communicating, and facilitating groups, because these are the talents that build strong relationships” (Wheatley, 1992, p. 38). Communities of learners and learning circles emerge when participants collaborate and learn together. These communities grow like human organisms; they self-organize as they learn, they self-regulate, and they adapt to their new sense of purpose, direction, and environment (Collay, 1998; DeFour, 1998; Hord, 1997). Leadership in these communities emerges naturally strengthening the entire organization. “They emerge from the group, not by self-assertion, but because they make sense, given what the group needs to thrive and what individuals need to grow” (Wheatley, 1992, p. 22).

- Sustainability of initiatives depends on the values, support, and intentions of the leadership team. Essential to sustainability of any initiative is careful consideration of the new practices and their compatibility with the current culture. If the current culture and values are inconsistent with the needs of successful implementation of the new innovation, implementation may never be fully realized. New innovations will become part of the new culture only after they are shown to clearly work, to be of significant value, and be effective then current practice. Encouraging, sharing success stories, and celebrating these successes in light of the new goals increase the probability that the new initiative will be valued (Kotter, 1996).

Key Findings

Trusted consistent leadership with moral purpose opens doors and provides opportunities. Site leader

As evident in conversations and observations, as well as from annual reports and evaluations, the role of leaders in the community and in the schools was viewed as essential to full and successful implementation of these major initiatives.

- The thinking and attitudes of the **superintendents and principals** of participating schools toward the innovation influenced the application of new strategies by all in the organization.
- Project leaders supported, inspired, and facilitated **effective implementation** of the projects.
- **Teacher leadership** was essential to successful design of and implementation of the initiatives.
- Building and nurturing **shared vision among stakeholders** was a key responsibility of the leadership teams.

- **Building capacity** of teachers and principals to improve student performance through the use of technology, inquiry, and real world applications was the emphasis of all Challenge grants.
- Establishing **communities of learners** was essential to building capacity.
- Key to meeting the needs of the learners was a sense of the developmental nature of the work and flexibility.
- **Collaboration** facilitated problem solving and developed **partnerships** and alliances essential to attaining the shared vision and building capacity.
- **Sustainability** was essential to ensure achievement of the shared vision.

The thinking and attitudes of the superintendents and principals of participating schools toward the innovation influenced the application of the new strategies by all in the organization.

The superintendent of the school district provided support for the innovation by declaring the value of the innovation and contribution to the success of the district's goals and providing emotional and financial support essential for full implementation. In the Challenge grant projects studied, the superintendents of the school districts had an influence on the district's implementation. One superintendent, who was a key person in the successful implementation of the TICG project, stressed the importance of his role in supporting the use of technology in the classroom. He, as well as other superintendents interviewed, shared their vision of the role of technology in increasing student performance. They promoted the project by developing strategies by allocating district revenues to support the grant's efforts. This support to ensure the sustaining of the effort was often in the form of additional funds for professional development, infrastructure,

first class e-mail systems, technical support for the campuses, and ongoing upgrades for equipment and software. Another superintendent shared how he has led the use of technology efforts for many years in his district. Technology plans were developed as well as strategies for monitoring the district's progress in using technology to increase student performance.

In all cases, when the superintendent valued the innovations of the Challenge grants, the grants were valued by others in the district, and the efforts were purposefully implemented by principals and teachers in the district.

The principal of the school was another key leader in the successful implementation of the Challenge Grants. The principal's forward thinking and positive attitude encouraged the use of technology in the classroom and supported efforts to ensure effectiveness of the innovation in increasing student performance.

One leader stated:

> *Principals lead and drive, support and nurture change efforts. It happens if they support and lead the initiative.*

Principals set the tone, modeled use of technology, and participated in training with their teachers. All the principals interviewed established expectations for the use of technology in the classrooms. They monitored implementation and visited with teachers regularly about their progress. They often relied on the teachers and staff leaders who were the most successful with the use of technology, to share and model what they were doing in their classrooms for other teachers in staff and team meetings.

Principals, who led innovations as demanding the integration of technology into a standards-based, inquiry approach to teaching**,** provided time for teachers to learn together, supported their staff development efforts, and reflected with them about what

they were learning. They provided safe space for teachers to try, experiment, and take risks. The principal was integral to the successful implementation of the innovation.

One principal stated:

Principals need to inspire teachers; as the principal of the school, I do this through modeling.

Another individual commented:

My job was to keep saying to others, your main job is to learn! I will support your efforts, learn with you, provide a safe place for trying new things, but we are all going to learn here!

Another stated:

It always sounds a little pompous, but it's my belief that if a principal does not support a program in a school, then it does not occur. [TICG project] was introduced to the high schools in our district as the opportunity to participate in a pilot program so we had the outline for what was suppose to occur. I wanted Roosevelt to be a part of that. Our math scores had shown tremendous improvement over a multi-year period, and my intent was to maintain that progress. From what I saw of [project], it seems like it would provide the emphasis to keep moving. Supporting that opinion was a math department chairperson who was intelligent and progressive. He believed that this program would be something we could profit from. So, we took the step to be a pilot site and we just haven't looked back.

In projects where principal leadership was not present and district leadership was not intimately involved in supporting the effort, the barriers tended to slow or impede progress. Resources essential for the technology infrastructure, time for staff learning and sharing, and monitoring of progress toward implementation were not present.

In several grants the role of the principal in successful implementation was not considered when the grant application was designed and the innovation developed, but activities were specifically designed for school leaders later in the grant as the grant leadership realized the significant role principals were playing in the implementation of the strategies. Grant leadership teams began to design unique staff development

strategies such as conferences for superintendents and principals. Teachers and students engaged the superintendents and principals in the project by sharing what they were learning. To insure that the principals were aware of what they should see in the classrooms, special training programs were offered for them.

Project leaders supported, inspired, and facilitated effective implementation of the initiatives.

Just as significant in the effective implementation of the grants was the leadership of the directors of the grant projects. Grant participants, whether they were superintendents, school staff, parents, or partners in the community, held the grant directors in highest regard. The results of the grant were often directly linked to the participants' respect for and trust in the project director. This factor was a significant force in the success of the grant. All of the project directors maintained a strong commitment and passion to achieve their project's goals and such effort encouraged those working diligently to implement the innovations.

Teacher leadership was essential to successful design of and implementation of the initiatives.

One of the key roles of the principal, the administrative team at the campus, and the project directors was empowering others. Leaders trusted others to do the job. A major area of focus in the Challenge grants studied was teacher leadership. The attitudes and behaviors of those developing training, leading the development of curriculum, providing on site support, designing infrastructure, and designing strategies for implementation affected the involvement of and attitudes of teachers. Grant leadership

teams believed that when teachers were treated with respect, valued for their talents, skills, and contributions; engaged in the decision making; and led major efforts, they perceived themselves as valued, respected, and listened to. Because of this respect and sense of inclusion, teachers were more eager to join in the effort. This focus on teacher leadership in all of the grants inspired many other teachers to join in the initiative.

The principal again played a major role in creating a healthy school culture where people contributed their skills and talents and were treated with respect and dignity. Such an environment nurtured the development of teacher leaders. People felt safe to learn and grow. They were willing to hold conversations with fellow teachers about what they were learning. Principals acknowledged teacher leaders in for their efforts, and this nurturing reinforced for everyone in the school the vision of the school and the value of learning. In all of the projects, teachers reported that they were treated with great respect, valued as professionals, and engaged in learning, and shared what they had learned.

Building and nurturing shared vision among stakeholders was a key responsibility of the leadership teams.

Shared vision keeps us together; the grant finds its place in the vision. Project leader

Developing a sense of shared vision among all in the project took considerable effort on the part of leadership teams responsible for designing the innovations. A shared vision, often determined after many hours of conversation, helped those involved in implementation to remain focused on their goals and to sustain the organization through many challenges.

The primary focus of all the grants was to ensure students impacted dramatically increased their learning and improved their attitudes toward education. All projects saw technology only as a tool to connect students and teachers to real data and the world beyond their community. All stakeholders believed that students would perform significantly better on measures of state and national standards if technology were used to integrate curriculum and engage students in inquiry. Respondents commented:

> *The focus of the grant is on student achievement of curriculum standards, not technology*.
>
> *The goal of the grant is to bring the district into the 21st century." The plan was dynamic; it morphed as we better understood the needs of students and teachers*.
>
> *We needed to work systematically to reach all students, not work with a project notion. We needed to make changes in all classrooms by introducing technology in the classrooms that don't have it and preparing classroom teachers with the expertise to use it*.
>
> *We are grateful for individuals who had the foresight that technology is an important aspect of education, who would find the means to make it come true, and have the commitment to sustain the effort*.
>
> *Technology has many faces; chalk boards are old technology; using electronic media, over head projectors, sensing instruments, and graphing calculator are all technologies. The value of technology is dependent on the type of application in the curriculum.*

A shared vision was often difficult to create and often expanded as people began to work on implementation. Many sites attributed continuous conversations as the process for achieving or reaching a common and shared vision. Respondents indicated:

> *Conversations by students, principals, and teachers are more focused today on issues of learning and content. We now talk more about what the instructional issues are, where the gaps are. The conversations are far more focused now!*
>
> *An engagement in learning by teachers and principal on a focused endeavor has been a success; people are talking about similar things now!*

The Aurora effort was conceptually more complex than the other projects and the leaders of this effort said that they were a full year coming to shared vision. It took many conversations; each stakeholder trying to understand each other. Many said they had to come to a common understanding of what geography really was to understand the vision some had for the project and its impact on teaching and learning.

Furthermore, as the efforts designed are implemented, many found their visions expand. El Paso, moved from a seven member leadership team at a campus to a full campus model in the final year at Canutillo ISD. One leader stated:

> *Our vision has expanded because technology has allowed it to expand. First year, the vision was being built; we were bringing together 80 or 90 people from public agencies, universities, public schools, community social and political services organizations to share a vision of an unidentified field such as use of technology in the classroom. Building shared vision takes time and many conversations. We worked at it a year*.

