The Dissertation Committee for Willie James Adams certifies that this is the approved version of the following dissertation:

A Study of Principals and Teachers Perceptions of School Technology and Readiness

Committee:

Paul Resta, Supervisor

Kevin Michael Foster

James Barufaldi

Norvell Northcutt

Todd Reimer

A Study of Principals and Teachers Perceptions of School Technology and Readiness

by

Willie James Adams, B.S.; M.S

Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin
May 2011

Dedication

This work is dedicated to my mother Mattie Lou Ellison (†), my father Laurie Adams (†), my wife, Laura, my son Alexander, my daughters Julie, Rachel, and Sylvia, my son-in-law Eddie, and my grandchildren Anthony, Niani, Nazeem, Bethany, and Joshua.

Acknowledgements

I would like to express appreciation for the assistance I received from my dissertation committee, Dr. Paul Resta, Chair, Dr. Norvell Northcutt, Dr. James Barufaldi, Dr. Gregg Foster, and Dr. Todd Reimer. Without their guidance and support, I would not have finished the study.

I also wish to thank Dr. Marylu De Hoyos, Educational Service Center 13, Dr. Jim Scheurich, Texas A&M University, and Jon Lopez and Anita Givens, Texas Educational Agency.

Most importantly, I want to thank my wife, Laura Adams, for believing in me and carrying me over the finish line. Her faithfulness inspired me to complete this work.

To all of my family and friends who played a part in this accomplishment, I am forever indebted to you.

Thank you Dr. Oscar Mink (†). May you rest in peace?

A Study of Principals and Teachers Perceptions of School Technology and Readiness

Publication No.______________

Willie James Adams, Ph. D.
The University of Texas at Austin, 2011

Supervisor: Paul Resta

The primary purpose of this study was to determine what factors influence the integration of educational technology as perceived by Texas teachers. The secondary purpose was to examine the relationships between the determinant factors. This study answered the following questions: 1) Are there significant differences in teachers' perception of school technology and readiness across grade level and subject area? 2) Are there significant differences in teacher-principal technology readiness congruence across school percentage of economically disadvantaged students? 3) How do teachers' perceived levels of technology readiness predict student mastery of Technology Applications (TA) TEKS?

To address the research questions quantitative procedures were followed to investigate whether significant relationships existed among dependent variables, school

technology and readiness, and teacher-principal school technology and readiness congruence, and the independent variables (a) grade level, (b) subject area, and (c) percentage of economically disadvantaged students.

Data analysis indicated significant differences in teacher school technology and readiness perceptions by grade level and subject area, and significant differences in teacher-principal school technology and readiness congruence by school percentage of economically disadvantaged students. Using path analysis a theorized Texas School Technology and Readiness Effects Model was validated.

The findings were that (a) teachers in higher grade levels and more technical subject areas perceived their school technology and readiness at significantly higher levels; (b) as the percentage of economically disadvantaged student increased in a school, teachers perceived their school technology readiness at lower levels and were less congruent between their perceived school technology and readiness and their principals' ratings of the teachers' school technology and readiness; and (c) Leadership Administration and Instructional Support, followed by Infrastructure for Technology, Educator Preparation and Development, and Instruction Practice were the main drivers for student mastery of Technology Applications (TA) related Texas Essential Knowledge and Skills (TEKS).

Table of Contents

List of Tables xi

List of Figures xiii

CHAPTER ONE: INTRODUCTION **1**

Increasing the Supply..2

Improving the Resources 4

Uncovering the Technology Adoption Issues.......................................5

Monitoring Progress..7

Texas School Technology and Readiness..10

The Problem...13

Research Questions...16

Conclusion 17

CHAPTER TWO: REVIEW OF LITERATURE **22**

Increasing the Supply..22

Improving the Resources 24

Apple Classrooms of Tomorrow...25

Technology Adoption Issues...26

Barriers to Change 30

Teacher Quality...32

Leadership..32

Professional Development 36

Organizational Congruence 38

Progress Monitoring........39
Monitoring the Learning Environments........40
Student-Centered Learning Environments........42
SBEC Technology Applications Standards........47
Summary........49
CHAPTER THREE: METHODOLOGY **51**
The Participants........51
The Instrument........52
Data Acquisition........56
Data Analysis........58
Research Question 1........59
T-STaR Teaching and Learning Variables........61
T-STaR Educator Preparation and Development Variables........62
T-STaR Leadership, Administration, and Instructional Support Variables........63
T-STaR Infrastructure Variables........64
Research Question 2:........65
Research Question 3:........66
Path Analysis........68
Limitations and Advantages of Path Analysis........70
T-STaR Key Indicators........71

Limitations 72
Summary 72
CHAPTER FOUR: RESULTS **73**
Research Question 1 73
Research Question 2: 91
Research Question 3 94
Summary 97
CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS **99**
Summary 99
Discussion 100
Implications for Practice and Policy 114
Conclusions 120
Further Research 120
Researcher's Reflection 122
APPENDICES **124**
Appendix A: Consent Form 124
Appendix B: Texas School Technology and Readiness (T-STaR) Performance Descriptions 127
Early Tech 127
Developing Tech 128
Advanced Tech 129
Target Tech 130
REFERENCES **131**

List of Tables

Table 2.1: Contrasting views of traditional and constructivist learning environments Ringstaff and Kelly (2002)..44

Table 3.1: T-STaR Subscale Reliability Analysis 60

Table 3.2: Teaching and Learning Item Frequencies..61

Table 3.3: Educator Preparation and Development Item Frequencies 62

Table 3.4: Leadership, Administration, and Instructional Support Item Frequencies 63

Table 3.5: Infrastructure Item Frequencies...64

Table 4.1 Descriptive statistics for Teaching and Learning composite scores by school grade level 74

Table 4.2 Descriptive statistics for Educator Preparation and Development composite scores by school grade level...76

Table 4.3 Descriptive statistics for Infrastructure for Technology composite scores by school grade level 78

Table 4.4 Descriptive statistics for Leadership, Administration, and Instructional Support composite scores by school grade level 80

Table 4.5 Descriptive statistics for Teaching and Learning composite scores by subject area...82

Table 4.6 Descriptive statistics for Educator Preparation and Development composite scores subject area 84

Table 4.7 Descriptive statistics for Infrastructure for Technology composite scores by subject area...86

Table 4.8 Descriptive statistics for Leadership, Administration, and I nstructional Support composite scores by subject area.....................88
Table 4.9 Descriptive statistics for Teacher-Principal School Technology and Readiness congruence by school percentage of economically disadvantaged students...91
Table 4.10: Summary of Model-Fit Statistics..94
Table 4.11: Path Coefficients in the Texas Teacher Technology and Readiness Effects Model...95
Table 5.1: 2008-2009 Teacher T-STaR Focus Area Counts................................102

List of Figures

Figure 1.1: 2008-2009 T-STaR State Campus Level Assessment........................11

Figure 2.1: Instruction as Interactions of Teachers, Students, and Content in Environments 41

Figure 3.1: T-STaR Submission Process 56

Figure 3.2: T-STaR Focus Areas Effects Model 67

Figure 4.1 Teaching and Learning composite score means by school grade level...75

Figure 4.2 Educator Preparation and Development composite score means by school grade level 77

Figure 4.3 Infrastructure for Technology composite score means by school grade level...79

Figure 4.4 Leadership, Administration, and Instructional Support composite score means by grade level 81

Figure 4.5 Teaching and Learning composite score means by subject area..........83

Figure 4.6 Educator Preparation and Development composite score means by subject area 85

Figure 4.7 Infrastructure for Technology composite score means by subject area...87

Figure 4.8 Leadership, Administration, and Instructional Support composite score means by subject area..89

Figure 4.9 Teacher-Principal School Technology and Readiness congruence by school percentage of economically disadvantaged students.............92

Figure 4.10: Texas Teacher Technology and Readiness Effects Model................94

Figure 5.1: 2008-2009 Teacher T-STaR Focus Area Ratings 101

Figure 5.2 Subject area teachers by grade levels 105

Figure 5.3: Texas Teacher Technology and Readiness Effects Model................111

CHAPTER ONE: INTRODUCTION

The publication of *A Nation At Risk* (Denning, 1983) was the clarion call for America to prepare the nation's school children to compete in a global economy dependent on twenty-first century skills. The report acknowledged the imperative of integrating technology into the nation's educational system.

Regarding technology the report revealed three motivators for change that remains true today. Mainly, 1) computers and computer-controlled equipment are penetrating every aspect of our lives—homes, factories, and offices, 2) by the turn of the century millions of jobs will involve laser technology and robotics, and 3) technology is radically transforming a host of other occupations: health care, medical science, energy production, food processing, construction, and the building, repair, and maintenance of sophisticated scientific, educational, military, and industrial equipment (Denning, 1983, p. 470).