A shared vision kept everyone involved in the projects focused on the same goal: increased student achievement.

Building the capacity of teachers and principals to improve student performance through the use of technology, inquiry, and real world applications was the emphasis of all Challenge grants.

One respondent stated:

> *So whether it is literary leaders or leaders in math, science, and technology, we want to develop the capacity of teachers as leaders and learners.*

A major focus of all grants was professional learning. The professional learning focused on the assumption that improving student performance was dependent on improving teaching and learning. Building the capacity of the staff to use technology to increase student performance through real world curriculum and inquiry approaches was

the emphasis of all of the six projects studied. An analogy shared by one person interviewed was that of physical fitness.

> *Physical fitness is a new goal for me and I can compare the strategies we are implementing through the challenge grant to physical fitness in implementing technology in the classroom. Physical fitness starts with the fact that we know we need to be physically fit; first you have to recognize a need; we had to be technologically fit; some of exercises we could do on our on; but for some of them we had to go to the gym and we needed a trainer; some of the equipment can be helpful or it can be damaging to us if we do not know how to use it. Sometimes we need to take supplemental vitamins; sometimes teachers may need to take supplemental help. As you become fit, you can expand to more challenging equipment or strategies. Even when you are more productive, you still need to learn and stretch yourself. That is what the Challenge Grant has allowed us to do, build capacity to be technologically fit and still we need to learn and grow!*

Establishing communities of learners was essential to building capacity.

One respondent stated:

> *The purpose of establishing learning communities is to help build capacity in the schools so that technology is used as a key tool improving student performance.*

All of the six projects studied had as a goal to develop a collaborative culture in the school and the organization of continuous learning and sharing. Teachers were expected to share with others at their schools what they were learning. They were expected to create lessons and models for other teachers. The goal of establishing such a culture was to develop a critical mass of teachers in the school who were learning together.

Training a substantial number of staff assisted in developing learning communities**.** Training was then supported by regular meetings and conversations among participants. In addition, other tools for learning were developed, such as chat rooms and video conferencing. Teachers, involved in the SATEC project in San Antonio the first

year, reported that their monthly ½ day meetings supported revisions in the curriculum; provided opportunity for sharing of lessons; and provided time for curriculum mapping and planning. This led to successful implementation. Others reported that regular presentations to faculty or sharing after school what they were learning piqued others' interest in learning how to apply in their classrooms what the teacher leaders were learning.

One major emphasis in most projects was the development of principal leadership in using technology to increase student performance. Principals supported the development of learning communities, which assisted teachers in implementation strategies. Comments voiced:

> *With a team of principals, we developed a checklist of what principals would see in effective classrooms, established strategies for collecting data around teachers' performance in implementing the initiative, and hosted conversations.*
>
> *It's about supporting the principals as leaders.*
>
> *I am simply amazed with the drive of principals; they keep coming and leaving their sites. I asked them why. It's having the opportunity to talk to each other, to talk to others who are doing the same thing and learning from one another.*
>
> *When we first started working, many principals and teachers had a hard time remembering the last professional development opportunity or research book they had read. Now it is much more standard practice. It's part of the culture.*
>
> *Continuous is not once a year. On site professional development builds capacity and establishes a real community of learners.*
>
> *Research and communication lead to implementation*.

Because of the design of the Challenge grants, stakeholders are learning from each other and expanding the efforts of the grant to reach more students.

Key to meeting the needs of the learners was a sense of the developmental nature of the work and flexibility.

The model is somewhat organic.

Recognizing the developmental nature of the innovation and the need to be flexible and to listen carefully to the participants throughout the implementation had tremendous impact on the Challenge grants. Meeting of the needs of the learners impacted the attainment of their shared vision and helped build capacity of the staff.

A significant factor that contributed to the success of the projects was that leadership teams, while remaining true to the vision and goals of the effort, listened to the teaching staff, parents, and community partners and redesigned the processes and systems to better meet their needs. The generative nature of all the projects was reflected in the willingness of leaders to listen to others. Stakeholders were involved in the development and design of the change efforts. They were constantly asked for feedback; and their opinions were valued and listened to throughout the development and implementation phases. The leaders constantly worked courageously and persistently through many barriers that would have caused many other leaders of such initiatives to lose focus and stop progress. Flexibility allowed for continuous revision. Because of their willingness to listen and modify strategies, teachers continued to engage in the project, learn, and grow. One leader stated:

> *As the program went on, it got better and better. Those teaching and training various classes became more sophisticated as they listened to feedback and adjusted their practice.*

Leadership teams began to offer training sessions in a variety of ways and at many different times to meet the needs of participants. Training sessions were offered during school days, after school, on weekends, and during summer. Distance learning, on line support, differentiated instruction, At-the-Elbow staff support, TechPreps, all

emerged based on feedback from participants. Some leadership teams designed ways to offer college credit and other programs either developed master's degree programs as a way to engage teachers in deep, reflective practice and planning. Some leaders fostered individuals involved in the projects to seek higher degrees at local colleges and universities. Comments expressed:

> *We adjusted the staff development as we go. We adjust based on the feedback and needs of the staff. We are constantly using technology to give us immediate feedback about our training so that we can make adjustments immediate in our work.*
>
> *Teachers were not receiving their equipment even though it was being sent to the school. We changed our processes. We hosted a Distribution Day at the school. We delivered the equipment and made sure everything was set up and working properly before we left.*
>
> *Teachers balked at the idea of "one size fits all;" we differentiated our courses of study. Now there are basic courses and then courses that teachers have a lot of choice about.*
>
> *We learned early in training teachers that they needed assistance in identifying and creating authentic tasks and to discern when an activity actually incorporated higher order thinking. We began to extend our thinking about the needs of teachers and how best to assist them.*

Program changes were made in delivery systems for training and other support needs for learners emerged. Schools needed greater technical support so schools districts provided technical assistance. Teachers needed support when they were trying new things in their classrooms. Mentors and school-based support programs, such as Tech Preps and personalized training and coaching at the school, began to emerge in all projects.

Because some of the projects had so many changes either in the design of the programs or in the leadership of them, continuous support was sometimes jeopardized. Yet these projects continued to move toward their goals because of visionary, passionate,

and trustworthy leaders who emerged from within the organizations to inspire, guide, and facilitate others to embrace the initiative. One comment made was:

> *We trained together; we coached and supported each other; teachers need time to explore, practice; we learned to break up time and to cultivate discussions.*

Collaboration facilitated problem solving and developed partnerships and alliances essential to attaining the shared vision and building capacity.

The leadership team in these Challenge grants modeled collaboration. Collaborative efforts focused on building partnerships with others; partnerships with the community, with parents, with teaching teams, with educational institutions, and with businesses. Teacher leaders collaborated to develop curriculum or train others. Principals collaborated with one another and with teachers to maintain the focus, support the efforts, and provide feedback to those designing and implementing the initiatives. Teachers, parents, community partners, and many other public and private organizations collaborated to find common, shared visions. Students in graduate courses collaborated to produce student lessons, share their projects, and analyze student work. All grant leadership teams believed that teacher teaming and collaboration was essential for changing teacher behavior and improving student learning. One leader stated:

> *Teachers were in meetings sharing and problem-solving, creating curriculum, and designing lessons. This sharing contributed to their success and new energy emerged from the team as they worked together.*

Aurora and RETA have been working to develop state wide learning communities, and all involved believed strongly that their vision and work would impact students and educators across the nation. Leadership teams, in all the projects, worked to build cultures of collaboration. El Paso has concentrated on building a community vision

for student success and community learning. Aurora collaborated with other partners to assist them in using the Aurora technology to achieve their organizations' goals.

Another major aspect of collaboration was collaboration among district staff that supported the schools. Curriculum and education technology staffs collaborated to ensure that the curriculum developed was standards-based and addressed the student performance goals of the districts. Educational technology worked with the training teams to support schools and the interactive direction of the curriculum (ACT Three). Leaders worked with principals to develop their skills in understanding the new expectations in classroom practice.

Sustainability was essential to ensure achievement of the shared vision.

Another major finding that assisted Challenge grant efforts was the leadership team's commitment to sustainability beyond the funded years. Leaders believed that to sustain the Challenge grants, they must be treated as high-profile programs within the District and discussed frequently among leadership teams, teaching staff, and community members. RETA established as one of its goals collaborating with state, department of education, and legislature to sustain the vision and goals of the project. Being a high-profile program in districts and states meant that the innovation had ongoing budget support from district/state funds in addition to the grant funds. Such things as hiring technical support for each campus or hiring district-wide trainers to continue the efforts after the grant monies were expended sent a message to others in the district that the initiative was valued and will continue. All of the Challenge grant recipients studied have used additional district and state resources to fund and support the efforts with

buying additional computers, wiring of all of their schools, and providing additional technical support. Many sought additional funding from other grant resources or aligned other resources with the goals of the Challenge grants. In particular, Sweetwater High School District combined efforts of the Challenge grants with California's Digital High School initiative and what grew exponentially. El Paso project leaders cannot remember seeking other grant funding for other initiatives that did not lead to supporting the goals of their Challenge grants. Seeking a second Challenge grant was El Paso's effort to continue and expand their original Challenge 95 grant.

Conclusion

Table 10 identifies the processes and structures that contribute to the success of these projects and other initiatives.

Table 10. Processes and Structures Developed and Implemented

	Challenge 95	ACT Now!	Aurora Project	SATEC	Challenge 98	RETA
Leaders: Project, Superintendents, Principals, Teachers	X	X	X	X	X	X
Building and Nurturing Shared Vision Among Stakeholders	X	X	X		X	X
Building Capacity of Teachers and Principals	X	X	X	X	X	X
Establishing Communities of Learners	X	X	X	X	X	X
Meeting Needs of Learners: Developmental and Flexibility	X	X	X	X	X	X
Collaboration and Partnerships	X	X	X	X	X	X
Sustainability	X	X	X	X	X	X

Through skilled, visionary leadership and a shared vision, learning communities emerged that engendered passion and commitment. Through listening to others, modifying strategies and authentically collaborating, creative ideas emerged as promising practices. By committing to achieve the project's goals and collaborating with stakeholders, visionary project leaders built trust in the organization and increased the organization's efforts to achieve its goals.