With the nation at risk in the 1980s policymakers set out to address educational technology integration, but the reality was that in 1982 the supply of educational computers was scarce—there were only an estimated 52,000 computers in the nation's schools (Goor, Melmed, & Farris, 1982, p. 4).

Not only were the number of computers limited, but also those early systems were relatively expensive, and afforded only rudimentary forms of computer-aided instruction

(CAI). In the 1980s educational computer use consisted mainly of computer literacy instruction, remedial and compensatory education, and drill and practice (Goor, Melmed, & Farris, 1982, p. 4).

Furthermore, the body of knowledge about best practices integrating technology into teaching and learning to improve student achievement was beginning to emerge. Lastly, the transformation would require the efforts of public, private, federal, state, and local stakeholders. The tasks beforehand were to increase the quantity of educational computers, improve the quality of the technology resources, resolve the technology adoption issues, and monitor state and local progress.

This chapter briefly reviews the historical role of policymakers in increasing the supply of computers, improving the quality of the technology resources, resolving the technology adoption issues, and monitoring state and local progress. Then a concise overview of Texas School Technology and Readiness follows, leading to the statement of the problem and purpose for this study.

Increasing the Supply

The computer supply issue changed for the better in the 1990s, as more powerful and moderately affordable personal computers became available. Corporations took the lead as they began to use the increasing supply of microcomputers, in tandem with the burgeoning Internet, to communicate with each other and with their customers. Realizing the importance of closing the *Nation At Risk* skills gap, domestic corporations in partnership with federal, state, and local education agencies began the process of *reinventing* America's schools (Gerstner, 1994; CEO Forum, 1997; ACOT, 1983).

Additionally, Congress established several national and statewide policies aimed at stimulating the integration of technologies into schools. The Goals 2000: Education America Act passed in 1994 included funding for research and projects designed to enhance technology usage in the teaching and learning process (Goals 2000, 1993).

In 1996 Congress once again made educational technology a national priority with the passage of the Telecommunications Act which established the Universal Service Fund for Schools and Libraries, also known as the E-Rate Program, and provided discounts on telecommunication services, Internet access, and internal connections for all public and private schools and libraries. The E-Rate program also provided for necessary infrastructure and placed emphasis on ensuring adequate access to technology for teachers and students (NCES, 2002).

The technology acquisition efforts of the 1990s were highly successful in closing the availability gap. By 2006 there were an estimated 12.7 million personal computers in public schools used solely for instructional purposes (FRSS, 2006). In addition, public schools have made consistent progress in expanding Internet access in instructional rooms due in part to the funding of the E-Rate program and the efforts of consortiums such as the CEO Forum. Today, nearly 100% of public schools in the United States have access to the Internet, compared with 35% in 1994. Furthermore, over 94% of public school instructional rooms have Internet access, compared to 3% in 1994, and the ratio of students to instructional computers with Internet access in public schools is about 3.8 to 1, a decrease from the 12.1 to 1 ratio in 1998 (FRSS, 2006).

Improving the Resources

As schools began to improve their inventories of computer technology they also started relying on various partnerships with businesses to help them develop the business strategies and processes for acquiring, allocating, and integrating technology resources. IBM launched the Reinventing Education program (Gerstner, 1994). The goal of the initiative was to use new applications of technology to jumpstart fundamental and lasting school reform leading to higher student achievement. Apple's contribution to educational reform was Apple Classrooms of Tomorrow (ACOT), a research and development collaboration among public schools, universities, and research agencies (Baker, Gearhart, & Herman, 1990). Initiated in 1985, ACOT's goal was to study how the routine use of technology by teachers and students might change teaching and learning.

Another initiative that was successful at raising public awareness for integrating technology into the classroom was the CEO Forum on Education and Technology (CEO Forum, 1997). Recognizing the strategic role technology played in the knowledge workplace and the global economy, the CEO Forum set out to ensure that America's schools effectively prepared all students to become contributing citizens and productive workers in the twenty-first Century.

The forum's vision was to "provide students with the opportunity to combine the best of traditional learning with the unprecedented opportunities technology offers" (CEO Forum, 1997, p. 3) as it focused on four keys areas: 1) Connections to the Internet; 2) Availability and accessibility of hardware; 3) Adequate professional training and development; and 4) Appropriate educational content (CEO Forum, 1997). The goal was to create equitable access to technology and develop highly trained educators equipped to use technology to achieve high academic standards. As a lasting legacy to the work of the CEO Forum, the forum developed the School Technology and Readiness (STaR) Chart to assess and monitor progress toward integrating technology in the nation's schools.

Uncovering the Technology Adoption Issues

As the presence of computers in schools became commonplace, educational researchers began enriching the technology integration knowledgebase. Prior research suggests that there exist both *conditions* that enable teacher adoption of technology (Ely, 1990, 1999; Granger, et al., 2002) and *barriers* that inhibit (Cuban, 2001, 2003) effective educational technology integration.

According to the Office of Technology Assessment (OTA) educational technology under-integration was a result of at least four factors: 1) inadequate teacher training; 2) a lack of vision of technology's potential for improving teaching and learning; 3) a lack of time to experiment; and 4) inadequate technical support (OTA, 1995).

Cuban (2003) argued that the existing gap between technology availability and teacher practice is a result of intractable working conditions, external demands, and unreliable technologies which results in teachers' inability to integrate technology into the classroom in an era of increasing external accountability (Elmore, 2004).

In separate studies Ely (1990, 1999) found eight conditions that facilitate the adoption of educational technology innovations: dissatisfaction with the status quo, knowledge and skills, resources, time, rewards, participation, commitment, and leadership (Ely, 1999).

The National Educational Technology Standards (NETS) Project developed standards to guide educational leaders in planning for effective use of technology to support learning, teaching, and educational management (ISTE, 2002). NETS uncovered eight essential conditions for implementing technology into the teaching and learning process: shared vision, access, skilled educators, professional development, technical assistance, content standards and curriculum resources, student-centered teaching, assessment, community support, and support policies (ISTE, 2002).

While focusing on teacher development and leadership support, Granger et al. (2002) suggested that informal technology education, such as 'just-in-time' learning, was most influential on teachers' technology adoption. Furthermore, supportive and collaborative relationships among teachers, a commitment to pedagogically sound implementation of new technologies, and principals who encourage teachers to engage in their own learning were viewed as highly useful factors.

Finally, Becker (2004) found that teachers considered by their peers to be exemplary computer users themselves encourage their students to exploit computers as intellectual tools for writing, analyzing data, and solving problems. Becker (2000) identified several factors that describe the exemplary computer-using teacher as: the teacher's goals, frequency of the student's computer use, experience level of student computer users, the relevancy of the computer use compared to the desired outcome of the learning activity, and finally the general functions of the computer in the class or lab setting.

Monitoring Progress

Meanwhile as technology was becoming more prevalent and research was revealing conditions for integration, the states were busily developing their own plans for technology in response to the national and private initiatives. In 1996 the Texas Education Agency (1988, 1996, 2000, 2006) created the first of a series of Long Range Plans for Technology (LRPT). The plan attempted to capture the vision and expectations for acquiring and using technology to transform Texas schools into learning communities through which communication and collaboration between students, parents, teachers, and leaders help prepare students to compete in a global workforce.

While the technology infrastructure has improved dramatically over the past three decades, only 20% of teachers considered themselves well prepared to use technology in their classes (NCES, 2000). In another national survey, Ravitz, Wong, and Becker (1999) found that approximately 40% of teachers require monthly assistance in integrating technology into a lesson. The challenge became establishing and implementing strategies to develop the knowledge and skills necessary for teachers to effectively use technology as an instructional tool in order to close the gaps in student achievement. The researchers found that teachers were not averse to using technology, but instead they needed increased opportunities to develop their capacities for transforming their practice (Ravitz, Wong, and Becker, 1999).

In the state of Texas it was felt that teachers and students were unprepared to use technology effectively, and so the state legislature enacted mandates that required both teachers and students to demonstrate their technology skills. The *Long-Range Plan for Technology 2006-2020* ensured educator preparation and development by requiring that all educators who graduated from an educator preparation program would know how to use technology effectively in the teaching-learning process as demonstrated by the State Board of Educational Certification (SBEC) Technology Applications (TA) Standards. In turn, these highly qualified educators were to develop new learning environments that utilized technology as a flexible tool where learning is collaborative, interactive, and customized for the individual learner and ensured full integration of appropriate technology throughout all curriculum and instruction.

In concert with technology literate teachers, school leadership was expected to create the vision and expectations for using technology to transform Texas schools into knowledge building communities through which communication and collaboration between students, parents, educators, and leaders prepare students to compete in a global workforce.

Next the state of Texas turned its attention to monitoring. The Texas School Technology and Readiness (T-STaR) Chart (TEA, 2004) was designed to help campuses and districts determine their progress toward meeting the goals of the *Long-Range Plan for Technology 1996-2010*, and to measure the impact of federal, state, and local efforts to improve student learning through the use of technology.