FOURTH EVALUATION QUESTION: What processes and structures contributed most to the projects' success and what barriers impeded them?

Review of Literature

- As schools, districts, and states set the use of technology in education as a priority, a study by the Office of Technology Assessment (1995) concludes the following as essential:
    - Educational rationale should guide technology decisions.
    - Those wishing to invest in technology should plan to invest substantially in human resources.
    - Teachers cannot use technology without systemic support.
    - When it comes to learning to use technology, "hands-on" training is more than a gimmick or motivator.
    - Access to equipment is essential.
    - Although there are a number of models for training teachers and implementing technology, there is no one best way of using technology or of training teachers to use technology.
    - Follow-up support and coaching is as essential to effective staff development as is the initial learning experience.
    - Many technology-rich sites continue to struggle with how to integrate technology into the curriculum.
    - When condition are right – resources, time, and support – high-exciting things happen in technology-rich environments (OTA, 1995).
- Setting integration of technology with teaching and learning as a priority requires all stakeholders to collaborate and share a common vision. McLaughlin & O'Reilly (1998) state that "successful collaboration, whether it occurs at the individual or at the organizational level, requires that all participants have the same clear idea or vision of

what they are trying to achieve (e.g., the critical "look fors" or outcomes as well as what their own organizational collaboration should look like)" (p. 163). Often idea or vision is designed by the program developers as a logic model or a conceptual framework.

- It is important that stakeholders in this collaboration include representatives from diverse populations (e.g., parents, teachers, administrators, universities, community, business partners). Hohn (1998) states that "change efforts need to be a combination of top down and bottom up strategies, strongly led, and combining pressure to change with the support to do so: support in terms of time, financial resources, and decision-making power" (p. 1).
- Professional development is a key component in the application and acceptance of Technology Innovation Challenge Grants. Loucks-Horsley (1998) states that a process for planning and implementing a professional development program should include these elements:
    - There need to be goals, a set of clear and shared outcomes for the program.
    - These goals must drive all other elements of the design.
    - There needs to be planning – careful consideration of how the pieces fit together and how to proceed over time.
    - The plan must be implemented.
    - There needs to be reflection on and evaluation of what happened that feeds back into adjustment in plans and subsequent actions, as well as in goals (p. 5).
- The design for professional development in these sites mainly focuses on training models. Richardson (1998) identifies these characteristics of successful training models:
    - The training process should be school-wide and content-specific.
    - Principals (or program directors) should be supportive of the process

and encouraging of change.
    - The training should be long-term, with adequate support and follow-up.
    - The training process should encourage collegiality.
    - The training content should incorporate current knowledge obtained through well-designed research.
    - The process should include adequate funds for materials, outside speakers, and substitute teachers to allow teachers to observe each other (p. 5).

- It is insufficient to offer professional development opportunities, but it also requires those professional development opportunities to promote changes in their teaching practices. Research on change indicates the "importance of attending to individual teacher needs over time, providing learning opportunities tailored to those needs, and creating a climate of collegiality and experimentation and a capacity for continuous learning and support" (Loucks-Horsley et al., 1998, p. 6). Richardson (1998) states "that when a teacher tries new activities, [she] assesses them on the basis of whether they work: whether they fit within [her] set of beliefs about teaching and learning, engage the students, and allow her the degree of classroom control she feels is necessary. If she feels the activity does not work, it is quickly dropped or radically altered" (p. 2).
- Originally many of the professional development opportunities focused on learning technology skills, such as word processing, spreadsheet, or other software. However, the application of technology through the integration of technology into the curriculum causes a refocus in the design and delivery of professional development opportunities. Means & Olson (1995) conclude that when teachers integrate technology with curriculum, they become curriculum developers. They identify three different models used for integrating technology into student-centered curricula. In one model, the teacher selects an appropriate piece of software and integrates it into

existing instruction. In a second model, the teacher selects different resources for use as part of a multimedia curriculum. In a third model, the teacher constructs a curriculum unit based on specific standards and uses a variety of technology applications (e.g., word processing, spreadsheets, Internet).

- Curriculum development used to be viewed only as the creation of new curriculum; however, now it is also viewed as an effective strategy for professional development (Loucks-Horsley, 1998; NSDC, 2001). Loucks-Horsley (1998) reports that "development and adaptation of parts of a curriculum also contribute to teacher learning . . . (teachers) need to understand state and local frameworks, national standards, the appropriateness of content and concepts presented at each grade level, and the sequence of other topics offered in each grade level" (p. 17).
- District commitment and administrative support for teachers are important for successful integration of technology in the classrooms. This includes time for teachers to participate in professional development that is hands-on and allows practice with hardware and software that can be used in the classrooms and time for collaboration and planning with colleagues (Hasselbring, 2000).
- Numerous studies identify the following barriers to the use of instructional technology: lack of access to hardware and software, limited technical support, lack of time for teachers to collaborate and plan how to integrate
- Killion (2002) states that "a program's theory of change can be based on existing research, current practice, or program's developer's implicit theories of actions" (p. 55). The training model used in all the TICG projects reflected the research of Joyce and Showers (1982) on transfer of training. The research states to increase the transfer

of training to the classrooms for student achievement, the training model needs to include these components: theory, demonstration, "comfort level" practice, and either study groups, follow-up sessions at the school sites, or mentoring (Killion, 2002; NSDC, 2001; Joyce & Showers, 1995).

- Guskey (2000) has identified five critical levels of evaluating professional development: 1) participants' reactions, 2) participants' learning, 3) organization support and change, 4) participants' use of new knowledge and skills, and 5) student learning outcomes.

Key Findings

During cross-case analysis, eight factors were identified as facilitators of and eight factors were identified as barriers to the integration of technology into the curriculum. These factors helped to formulate hypotheses about the characteristics of professional development programs that ensure high-quality learning for teachers and students in order to reach the designated goals.

Helping Factors

Consistently across all sites, common themes about processes and structures that contributed to the success of the TICG projects emerged from triangulation of data. These themes included:

- A **shared vision** was developed and supported by all stakeholders.
- Integration of technology with standards-based curriculum was a high priority and linked to district goals with **commitment and support** from leaders.
- **Connections** were made to other state and federal initiatives.

- The design and deliver of **training** for teachers focused on integration of technology with standards-based curriculum.
- Professional development was designed with selection of and **training by quality trainers** (i.e., Train-the-Trainer Model).
- **Capacity was built** for appropriate use of technology in the classroom.
- **Adequate resources** were provided, which included sufficient funds, technology infrastructure, and personnel.
- A **culture of learning** with technology in communities (parents, business partners, universities, city and state) was established.

A shared vision was developed and supported by stakeholders.

Consistently across all sites, participants were not only aware of the vision but were able to articulate the vision for educational technology. The participants interviewed knew that there were key leaders who saw a need and an opportunity through the TICG program. Several of the sites, not chosen for a Challenge grant in the first round, kept the vision and reapplied or refocused on a different content area.

Respondents consistently stated the importance of having a shared vision and staying focused on that vision.

> *Schools with the foresight to see that technology would become an important part of education. Individuals that took it upon themselves to find the means to make the implementation of the grant and sustainability of the effort*.

> *The [TICG project] believes that it is important to develop a shared vision among all participants to ensure the success of the project. The teachers developing and using the system are the core group in promoting the growth of the project and their understanding and acceptance of the Project's vision is crucial to success. There is also the need to recognize that the vision is growing and changing as the*

participants contribute and recommend changes for the improvement of the project.

[Site] is a poor town and without funds could not have changed. The Challenge grant changed the landscape of the town. . . . [TICG project] helped to reach that vision.

Integration of technology with standards-based curriculum was a high priority and linked to district goals with commitment and support from leaders

Schools/districts that were the first participants in the projects demonstrated strong leadership and a commitment to sustained professional development. Often the districts contributed funds to help with wiring throughout the schools so that there was connectivity to the Internet in all classrooms. The hiring of district and school technology coordinators demonstrated their commitment to having someone assist the teachers in troubleshooting and integrating technology in the classrooms.

During one site visit, a poster was displayed that confirmed the district's focus on technology as a priority. The district expectations were:

- Make technology accessible to all stakeholders.
- Infuse technology into the classroom.
- Integrate technology into the curriculum.
- Enhance technology literacy for students, staff and parents.
- Facilitate the links between the SUHSD and the local and global communities.
- Assist the DTAC in their efforts to enhance and implement technology at their sties.
- Provide professional development and support for every technology user.
- Assist in the implementation of a district-wide Student Information System.
- Explore the merit of emerging technologies.
- Assist sites with technology planning.

Another site demonstrated their support by hiring technology staff as evident by this comment:

At the same time we have been involved with [TICG project], the district has hired a technology specialist and a technology director. This has helped to merge

the instruction and the technical support. This has merged/complemented what the district and [site] are doing. The technical staff serves as liaison to help staff.

Another site emphasized the importance of having a site leader to place technology as a priority:

The perspective of the site leader is important. As we know in any effort in doing reform and renewal . . . the commitment of the site leader to make this a priority . . . is essential to make sure buy-in is at the site and district . . . the site leaders always had to be up and front as a renewal strategy.

Connections were made to other state and federal initiatives.

The interviews and documents clarified that the sites were focused on systemic reform and that the funds from the grants provided continuation of their reform efforts or served as a catalyst for other state and federal initiatives. Some of these included, but were not limited to, Urban Systemic Initiative (USI), Technology Literacy Challenge Grant (TLCG), and Technology and Innovation in Education (TIE).

One example of the connection of TICG with a state initiative was the connection to the Digital High School grant in California. During the second year of the project, four high schools were recipients of the California Digital High School grant. The purpose of the grant was to ensure that all students have access to computers and the Internet in their classrooms. One requirement of the grant was professional development, which was met by having the teachers participate in the 40 hours of Act Now! training.

One individual stated:

The state of California passed the Digital High School which provided funding to wire every classroom and put a computer in every classroom. It was not a competitive grant but had to write a plan. (We) had to write benchmarks for students and write a professional development plan with it. We will be the professional development plan for your plan. You buy the equipment and we will provide the trainers.

Another example of the integration of funds from various grants was stated:

> *We take an integrated approach to the grants so that we scaffold . . . [TICG project] built on what we learned from [TICG project] but filled the gaps of a system effort in [site]. We integrate the various grants . . . bottom line is improving student achievement for all students in [site] so area. Important but only a piece of a systemic effort that has been in place for ten years . . . National Science Foundation grant, Teacher Quality Enhancement grant . . . not duplicating or canceling out . . . building on these.*

One site expressed its continuous focus on a shared vision by merging its TICG project with USI.

> *They joined and married each other – USI and [TICG project]. USI is broad base and trying to get curriculum that existed into the classroom. [TICG project] broad enough focus but narrow enough to get our hands around it. Just because there was not algebra curriculum to buy, teachers had to own it and buy it. There was something about owning it – different than USI – participated, learned by it. Without both pieces, we wouldn't have gotten as far.*

SATEC has combined the funds from Technology Innovation Challenge Grant (TICG) for math and Technology and Innovation in Education (TIE) for math and science to equip 72 SATEC math classrooms with appropriate hardware and software.

The design and deliver of training for teachers focused on integration of technology with standards-based curriculum.

A major emphasis on professional development was evident in the TICG projects. Each site designed its own model of professional development, which mainly focused on training linked with curriculum development.

Various curriculum strategies, such as WebQuests, ACT Online, Hot Lists, SATEC math, Aurora's GeogWeb, and RETA New Mexico curriculum, and Marco Polo, were often the content of the instructional technology training design. Tools, such as Internet searches, spreadsheets, PowerPoint, Hyperstudio, image analysis software,

curriculum-interfaced probes, and simulation activities, provided teachers opportunities to experience in training sessions similar to experiences that students would have in the classrooms (i.e., transfer of training).

Reflection and adjustments based on feedback affected the training design. It was evident in Act Now! that trainers listened to the feedback given after their training sessions and adjusted by being flexible and restructuring their training sessions.

> *Restructuring. First, the core 24 hours of core instruction – the workshops – were restructured, presented over six 4-hour sessions (rather than three workshops each lasting 8 hours). This redesign aligns with research which suggests that adults need time to reflect on or process what they've learned in order to integrate it into preexisting knowledge and skills. . . . Secondly, the 16 hours of electives were offered in several "flavors' – with each one attending to different types of learners.*

In another project, the professional development design included training for both teachers and administrators with follow-up sessions throughout the school year. One respondent stated:

> *At the [site], the coordinator has successfully spearheaded a second season of "Walk the Talk" (WTT). This unique year-long professional development program brings school teams of administrators and teachers together in the summer for an intensive week-long series of training sessions. Although the curriculum has both an administrator and a teacher track, the school teams also share joint learning and planning sessions. Four WTT follow up training sessions are held during the school year, in addition to the site visits and peer to peer training sessions.*

Professional development was designed with selection of and training by quality trainers

The professional development training designs were often structured to provide opportunities for early adopters to buy-in, model, and mentor or train others in the integration of technology into the curriculum. Most projects employed a Train-the-Trainer Model for professional development.

Schools involved in the Aurora Project had peer facilitators. The peer facilitators were trained in technology and curriculum development to provide ongoing training and support to the teachers.

One leader stated:

> *Once any site got three teachers trained, they got a site peer facilitator. They have had to be in the program for one year and then have done the activities. We have structured professional development on Saturdays to share teaching styles and use of technology.*

Training in the ACT Now! project was delivered by a team of trainers, known as TTQAT, Technology Training Quality Assurance Team. Some members of TTQAT were also assigned to the district's EdTech Department and were on special assignment within the district, known as teacher-on-special assignment.

One respondent stated:

> *At one point during the grant we had upwards of 33 trainers, which we called TTQAT and that stands for Technology Training Quality Assurance Team. And how we ensured the quality of the trainers was we had training of trainers. We solicited people in our district so they were district personnel who had a keen interest in technology and had developed some skills on their own. We took those folks, enhanced their skills, found out what kinds of training they were qualified to do, and gave them some support in terms of training, and then they were ready to be on our TTQAT to do training.*

RETA has classroom teachers that have been trained to be instructors. The instructors were involved not only in training, but in giving input and the development of the training modules. Training and curriculum development occurred during the three-day Professional Development Institute held at New Mexico State University in June. After completing training and using technology in their classrooms, teachers became apprentices, working side-by-side with instructors, and then became RETA instructors themselves.

One instructor stated:

> *I took RETA as a participant. I was asked to be an instructor and didn't for various reasons. Then I rethought that and became an instructor. My role as staff developer and [educational technology] director is to make sure we are moving our teachers in a direction of good teaching and learning practices tied to standards with appropriate assessments and use of technology.*

Capacity was built for appropriate use of technology in the classroom.

Multiple ways to build capacity for use of technology in the classroom were employed and included: (a) cohort groups, (b) school-based teams, (c) school-based training and support sessions, and (d) classroom-based support. Consistently across sites, the design of the professional development included ongoing support (e.g., TechPrep, Sustained Professional Development, just-in-time, At-Your-Elbow), collaboration (e.g., training as a cohort, school-based teams), and hands-on experiences.

ACT Now! used a program, known as Situated Staff Development, which involved trainers going into the classrooms and modeling technology-based lessons in the classrooms. One trainer stated:

> *We volunteer to go into the classrooms. We ask the teachers what technologies they have available or what technology would they like to learn how to implement in the classroom with on of their existing lesson plans. Again, knowing that we don't have to infringe on any more of their time, we take an existing lesson – one that they already have. We walk away with that lesson plan. We come back t our office and take a look and see how to integrate the technology that they want to use. They may have a computer that they want to integrate. They may have a graphic calculator they want to integrate. They may even have an old laser disc that has been sitting there that they want to integrate. But we develop a lesson and then go back and model for them. We actually teach the lesson, and we ask the teacher to observe. That's it, observe, walk around and monitor how their students are reacting to the technology.*

Another way to build capacity for use in the classroom was expecting teachers, who were involved in training at UTEP, to form teams back at their school sites and to mentor other colleagues at the schools. This was evident by these comments:

> *We have built capacity within the district by having a group of teachers involved at each campus. I see teachers making presentations with PowerPoint and student products being demonstrated*.

> *We see our work as the challenge to build the capacity of schools to use technology as a key tool to improve student achievement. We are working on teachers to a high level of delivery. . . . valuable tool to meet standards . . . connect with schools, develop capacity of teachers to build capacity at school site and work with principals to buy in fully to commit and support so students use technology effectively*.

In the chapter, "Teachers Helping Teachers: Pathway to School Improvement," by Jorge Descamps (In Chen & Armstrong, 2002), teachers from H.D. Hilley Elementary School (participants of Challenge 98 grant) shared strategies for integrating technology into their classrooms. One teacher, featured in the chapter, mentored other teachers as part of her coursework at UTEP.

The Aurora Project had three distinct methods of providing professional development to build capacity: 1) large group presentation at a central location to share the vision of the project, 2) scheduled district and building level activities after school or during the summer to train teachers in using the curriculum system as a delivery Web-based system and development of curriculum activities with standards for evaluation, and 3) day to day support to train teachers individually or in small groups during or after school in the use of technology.

RETA demonstrated building capacity by providing continuous learning opportunities for those in the leadership roles. This was evident in the end of year report:

> *The mainstay of the professional development effort for the RRC site Coordinator is the three-day RETA Training Workshops held at New Mexico State University at the end of each school year during the first week of June. In addition, the site coordinator is part of the NMSU-RETA Online Doctoral Cohort Pilot Project, whose major emphasis is curriculum and instruction with a minor emphasis on the integration of technology in education. The Doc-Cohort courses are a continuous source of new information, knowledge, and resources for developing workshops and conference presentations* (p. 7).

An unexpected outcome of building capacity was teachers leaving the classroom and assuming other leadership roles dealing with the use of technology, such roles as a trainer/instructor or a technology coordinator/director. This was stated in an exit evaluation report.

> *A number of the (TICG project] graduates have made career changes since completion of their programs. Two are facilitators employed by the Regional Education Service Center and are assigned to multiple schools, thus they impact large numbers of teachers and students. Two have moved to the central offices of local school districts; in their capacity, their technology training touches many children. Four others have left the traditional classroom to become technology instructors in computer labs on their campuses. Their work positively affects not only students, but faculty members as well. Those teachers who remain in the classroom have taken on grater responsibilities, sharing their technology training with colleagues* (p. 7).

Adequate resources were provided, which included sufficient funds, technology infrastructure, and personnel.

Resources needed for successful implementation included sufficient funds for equipment and training, infrastructure to support the use of the equipment, and human resources to lead and support ongoing implementation.

One individual clearly emphasized the adequacy of resources that the grant allowed:

> *One of the wonderful things that came out of this grant is that it brought our district into the 21st century. We were in bad shape. We had no connectivity. The grant made that happen basically. There were very few computers in the district. . . . We had a few progressive principals who let a few of us have 3 or 4 computers in the classroom. But there was no connectivity. Internet was unheard*

of. What [TICG project] has done is it really provided in the infrastructure and really did get us thinking about . . . It got us thinking about what we wanted to do in the district. It was written into the grant that students had equal access to technology. Everything we do is based upon the grant. It is being sustained because we now we've had to build upon what we already had. . . . The infrastructure is providing the support that we need to carry forward.

Availability of software, either through the project or at a reduced price, allowed teachers to take back what they had learned during the training sessions and use it immediately with their students. This was a statement from *Customer Spotlight*:

RETA participants learn how to use specific software during hands-on professional development sessions and then are able to take that software back to their own classrooms/schools to share with students and colleagues. Through the TICG funds, "RETA is bringing technology curriculum integration to all of New Mexico's 89 school districts. Adobe software is integral to helping RETA streamline administration and communication and make the most of limited federal funding. In addition, the software offers students the skills they need to compete in today's information-drive workplace.