Based on the CEO Forum's STaR (CEO Forum, 1996), data from the T-STaR has been used in a variety of ways. Administered annually to all Texas teachers and campus principals, the T-STaR provided a valuable snapshot of the state's educational technology landscape. Campus and district summary data were routinely reported to school boards, community groups, and technology planning committees; statewide summary data was reported to state and federal policymakers; and implementation data from the T-STaR was used to report the state's progress toward the requirements in *No Child Left Behind, Title II, Part D which* required all states:

a) To assist every student in crossing the digital divide by ensuring that every student is technologically literate by the time the student finishes the eighth grade, regardless of the student's race, ethnicity, gender, family income, geographic location, or disability and

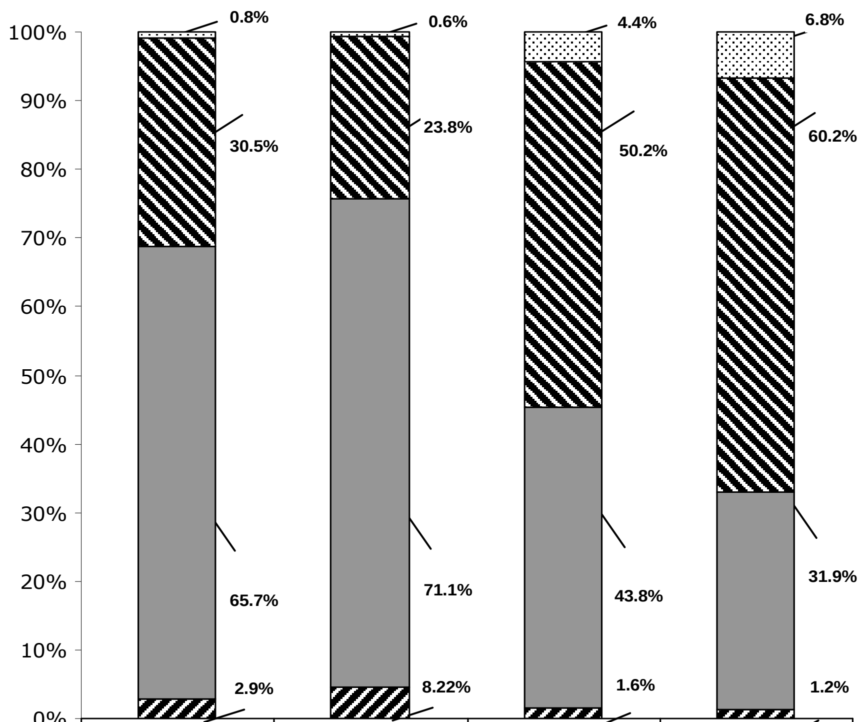
b) To encourage the effective integration of technology resources and systems with teacher training and curriculum development to establish research-based instructional methods that can be widely implemented as best practices by state educational agencies and local educational agencies (NCLB, 2002).

Texas School Technology and Readiness

The Texas School Technology and Readiness survey *(*T-STaR) captures Texas schools' progression through the stages of technology adoption. According to the Long Range Plan for Technology, Texas schools are to transition through four distinct phases of technology readiness: 1) early tech, 2) developing tech, 3) advanced tech, and 4) target tech (TEA, 1988, 1996, 2000, 2006).

In addition to measuring the stages of technology adoption, the T-STaR assessment instrument focuses on four key areas and their affects on students, teachers, and leaders. As shown on Figure 1.1, the four components of the assessment are: 1) Teaching and Learning; 2) Educator Preparation and Development; 3) Administration and Support Services; and 4) Infrastructure for Technology. These components are included within the T-STaR assessment instrument.

Figure 1.1: 2008-2009 T-STaR State Campus Level Assessment



	Teaching & Learning	Educator Preparation	Administration & Support	Infrastructure
Target	0.8%	0.6%	4.4%	6.8%
Advanced	30.5%	23.8%	50.2%	60.2%
Developing	65.7%	71.1%	43.8%	31.9%
Early	2.9%	4.5%	1.6%	1.2%

Figure 1.1 depicts the results of the 2008-2009 campus level T-StaR assessment, which incorporates both the individual teachers' and principals' school technology readiness assessments. The table within the figure reports the percentage of Texas

schools at each of the four technology integration stages (Early-Tech, Developing-Tech, Advanced-Tech, Target-Tech) across each of the four focus areas.