A culture of learning with technology was established.

A summative evaluation report identified "an emerging culture of technology and learning" and defined it as:

Changing expectations and aspirations among teachers and students [occurred]. For example, as their knowledge of technology – including computers, software, hardware, and the Internet – grew, teachers and students asked for greater access. Teachers advocated for greater technology and were proactive in seeking and procuring funding and training in computers and software use (p. 11).

A culture of learning with technology included all stakeholders - students, teachers, parents, administrators, university faculty, members of the community, and business partners. These stakeholders worked together to solicit appropriate funds, designed and evaluated effective professional development for implementation of educational technology, and participated in effective use of technology.

Comments that represented these points of views from across sites were:

I think that what has worked best for us is constantly having the key players talking to each other. We tend to do that face-to-face. The model is somewhat organic . . .

you need all the parts to work well so the body will function and do what it is suppose to do. We are about student achievement. . . . You get all players – community, students, teachers, parents, principals, college – all in the same room and at different levels. . . . K-16 partnerships with all sectors. There is not single entity that can do it by themselves. Given the resources that we have, pooling together to keep body well functioning . . . end result is increased student achievement.

Working at a service center we have a lot of people approaching us. As [TICG project we were on the receiving end. [TICG project], the groundwork was kind of laid. It has been the most collegial partnership I have ever been involved in. It has been very consistent. There is a vision. There have been some revisions. We have been able to stay pretty close to the original plan. . . . [university] will be institutionalizing their masters in technology. The only people who have gone through the master's program have been [participants of TICG project]. This will be important as people have to be certified in teaching certain areas. A lot of new teachers who know that can get a degree in instructional technology.

One individual identified the two important factors, professional development and leadership, as key to developing a culture of learning and implementing technology.

Experiences with the district's Technology Innovation Challenge Grant revealed two important factors. First, professional development may not result in modification of teaching practice unless the training follows the teacher all the way to the classroom. Teachers need help right in their own environments to ease them into new ways of thinking about how learning can take place with the support of technology. Second, site leadership plays a key role in motivating all staff to attend training and to use their new skills.

Hindering Factors

Consistently across all sites, common themes about processes and structures that impeded the success of the TICG projects emerged from triangulation of data. These themes included:

- Slow and inadequate **acquisition of equipment** delayed the use of technology in the classrooms.
- **Complexity of integrating curriculum** increased demands on teachers.

- Complexity of **learning to change** and **collaborate** hindered changes in teaching practices.
- **Impact evaluations** were hampered by changes in evaluators and methodologies used.
- **Time constraints** for teachers inhibited opportunities to learn, assimilate, and transfer learning to the classrooms.
- **Attrition** and changing technology increased demand for technical support
- Lack of **early engagement of administrators** inhibited implementation at some schools.
- Changes to learner-centered classrooms were diminished by inconsistent transfer of **instructional approaches.**

Slow and inadequate acquisition of equipment delayed the use of technology in the classrooms.

Following training sessions, teachers were often delayed in using technology in their classrooms due to various reasons: lack of connectivity to the Internet for all schools and in all classrooms, availability and compatibility of hardware and software, and need for ongoing maintenance of existing equipment.

The following frustrations were voiced by participants relevant to technology infrastructure:

> *In the early days the network itself was shaky. The district was split with Macs and PCs. A lot of people had problems in their classroom. They couldn't get tech support in the classrooms.*
>
> *When we started training, the computers hadn't arrived yet and that was negative. When the computers arrived, they weren't able to be used. Frustrating – we weren't wired. . . . Unfortunately, we needed access that year. I wonder how much was lost.*

Most of the platforms were PC on my campus and about 50% of my cohorts were using Macs. So when we went into the lab we couldn't download to take the programs back. [site] redid their work so that they had both platforms. We exchanged and learned how to use both platforms and yet practiced on our own platform.

Complexity of integrating curriculum increased demands on teachers.

It was evident that some teachers neither saw curriculum development as professional development nor felt that all teachers could or should write curriculum. However, most districts expected that teachers know the national and state standards and implement them in their classrooms. Having access and using the Internet provided an avenue for teachers to learn more about content standards.

One evaluation report stated:

> *All the teachers we interviewed agreed on one thing: the integration of technology into the curriculum is not an easy task. First of all, it is time consuming. According to them, it is taking them a lot of time to learn to use the equipment and software in order to create activities that will be both interesting and beneficial for their students. . . . Another important point that these teachers made was that they need more guidance in how to integrate computers into their curriculum* (pp. 8-9).

Often teachers developed WebQuests or other technology lessons based on their current knowledge as a means of fulfilling only the requirement for credit in the courses.

One leader stated:

> *As I look back on a portion that was aimed at teachers developing their own lessons and then having a database available to all teachers, I think that became problematic in the sense that the lessons themselves, the rubric, and the WebQuest that they had to follow was complicated. . . . people met their requirements . . . I don't believe that many of those folks went back and created an additional lesson or a series of lessons, which was really what we wanted, simply because of the time requirements to do so.*

Complexity of learning to change and collaborate hindered changes in teaching practices.

Implementation of technology in the classrooms required teachers to reflect on their pedagogical beliefs and practices as they participated in training sessions on the integration of technology into the curriculum. The design of the interactive workshops, team efforts on a technology projects, mentoring colleagues, or working as teams at the school sites required collaboration. The intent was to develop learning communities among participants involved in training sessions as well as at the school sites. Developing a collaborative culture was easier for some teachers and schools than others. The following comments acknowledged the complexity of learning to change and collaborate:

> *Constant, constant change. Two edge sword – teacher perspective is hard to sell if it is going to be different tomorrow. I don't like change – teachers as a whole are like this. This whole thing has been a constant change.*
>
> *We haven't been as successful in using the system to collaborate. . . . I have kind of paid attention to this, not implemented, a learning community where all people learn together- pre-service, in-service, public schools, and college working together. We need to change the way we teach our classes. . . . We need to begin to do what we can do that we couldn't do before - share resources, look at student progress online, use portfolios online, generate data online for portfolios.*
>
> *I think that what was challenging was the time. It was a lot of hours, not just in the training workshops. We had several hours to commit to during the summer and the projects to do. . . . We built a closeness as a team. . . . We had to work as a team and put ideas on the table to turn in our products. Each person had something to contribute.*
>
> *Most teachers are really not change agents. Until they can become comfortable with the teaching practices, they will stick with what is comfortable.*

Impact evaluations were hampered by changes in evaluators and methodologies used.

It was apparent from the review of documents and responses from interviews that the focus and measures used in annual evaluations varied from year to year at some sites. Some of the changes were due to changes in evaluators and feedback on data collection or methodologies used. Many evaluations included primarily the use of surveys and focused on attitudes, perspectives, and use of technology. Most evaluations relied on volunteers to complete the surveys or participate in interviews, focus groups, or classroom observations.

Although the primary goal was to increase student performance, very little data were available to suggest that when teachers integrated technology into the curriculum student achievement increased. Consistently, the review of evaluation reports and responses from interviews indicated lack of measures to link the impact of technology to student achievement. Most informants reported that too many variables existed in schools today to link directly the use of technology to performance on standardized tests.

One comment made in an evaluation report clearly reflected how most felt about assessing student achievement in the use of educational technology.

> *One weakness in the curricular model – and a weakness inherent in other technology initiatives with which the evaluation team is involved – is student assessment. Teachers remain stymied by how to effectively assess student work – whether completed individually or as part of a team*.

Responses from interviews reflected the need for a better understanding of measures used to link the use of technology to student achievement. Respondents stated:

> *To get change, you need to show differences in student understanding. It needs to be of value to student understanding.*

> *Don't have accurate student achievement. The level of implementation hasn't been taken into consideration. Too difficult to track success and failure.*

Time constraints for teachers inhibited opportunities to learn, assimilate, and transfer learning to the classrooms.

Time constraints across the sites affected opportunities for training; time to assimilate training and transfer to the classroom; the learning curve involved in learning standards-based curriculum as well as the use of technology; and collaboration with others to share, problem solve, and look at student data.

One major barrier consistent with the research literature was the need for teachers to have time to assimilate the knowledge, skills, and dispositions related to integrating technology into the curriculum. Throughout this study, time constraints were consistently mentioned as evident by these comments:

> *Curriculum development is an intense process requiring significant time for reflective thought. This time simply is not commonly available during the school year. Based on feedback from our developers, we have adapted our developer's professional development to support the summer time frame for their development activities*.
>
> *We definitely need more teachers training with technology and we need more time to assimilate the training. . . . I believe we have to sit back and just allow time to try it. . . . Time is the most need thing.*
>
> *You have the technology and the training but then no time to become comfortable with the attitude of teaching using technology*.
>
> *We had an assumption when we wrote the grant that we were going to have teachers at a certain level of technology and math and teachers weren't at the level we thought. We had an idea that we had a timeline for lessons to be published. Our schedule was more optimistic than we had planned. They weren't at that point. Timeline didn't turn out*.

Attrition and changing technology increased demand for technical support.

Often state and federal guidelines affected the need for changing approaches to delivery, design, budget, and evaluation of projects. Learning about the use of technology was often referred to as "a moving target" because of the daily changes occurring in hardware and software. These changes required updating of equipment and continuous training for teachers as they became involved in the projects. These statements reflected the frustrations of constant upgrading:

> *The original design written down and the vision wasn't wrong at the time . . . it was ever changing – added frustration and excitement. We threw in another niche – we had to upgrade. We had our own local upgrades. . . . There is interaction and ever changing mode of information.*
>
> *Technology moves faster than we can keep up with it. By the time we have developed a skill with the teacher, it is outdates.*

One evaluation report captured this anecdotal statement about updating technology skills.

> *I am one of the few technology teachers in the district to attend these sessions, and I have been teaching some of the skills we covered in the trainings already. Well, I guess you can teach an old dog new tricks. Technology is such a huge area; one that changes on a daily basis, so that even the most learned technophiles have to keep freshening their skills* (p. 5).

Attrition, teachers and administrators leaving once they were trained, caused issues related to who "owned" the equipment or availability of a "trained" person at a school site to troubleshoot or assist teachers in how to integrate technology into the curriculum. Another issue was providing technical support was a paid position for some individuals, while for others, it was in addition to their teaching duties.

One evaluation report noted:

> *The data also indicates a moderate problem with teacher attrition from year to year. A smaller portion of the attrition is due to teachers deciding that they do not want to participate in the project, but the larger amount is due to retirement, teachers leaving the classroom and teachers moving to other schools. The problem posed by attrition is the decrease in the planned number of curriculum*

activities being developed, and a smaller group of teachers to field test existing curriculum (pp. 4-5).

Other comments made:

I didn't go in with the intention of leaving the classroom but as we became more knowledgeable about technology there is a need for that. The timing was right. Administrators saw a need for individuals with this expertise.

As soon as our teachers are trained, they are very marketable. Two teachers are getting their master's degree in technology and one has taken a new position at a middle school. We are from a district that is fast growing so there is a turn over.

Lack of early engagement of administrators inhibited implementation at some schools.

Consistent with the research literature is the need for leadership and support from administrators. However, many projects were designed and initiated without careful consideration of the possible impacts principals and other central administrators could have on the outcomes. Several individuals interviewed, shared that it was not until several years into the projects before administrators became a focus. When principals were involved from the beginning, the projects moved forward; where they were not, principals had less involvement in the projects, did not always see how the efforts were integral to their school's mission, and strategies were even questioned. Those principals, not engaged early in the design, often simply did not have the time needed to invest in ongoing training in technology, did not provide essential technical support, and provided little time, if any, at the school for building the capacity of all staff. Just as with the teaching staff, it is important that principals and central administrators gain the knowledge and skills, so they can model and support teachers as they integrate technology.

One administrator clarified the difficulty in attending training sessions and the complexity of monitoring and following the established guidelines for maintaining ownership of equipment, if related to completing the required number of hours of training.

> *It was very difficult for me to attend training sessions [as an administrator]. . . You have to give people ample opportunity, had to monitor, and at some point you had to make a decision that they [administrators] weren't going to do it.*

One teacher stated the importance of having a principal trained or, at least, supportive of the technology training:

> *I don't think principals understood what was happening. Even this last year teachers complained about principals not being supportive. The principal who was at my school was part of my cohort and was very interested in technology and wanted to develop her own skills. She had to leave the program because she left the district.*

One site leader acknowledged the need to engage administrators early on but was not clear exactly how to do that.

> *There has to be something to work with administrators that has to come in earlier. It was easy to understand what to do for the teacher. But to have an administrator involved on the team might have been a good. I understand that we need to work with administrators but don't understand as clearly what their needs are.*

Changes to learner-centered classrooms were diminished by inconsistent transfer of instructional approaches

One assumption of using instructional technology was that a shift would occur from a teacher-centered classroom, using more traditional instructional approaches, to a student-centered classroom where students were engaged in inquiry-based lessons and constructing their own knowledge. During the selected classroom observations at the different schools, it was evident that teachers were at various levels of using technology.

In some schools and classrooms observed, technology was still simply a tool that replaced the chalkboard or overhead projector. Though teachers were using PowerPoint, they were still predominantly lecturing to students, students were in rows, and there was little student inquiry, discovery or exploration. Because of the challenges of changing classroom instructional approaches, most classrooms observed, who were predominantly using technology as a tool for inquiry, were trainers in their projects or early adopters. One explanation given during the interviews was:

> *Math traditional teachers teach like they were taught. Technology has forced them to look at lessons and how students learn differently. Difficult for teachers to let go of their beliefs . . .(they were) taught that way and the students should be able to do it. Students today learn differently and need different modalities today.*

Conclusion

Consistent with the research literature and National Staff Development Council standards, factors across all sites that helped or hindered the success of technology integration in the classrooms were (a) learning communities; (b) administrative and teacher leadership; (c) adequate resources, including funding for purchase and maintenance of equipment, (d) time for planning and collaborating, (e) instructional and technical support; (f) curriculum development, (g) design of a quality training model, including demonstration, practice, feedback, and coaching; and (h) evaluation.

CONCLUSION

The intent of this study was to find common patterns and themes that emerged across the six projects that identify characteristics of professional development programs that ensure high-quality learning for teachers and students. The results of this study can

be used to further explore and better understand how technology impacts teaching and learning.

- Through skilled, **visionary leadership** and a **shared vision**, **learning communities** emerged that engendered passion and commitment. Through listening to others, modifying strategies and authentically collaborating, creative ideas emerged as promising practices. By committing to achieve the project's goals and collaborating with stakeholders, visionary project leaders built trust in the organization and increased the organization's efforts to achieve its goals.
- Through skillfully designed **curriculum that integrated inquiry-based instruction**, application to the real-world, and technology, **students engaged** in meaningful ways, found interest and motivation for what they were learning, and **increased their performance.**
- **Professional development** fostered **learning communities** who intentionally used data to make decisions, engaged in curriculum planning, shared what they were learning with others, studied together, monitored student progress through the study of student work, and reflected on their own practice to increase student achievement.
- Authentic **partnerships with parents and community** facilitated the change of the culture of the community and shaped its commitment to high quality education for every child.
- **Adequacy of resources**, both financial and human, provided the time and quality of implementation needed for **sustainability**. Making **connections to funds from other state and federal initiatives** and in-district additional funds were all means of

providing **financial support** that allowed for more equipment and **human resources** to implement the project as designed.

- Although not explicated stated, the predominant theory of change for professional development was a **training model** based on research. The professional development design included constructivist theory; demonstration through the use of modeling; practice that included **hands-on experiences** at participants' comfort level, participant **feedback** given to the trainers within a timely manner, usually through surveys; and ongoing support through **mentoring**, teaming, on-site training and assistance, and modeling in classrooms.
- **Evaluation** methodologies were both quantitative and qualitative. The measures included pre-post surveys, focus groups, interviews, and observations. The evaluation teams were often in flux because of changes in membership, changes in the guidelines for evaluations required by U.S. Department of Education for TICG projects, the time and effort required to develop valid and reliable measures to link professional development to **student achievement**, and the vast amounts of data collected from basically volunteers.

LESSONS LEARNED

As a result of what has been learned in this cross-case study, five main factors (student achievement, curriculum development, professional development, administrative support, evaluation) emerged as facilitators of or barriers to the success of the integration of technology to improve teaching and learning, which will either enhance or restrict implementation and sustainability. Questions have been developed based on these

learnings to be a guide for further conversations and research on the integration of technology to improve teaching and learning.

Student Achievement

The TICG projects had a major goal to ensure that students were engaged in an integrated curriculum that allowed them to experience the world around them and to develop their thinking skills and inquisitive minds. The visionary leaders of these projects believed that the design and implementation of their projects would move students from passive recipients to engaged learners who were creating new knowledge and constructing their own meaning. These questions warrant further investigation:

- What new measures are possible to determine the impact of these major reforms?
- How could these measures utilize new ideas emerging from the field in assessing student learning, such as portfolio assessment, performance tasks?
- When should these measures be applied and how often so that researchers have access to reliable, valid data about student performance?

Curriculum Development

In all of these efforts, students were to be challenged through curriculum experiences that integrated technology as a tool to develop higher order thinking and inquiring minds. Real world problems were posed to students. Research, data gathering and data analysis were expected of students. They had the opportunities and expectations to share what they were learning with others outside their classrooms. Standards were integrated into those problem-posing learning experiences. Such curriculum as Web Quests, ACT Online, algebra in the real world, were powerful curricula to assist teachers

in accomplishing their goals. These questions warrant further investigation:

- Under what conditions and with what strategies can teachers become skilled curriculum writers?
- How much of the curriculum should teachers be responsible for writing?
- In all of these efforts, students were to be challenged through curriculum experiences that integrated technology as a tool to develop higher order thinking and inquiring minds. How do we assist teachers in being effective designers of such curriculum and instructional experiences so that they are models for their students?

Administrative Support

The role of the leader in the school cannot be underestimated in terms of full support of implementation of new initiatives. To provide leadership in major change efforts, principals clarified and held true to the vision and facilitated implementation by supporting those implementing the new strategies. They provided both opportunity for learning, coaching, and sharing, as well as technical support as needed. This question warrants further investigation:

- Under what conditions and with what strategies do all in the organization, including superintendents and administrators, come to a shared vision early in the design so that the efforts are fully and successfully implemented?

Professional Development

Though professional development was the primary focus of all of the Challenge grants, the changes in the classrooms were not always evident. The core leadership group had not sufficiently developed the skills of others in the school community. Where these leadership teams were most successful were in programs that had

leadership teams at every school and expectations that they were to assist others in learning. Time was also a factor. When teachers had planning and sharing time provided at the school, teachers learned together. When projects such as the El Paso Challenge 95 and 98 continued for a sustained period of time, greater change was seen in teaching and learning. These questions warrant further investigation:

- What strategies need to be in place to ensure that learning communities develop at every school?
- What assistance do teachers at the schools need to establish systems and structures for learning together?

Evaluation

Evaluations were designed based on the belief that student achievement could not be directly linked to technology integration with the current standardized measures. Although not explicit, the theory of change for the professional development design of the TICG projects, which was a training model, was based on the transfer of training research. The projects did not use the program's theory of change to guide the designs of their evaluations of professional development. Evaluations focused more on the participants' reactions and learnings. Evaluations of organization support and change, participants' use of knowledge and skills in the classrooms, and student learning outcomes were limited or nonexistent. Although the focus was on professional development, the impact of the professional development program was not often linked to student performance. These questions warrant further investigation:

- How can making explicit a program's theory of change help articulate to all stakeholders what the program is and how to get the intended results?