The first focus area, *Teaching and Learning*, measures the level of schools' progress toward ensuring all students have access to relevant technologies, tools, resources, and services for individualized instruction. As indicated in Figure 1, the 2008-2009 T-STaR assessment data reveals that a majority of Texas schools, 65.7%, are in the Developing-Tech stage of technology integration. Some schools, 30.5%, are in the Advanced Tech readiness stage.

The second focus area, *Educator Preparation and Development,* measure the degree that educators know how to use technology effectively in the teaching-learning process as demonstrated by the SBEC Technology Applications Standards. Target-Tech educators are expected to develop collaborative, interactive, and differentiated learning environments and to integrate technology appropriately throughout all curriculum and instruction. Results of the 2008-2009 T-STaR indicate that 71.1% of Texas campuses leaders assessed their educators at the Developing-Tech level, while 23.8% of the campuses reported their Educator Preparation and Development as Advanced-Tech. Only 4.5% believed that educators at their schools were qualified at the Early-Tech readiness level, and less than one percent, 0.6%, claimed the Target Tech level.

The third focus area, *Leadership, Administration and Instructional Support,* measures leaders' capabilities to develop, implement, budget, and monitor their technology plans. Target-Tech leaders create innovative, flexible, and responsive environments, which maximize teaching and learning and community involvement. The

2008-2009 T-STaR data reveal that 43.8% of Texas schools perceived their campuses' Leadership Administration and Instructional Support to be at the Developing-Tech stage of integration, while 50.2% of the campuses rated their Leadership Administration and Instructional Support as Advanced.

The last focus area, *Infrastructure for Technology*, captures statewide efforts to provide an educational technology system that ensures equitable access to all e-learning technologies for all users—teachers, students, leaders, and parents. Target-Tech infrastructure 1) delivers just-in-time technical support, 2) ensures secure and accurate data, and 3) affords interoperability and accessibility for all users. According to the 2008-2009 T-STaR survey a majority of Texas schools, 60.2%, were at the Advanced Tech, while 31.9% report their schools' Infrastructure for Technology as Developing Tech.

As shown in Figure 1.1, with more than 92% of campuses rating their technology infrastructure at the Advanced-Tech and Target-Tech levels, progress has been made in the area of Infrastructure. However, less than 32% of Texas schools are effectively implementing teaching and learning practices at the Developing and Target Tech levels. The 2008-2009 T-STaR data reveal the greatest need is for more effective educator preparation and professional development.

The Problem

As the state of Texas implements the Long-Range Plan for Technology, schools are expected to continuously build capacity for developing computer literate students and technology-qualified educators. According to Elmore, educational capacity is the degree by which learners, students, and teachers, utilize the knowledge, skills, and resources made available to support students, teachers, and content as they interact (Elmore, 2004; Cohen, Raudenbush, & Ball, 2003). Elmore adds that capacity is enhanced by

> … deliberately investing in the knowledge and skills of teachers and students to do the work of learning. This means literally using the schools and instructional structure that surrounds it as a mechanism to deliver resources and support to teachers and students to enhance their learning (Elmore, 2004, p. 222).

Despite earlier efforts to build technology capacity, which included increasing the quantity of educational computers, improving the quality of the technology resources, resolving technology adoption issues, and monitoring state and local progress, Texas schools remain in the early technology integration stages.

Data from the 2008-2009 T-STaR survey (Figure 1) indicates that very few schools have progressed to the Target Tech level of classroom technology integration. In the area of Teaching and Learning, relatively few Texas educators, 0.8%, have reached the Target Tech level. Likewise in the area of Educator Preparation and Development, a mere 0.6% of Texas teachers rate their preparation and continuous professional development at the Target Tech level.

Although prior research focusing on uncovering the conditions and barriers to effective technology integration has shed some light on the problems educators experience in integrating technology into their classroom, limited research has been done to understand the differential perceptions of technology readiness by teachers within individual schools. Specifically, little is known as to the general level of congruence of teachers' and principals' perceptions of technology readiness, as indicated in the T-STaR items. For example, what are the aspects of technology in which there tends to be the greatest congruence as well as the greatest differences in perception between teachers on their campuses and within their districts? The lack of congruence in perception of level of technology readiness by teachers may not only reflect the need for improved communication with the school community, but it may also serve as a barrier toward helping the school and district to move forward in addressing the technology and instructional needs of the school. It will also be important to understand the extent to which the level of congruence in perceptions is affected by campus characteristics, e.g., school size.

As shown by Figure 1.1 the state of Texas has made substantial progress over the last several years in terms of infrastructure and support—with over half of the state's schools above the Advanced Tech level for both Infrastructure and Administration and Support. However, the focus areas of Teaching and Learning and Educator Preparation are less developed and questions remain. The existing campus level reports do not help us understand the different technology integration and readiness perceptions between teachers and principals. Are they congruent? Are they diverging or converging across campus varying demographics? This study attempts to develop a better sense of factors which contribute to the growth in school technology and readiness across the four T-STaR focus areas.

Research Questions

The primary purpose of this study is to determine what factors influence the integration of educational technology as perceived by Texas teachers. The secondary purpose is to examine the relationships between the determinant factors. The research questions are:

1. Are there significant differences in teachers' perception of school technology readiness across grade level and subject area?
2. Are there significant differences in teacher-principal technology readiness congruence across school percentage of economically disadvantaged students?
3. How do teachers' perceived levels of technology readiness predict student mastery of Technology Applications (TA) TEKS?

Conclusion

The primary purpose of this study is to determine what factors influence the integration of educational technology as perceived by Texas teachers. The secondary purpose is to examine the relationships between the determinant factors. The report consists of five chapters. Chapter One introduced the research by reviewing the historical role of policymakers in increasing the supply of computers, improving the quality of the technology resources, resolving the technology adoption issues, and monitoring state and local progress..

Chapter Two provides a review of relevant literature. The review of literature includes studies that suggest that integrating technology into classrooms is an organizational change process. In addition it discusses the role of leadership that supports the change process by removing barriers, improving the conditions for learning by providing adequate professional development for teachers, and improving the technology infrastructure and support.

Chapter Three addresses the methodology of this quantitative study. For its methods this study utilized analysis of variance and path analysis. The chapter .describes the design and methods used for collecting and analyzing the data. It also includes information about the population and sample, instruments used in the study, and procedures for collecting and analyzing the data. Additionally, the chapter ends with limitations for the study.

Chapter Four describes the results from the data analyses which were conducted in the study.

Chapter Five provides a brief summary of chapters one, two, and three as well as a discussion of the study's most important findings. It presents the conclusions and discusses the implications of the exploratory study for theory and practice. The limitations of this study are discussed and the needs for further research are identified

Definition of Terms

Distance Learning: An educational process delivered and supported by technology (Internet, satellite, videoconferencing, emerging technologies, etc.) in which the teacher and student are separated by time and/or space (TEA, 2006).

Economically disadvantaged: Students reported for free or reduced-price meals under the National School Lunch and Child Nutrition Program. The percent of economically disadvantaged students is calculated as the sum of the students coded as eligible for free or reduced-price lunch or eligible for other public assistance, divided by the total number of students: number of students coded as eligible for free or reduced-price lunch or other public assistance total number of students (TEA, 2010).

Educator: Professional employee who holds a valid certificate or permit in order to deliver instruction to students; these employees may include classroom teachers, librarians, principals, counselors, or paraprofessionals delivering instruction under the direction of a certified teacher (TEA, 2006).

Educational technology: The systematic process of applying computer centered multimedia hardware, peripherals, software, and communications for teaching and learning, including administrative software that teachers may use in classroom management (Hoffman, 2001).

eLearning An umbrella term that refers to online or virtual courses, distance learning by other electronic methods and the use of technology to support teaching, learning, and professional development. or other public assistance (TEA, 2006).

Integrated/Integration: Use of technology by students and teachers to enhance teaching and learning and to support curricular objectives (TEA, 2006).

Librarians: Campus librarians are included in the term “teacher” used throughout the Texas Teacher STaR Chart (TEA, 2006).

LRPT (Long-Range Plan for Technology): Texas plan for integrating technology into the school system. Four key areas are: Teaching and Learning, Educator Preparation and Development, Leadership, Administration and Support Services, and Infrastructure for Technology (TEA, 2006).

Principal: An administrator in a school that acts as the sole administrative leader.

Professional Development: Also referred to as staff development or in-service training. Includes the National Staff Development Council's major models of professional development: training, observation/assessment, involvement in a development/improvement process, study groups, inquiry/action research, individually guided activities, and mentoring (TEA, 2006).

TA: Technology Applications is the curriculum area that defines what all students should know and be able to do with technology K-12 (TEA, 2006).

TA TEKS: Technology Applications Texas Essential Knowledge and Skills (TEA, 2006).