- How can theory-based change be evaluated?
- When teachers structure activities where students apply academic concepts to real-life, problem-solving situations, does student achievement increase?
- What valid and reliable measures are available or can be developed to assess the impact of professional development on student learning?

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Appendix

Sample Template

Sample template given to project directors to schedule with appropriate audiences a three-day site visit for in-depth interviews and focus groups.

Time	Place	Audience	Length of Time	Notes
		Individual Interviews		
		Director	90 minutes	
		State Department	45 minutes	
		Technology Staff	90 minutes	
		Title 1	60 minutes	
		Staff Development	90 minutes	
		Curriculum	60 minutes	
		Superintendent	60 minutes	
		Supervising District Administrator	60 minutes	
		Focus Groups (6-10 people)		
		Trainers/Instructors	90 minutes	
		Parents	60 minutes	
		Students	60 minutes	Middle and high school, if available, maybe during school walk through
		Teachers (elem)	90 minutes	
		Teachers (middle)	90 minutes	
		Teachers (high schools)	90 minutes	
		School Administrators (elem)	90 minutes	
		School Administrators (middle)	90 minutes	
		School administrators (high school)	90 minutes	
		Partners	90 minutes	
		Demonstration		
		Demonstration of products and services	60 minutes	Walk through by project staff

In-Depth Interview Protocol for Project Director

Complete the following

Interviewer:
Site:
Interviewee:
Position: Project Director
Date of Interview:
Place of Interview:
Time of Interview (90 minutes): From: To:
Comments:

Overview

Welcome, and thank you for agreeing to participate in this focus group. The National Staff Development Council has been asked to study the impact of six different Technology Innovation Challenge Grant (TICG) projects. We have a set of questions within a designated time that we need to ask in order to be consistent across all sites.

My name is _____. I am one of a two-person team from the National Staff Development Council (NSDC) collecting and analyzing data for this study. Begin with personal information to begin to establish a comfortable environment.

The purpose of today's focus group is to gather information about the TICG project. I will be asking you some specific questions and taking notes to capture what you say. I want to assure you that what you say will be confidential and your name will not be used in association with your comments.

Do you have any questions before we begin?

I would like to ask your permission to audiotape this focus group. I will be using the tape for my purpose only to be sure that I have captured accurately all your comments in my notes.

I will begin the tape and then ask for your permission again.

- Do you mind if I audiotape this conversation?

Questions

1. We are interested in learning as much as possible about your TICG project. Please describe who you are and what your role has been in planning and implementing this project. Who else has been involved?

Probe:

- Who was involved in the decision to develop this project?
- Who was involved in the original design of the project?
- Who has been most knowledgeable and skilled in the design and implementation of the project? Explain.

2. How has the project's actual implementation compared to the assumptions and plans set forth in the original proposal? Based on what you now know, how would you plan and implement the project differently?

3. Describe the series of events that have occurred during this project and what has influenced, both positively and negatively, those events?

   Probe:

   - Positively influenced
   - Negatively influenced

4. How did the barriers affect your success throughout the project? How did you address those barriers? What impact did these barriers have overall on the success of your project?

5. What kinds of technology infrastructure support has allowed you to be successful with implementation (e.g., tech support, hardware, software, people)? How has that support been sustained over time?

6. Describe what you would consider to be a high quality use of technology to promote student learning in the classroom. What percent of the use of technology in the classroom provides these kinds of high quality learning experiences for all students, including ELL, special needs, at risk, high poverty?

7. What types of professional development activities have been offered for this project?

8. What guides you in the design of the professional development activities?

9. What are the characteristics of the most successful professional development activities? How would you define most successful? How did you measure these characteristics?

10. What are the characteristics of the least successful professional development activities? How would you define least successful? How did you measure these characteristics?

11. How do you monitor the quality of the professional development activities?

12. What changes have occurred that you think are related to this project? How do you know?
    - Changes in teaching and learning environment
    - Changes in instructional practices
    - Curricular changes
    - Changes in your community

13. What indicators provide evidence that the use of technology in the classroom impacts the learning environment (e.g., climate, engagement, on-task behavior, motivation, discipline?)

14. How has student achievement changed in the district since the project's inception (i.e., gap narrowed, gains)?

15. What are the various ways that you have measured the impact of educational technology on student achievement? Which ways have been most useful to you?

16. How have attitudes about the use of technology changed over time with the implementation of this project?
    - Teachers' attitudes
    - Parents' attitudes
    - Students' attitudes

17. To what extent is technology used to communicate and collaborate within the district/ organization/community and outside the district/organization/community others?

18. If you were to construct a graphic that describes how you think this project has worked.

    Give example: If we talked about one theory of how a car starts we could say: Turning the key starts the motor. Putting the car into gear and adding fuel by stepping on the accelerator causes the car to move. To stop the car, the driver applies pressure to the brake pedal.

    Specifically, how have the activities related over time to produce the intended short- and long-term outcomes?

19. Has the experience of implementing this project caused your organization to pursue other projects based on its learning? Have any of these projects been funded? Explain.

20. To institute an educational reform, such as the use of technology in the classroom, what are the essential components for success (e.g., parent training, pre-service, professional development)?

21. What is the scope of influence of this project? Who are the beneficiaries?

22. Think about other innovations you have been involved with. How has this project been like those and how has it been different?

23. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

24. What else would you like to share about this project?

Appreciation

Thank you for your time. The information you have provided will be very helpful in the study of the impact of the Technology Innovation Challenge Grant projects.

Interview/Focus Group Questions for Administrators

Questions

1. We are interested in learning as much as possible about your TICG project. Please describe who you are and what your role has been in planning and implementing this project. Who else has been involved?

   Probe:
   - Who was involved in the decision to develop this project?
   - Who was involved in the original design of the project?
   - Who has been most knowledgeable and skilled in the design and implementation of the project? Explain.

2. How has the project's actual implementation compared to the assumptions and plans set forth in the original proposal? Based on what you now know, how would you plan and implement the project differently?

3. Describe the series of events that have occurred during this project and what has influenced, both positively and negatively, those events?

   Probe:
   - Positively influenced
   - Negatively influenced

4. How did the barriers affect your success throughout the project? How did you address those barriers? What impact did these barriers have overall on the success of your project?

5. Describe what you would consider to be a high quality use of technology to promote student learning in the classroom. What percent of the use of technology in the classroom provides these kinds of high quality learning experiences for all students, including ELL, special needs, at risk, high poverty?

6. What types of professional development activities have been offered for this project?

7. What are the characteristics of the most successful professional development activities? How would you define most successful? How did you measure these characteristics?

8. What are the characteristics of the least successful professional development activities? How would you define least successful? How did you measure these characteristics?

9. How do you monitor the quality of the professional development activities?

10. What changes have occurred that you think are related to this project? How do you know?
    - Changes in teaching and learning environment
    - Changes in instructional practices
    - Curricular changes
    - Changes in your community

11. How have attitudes about the use of technology changed over time with the implementation of this project?
    - Teachers' attitudes
    - Parents' attitudes

12. How has student achievement changed in the district since the project's inception (i.e., gap narrowed, gains)?

13. What are the various ways that you have measured the impact of educational technology on student achievement? Which ways have been most useful to you?

14. To what extent is technology used to communicate and collaborate within the district/ organization/community and outside the district/organization/community others?

15. If you were to construct a graphic that describes how you think this project has worked, what would it be?

    Give example: If we talked about one theory of how a car starts we could say: Turning the key starts the motor. Putting the car into gear and adding fuel by stepping on the accelerator causes the car to move. To stop the car, the driver applies pressure to the brake pedal. This is an oversimplification, of course.

    Specifically, how have the activities related over time to produce the intended short- and long-term outcomes?

16. Has the experience of implementing this project caused your organization to pursue other projects based on its learning? Have any of these projects been funded? Explain.

17. To institute an educational reform, such as the use of technology in the classroom, what are the essential components for success (e.g., parent training, pre-service, professional development)?

18. Think about other innovations you have been involved with. How has this project been like those and how has it been different?

19. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

Focus Group Questions for Teachers

Questions

1. We are interested in learning as much as possible about your TICG project. Please describe who you are and what your role has been in planning and implementing this project. Who else has been involved?

   Probe:
   - Who was involved in the decision to develop this project?
   - Who was involved in the original design of the project?
   - Who has been most knowledgeable and skilled in the design and implementation of the project? Explain.

2. Describe the series of events that have occurred during this project and what has influenced, both positively and negatively, those events?

   Probe:
   - Positively influenced
   - Negatively influenced

3. How did the barriers affect your success throughout the project? How did you address those barriers? What impact did these barriers have overall on the success of your project?

4. Describe what you would consider to be a high quality use of technology to promote student learning in the classroom. What percent of the use of technology in the classroom provides these kinds of high quality learning experiences for all students, including ELL, special needs, at risk, high poverty?

5. What types of professional development activities have been offered for teachers involved in this project?

   Probe:
   - How have these been altered to accommodate different learners, including their level of prior experience with technology and current technology resources?

6. What are the characteristics of the most successful professional development activities? How would you define most successful? How did you measure these characteristics?

7. What are the characteristics of the least successful professional development activities? How would you define least successful? How did you measure these characteristics?

8. What changes have occurred that you think are related to this project? How do you know?

- Changes in teaching and learning environment
- Changes in instructional practices
- Curricular changes
- Changes in your community

9. How have attitudes about the use of technology changed over time with the implementation of this project?
    - Students' attitudes
    - Teachers' attitudes
    - Parents' attitudes

10. Does technology in the classroom impact student achievement? How do you know that?

11. What are the various ways that you have measured the impact of educational technology on student achievement? Which ways have been most useful to you?

12. To what extent is technology used to communicate and collaborate within the district/ organization/community and outside the district/organization/community others?

13. To institute an educational reform, such as the use of technology in the classroom, what are the essential components for success (e.g., parent training, pre-service, professional development)?

14. Think about other innovations you have been involved with. How as this project like those and how was it different?

15. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

16. What else would you like to share about this project?

Focus Group Questions for Instructors/Coordinators

Questions

1. We are interested in learning as much as possible about your TICG project. Please describe who you are , what you teach, and how you have used what you have learned as a participant and/or instructor in your classroom?

2. Describe what you would consider to be a high quality use of technology to promote student learning in the classroom. How have these high quality learning experiences met the needs of all students including second language learners, special needs, and at risk.

3. What changes have occurred that you think are related to this project? How do you know?
    - Changes in teaching and learning environment
    - Changes in instructional practices
    - Curricular changes
    - Changes in your community

4. How have attitudes about the use of technology changed over time with the implementation of this project?
    - Teachers' attitudes
    - Students' attitudes
    - Administrators' attitudes
    - Parents' attitudes

5. What indicators provide evidence that the use of technology in the classroom impacts the learning environment (e.g., climate, engagement, on-task behavior, motivation, discipline)?

6. How has student achievement changed in your school since your involvement in this project? How do you know?

7. What types of professional development activities have been offered for teachers/instructors involved in this project?

    Probe:
    - How have these been altered to accommodate different learners, including their level of prior experience with technology and current technology resources?

8. What guided you in the design and implementation of your professional development (e.g., standards)?

9. What are the characteristics of the most successful professional development activities? How would you define most successful? How did you measure these characteristics?

10. What are the characteristics of the least successful professional development activities? How would you define least successful? How did you measure these characteristics?

11. How do you monitor the quality of the professional development activities?

12. To what extent is technology used to communicate and collaborate within the district/organization/community and outside the district/organization/community others?

13. Describe the series of events that have occurred during this project and what has influenced, both positively and negatively, those events?

14. What have been some barriers? How did the barriers affect your success throughout the project? How did you address those barriers? What impact did these barriers have on the overall success of your project?

15. What kinds of technology infrastructure has allowed you to be successful with implementation (e.g., tech support, hardware, software, people)? How has that support been sustained over time?

16. To institute an educational reform, such as the use of technology in the classroom, what are the essential components for success (e.g., parent training, pre-service, professional development)?

17. Think about other innovations you have been involved with. How has this project been like those and how has it been different?

18. If you were to construct a graphic that describes how you think this project has worked, what would it look like?

    Give example: If we talked about one theory of how a car starts we could say: Turning the key starts the motor. Putting the car into gear and adding fuel by stepping on the accelerator causes the car to move. To stop the car, the driver applies pressure to the brake pedal. This is an oversimplification, of course.

19. Has the experience of implementing this project caused your organization to pursue other projects based on its learning? Have any of these projects been funded? Explain.

20. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

21. What else would you like to share about this project?

Focus Group Questions for Technology Staff

Questions

1. We are interested in learning as much as possible about your TICG project. Please describe who you are and what your role has been in planning and implementing this project. Who else has been involved?

   Probe:
   - Who was involved in the decision to develop this project?
   - Who was involved in the original design of the project?
   - Who has been most knowledgeable and skilled in the design and implementation of the project? Explain.

2. Describe the series of events that have occurred during this project and what has influenced, both positively and negatively, those events?

   Probe:
   - Positively influenced
   - Negatively influenced

3. How did the barriers affect your success throughout the project? How did you address those barriers? What impact did these barriers have overall on the success of your project?

4. What changes have occurred that you think are related to this project? How do you know?
   - Changes in teaching and learning environment
   - Changes in your community

5. How have teachers' attitudes about the use of technology changed over time with the implementation of this project?

6. To what extent is technology used to communicate and collaborate within the district/ organization/community and outside the district/organization/community others?

7. Think about other innovations you have been involved with. How has this project been like those and how has it been different?

8. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

9. What else would you like to share about this project?

Interview/Focus Group Questions for Partners

Questions

1. We are interested in learning as much as possible about your TICG project. Please describe who you are and what your role has been in planning and implementing this project. Who else has been involved?

   Probe:
   - Who was involved in the decision to develop this project?
   - Who was involved in the original design of the project?
   - Who has been most knowledgeable and skilled in the design and implementation of the project? Explain.

2. How has the project's actual implementation compared to the assumptions and plans set forth in the original proposal? Based on what you now know, how would you plan and implement the project differently?

3. Describe the series of events that have occurred during this project and what has influenced, both positively and negatively, those events?

   Probe:
   - Positively influenced
   - Negatively influenced

4. Describe what you would consider to be a high quality use of technology to promote student learning in the classroom. What percent of the use of technology in the classroom provides these kinds of high quality learning experiences for all students, including ESL, special needs, at risk, high poverty?

5. What types of professional development activities have been offered for this project?

6. What changes have occurred that you think are related to this project? How do you know?
   - Changes in teaching and learning environment
   - Changes in instructional practices
   - Curricular changes
   - Changes in your community

7. How have teachers' attitudes about the use of technology changed over time with the implementation of this project?

8. To what extent is technology used to communicate and collaborate within the district/ organization/community and outside the district/organization/community others?

9. If you were to construct a graphic that describes how you think this project has worked, what would it be?

Give example: If we talked about one theory of how a car starts we could say: Turning the key starts the motor. Putting the car into gear and adding fuel by stepping on the accelerator causes the car to move. To stop the car, the driver applies pressure to the brake pedal. This is an oversimplification, of course.

Specifically, how have the activities related over time to produce the intended short- and long-term outcomes?

10. Has the experience of implementing this project caused your organization to pursue other projects based on its learning? Have any of these projects been funded? Explain.

11. To institute an educational reform, such as the use of technology in the classroom, what are the essential components for success (e.g., parent training, pre-service, professional development)?

12. Think about other innovations you have been involved with. How has this project been like those and how has it been different?

13. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

14. What else would you like to share about this project?

Focus Group Questions for Parents

Questions

1. We are interested in learning as much as possible about your TICG project. Please describe who you are and what your role has been in planning and implementing this project. Who else has been involved?

   Probe:
   - Who was involved in the decision to develop this project?
   - Who was involved in the original design of the project?
   - Who has been most knowledgeable and skilled in the design and implementation of the project? Explain.

.

2. Describe the series of events that have occurred during this project and what has influenced, both positively and negatively, those events?

   Probe:
   - Positively influenced
   - Negatively influenced

3. How did the barriers affect your success throughout the project? How did you address those barriers? What impact did these barriers have overall on the success of your project?

4. What changes have occurred that you think are related to this project? How do you know?
   - Changes in teaching and learning environment
   - Changes in your community
   - Curricular changes

5. How have attitudes about the use of technology changed over time with the implementation of this project?
   - Students' attitudes
   - Parents' attitudes

6. To what extent is technology used to communicate and collaborate within the district/ organization/community and outside the district/organization/community others?

7. If you were to construct a graphic that describes how you think this project has worked, what would it be?

   Give example: If we talked about one theory of how a car starts we could say: Turning the key starts the motor. Putting the car into gear and adding fuel by stepping on the accelerator causes the car to move. To stop the car, the driver applies pressure to the brake pedal. This is an oversimplification, of course.

Specifically, how have the activities related over time to produce the intended short- and long-term outcomes?

8. To institute an educational reform, such as the use of technology in the classroom, what are the essential components for success (e.g., parent training, pre-service, professional development)?

9. Think about other innovations you have been involved with. How has this project been like those and how has it been different?

10. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

11. What else would you like to share about this project?

Focus Group Questions for Students

Questions

1. Tell me a little about yourself, your school and what you are learning in this class.

2. What changes have occurred in the teaching and learning environment that you think are related to this project? How do you know?

3. What changes in instructional practices have occurred as a result of this project?

4. What curricular changes have occurred as a result of this project?

   Probe:
   - How is what you are learning apply to the world of work and your community?

5. As a student in this school using technology, what is working for you? What is not working for you?

6. What changes have occurred in your community that you think are related tot his project? How do you know?

7. How have students' attitudes about the use of technology changed over time with the implementation of this project?

8. To what extent is technology used to communicate and collaborate within the district/ organization/community and outside the district/organization/community others?

9. Think about other innovations you have been involved with. How has this project been like those and how has it been different?

10. What advice do you have for others, including Congress and Department of Education, who are undertaking similar projects using federal funds for educational reform?

11. What else would you like to share about this project?

Classroom Observation Protocol

Background information

Date: _____ Observer:_____

Teacher: _____

Subject: _____ Grade: _____

Number of students: _____ Length of class: _____

Learning Environment Describe how students are organized during the lesson. When and for how long do students meet as a whole class, work in pairs or small groups or work individually? What are students expected to learn and how are they organized to learn it?

Instructional Practices Describe the role of technology in teaching and learning.

Classroom Interaction Describe the extent to which language differences affect the patterns of interaction and to which attempts are made to address students with special needs. What accommodations are made in terms of materials/resources and in patterns of interaction (teacher-student and student-student)?

Other Describe anything else that seems important but not addressed above. Give specific examples and explain why it is important?

Document Analysis Framework

Type of Document

Date of Document

Author/Developer

Description of Contents

Data/Evidence

Question	Data/Evidence	Page	Comments
What impact have the projects had on their local community and on the fields of technology and professional development?			
What demonstrative and procedural knowledge have these projects contributed that can benefit other federally funded projects or local innovations?			
What theory of change drives innovations in technology and technology-related professional development?			
What activities contributed most to the project's success and what barriers impeded them?			

Findings

Recommendations

Noteworthy Contents (p.)

NSDC Staff Development Standards

Standard	Data/Evidence	Page	Comments
Learning Community			
Leadership			
Resources			
Data-Driven			
Research-Based			
Learning			
Collaboration			
Evaluation			
Design			
Equity			
Quality Teaching			
Family Involvement			

NETS (National Educational Technology Standards) for Teachers

NETS	Data/Evidence	Page	Comments
Technology operations and concepts			
Planning and designing learning environments and experiences			
Teaching, learning, and the curriculum			
Assessment and evaluation			
Productivity and professional practice			
Social, ethical, legal, and human issues			