Technology: Refers primarily to computer and computer-related technologies such as data communications, interactive video, and digital television (Picciano, 2002)

Technology implementation: Actions and results of a public program in terms of output and outcomes (Lane, 1990).

Technology planning: A formal set of ongoing actions taken by school districts to guide the implementation, evaluation, and revision of a program for educational technology that may or may not result in a written technology plan (Hoffman, 2001).

Texas STaR Chart: Online School Technology and Readiness (STaR) tool allowing campuses and teachers to assess technology development and use. Developed by the Educational Technology Advisory Committee (TEA, 2006).

CHAPTER TWO: REVIEW OF LITERATURE

This chapter is a review of the educational technology integration literature. The review focuses on four major components which affect teachers' integration of technology: increasing the quantity of educational computers, improving the quality of the technology resources, resolving the technology adoption issues, and monitoring state and local progress.

Increasing the Supply

Beginning in the 1980s, research on school expenditures suggested that different patterns or amounts of spending did not have major effects on student learning (Hanushek, 1989). However, a growing body of research argued that expenditure patterns—particularly how schools spend their funds—does have consequences for teaching and learning (National Research Council, 1999). Anderson and Becker (2001) researched how schools spend money on information and communication technologies and found that over the past two decades, schools have been spending increasing proportions of their discretionary funds to acquire computer equipment, software, and related supplies and services (Pelavin, 1997), and schools have come under increasing pressure to account for those expenditures (Anderson & Becker, 2001).

As the number of computers increased in the classroom schools turned to the private sector for practices which promoted information technology accountability. One tool that was widely adopted was Total Cost of Ownership (TCO). Developed in 1987 by the Gartner Group, TCO was developed as a means of clearly and reasonably addressing the real costs attributed to owning and managing an IT infrastructure in schools (Consortium for School Networking, 2001).

Gartner TCO identified costs as being made up of two major components—direct and indirect. Direct costs traditionally formed the area that organizations found easiest to measure and as a result direct costs often received primary focus. Typically, direct costs were made up of labor and capital costs (Gartner, 2003). The vast majority of school technology-related expenditures have been devoted to building up the hardware infrastructure of computers, peripherals, and network connections. Much of this has been to keep up with an ever-changing market supplying newer and more capable computer-related equipment. Estimates of K-12 spending on educational technology during the early 1990s found that nearly two thirds of all investments on technology have been for this technical infrastructure (McKinsey & Co., 1995).

The other component in the Gartner TCO was indirect costs. Indirect costs were more elusive and difficult to measure and rationalize. The soft nature of indirect costs meant that their impact on owning an IT infrastructure was often underestimated (Consortium for School Networking, 2001). The Gartner Group found that some organizations dismissed the impact of indirect costs completely. Indirect costs typically represented a substantial component—as much as 60%—of the total cost of managing and owning an IT infrastructure (Gartner, 2003).

Indirect costs typically reflected the factors that influenced direct cost decisions; for example downtime or quality of service. Most importantly, indirect costs were often a result of misdirected funding in direct costs like technical support, training and help desk; therefore, making those costs look artificially low, and further, shifting those costs to business units reducing available resources to perform core competencies tasks, which in the case of schools is learning. This apparent disconnect between the manner by which schools were able to account for the direct costs of technology and not able to account for indirect costs led some researchers to conclude that educational technology was underserved and underused (Cuban, 1986, 2003; Cuban, Kirkpatrick, & Peck, 2001).

Improving the Resources

Beginning in the mid-1990s, American schools have been adding expenditures for Internet access to their technology budgets. Thus the share of technology-related dollars spent for hardware may be even greater now than before Internet connections became widespread in schools. At the same time, the widespread consensus among those in government and research who have been studying computer use in education is that effective use of educational technology depends most strongly on the human element—on having teachers and support personnel who have not only technical skills in using computers but practical pedagogical knowledge about designing computer activities that create intellectually powerful learning environments for students.

The OTA Report on Teachers and Technology (1995) concluded that for teachers to use technology effectively, they needed more than just training about how to work the machines and technical support, but they needed hands-on learning, time to experiment, easy access to equipment, and ready access to support personnel (Office of Technology Assessment, 1995, p. 129).

The President's Committee of Advisors on Science and Technology and Panel on Educational Technology (1997) and the CEO Forum (1999) drew similar conclusions. The Department of Education's (2000) National Technology Plan made improving the instructional support available to teachers who use technology a national goal. A recent TLC (Teaching, Learning and Computing) report by Ronnkvist, Dexter, and Anderson (2000) elaborated upon the critical ingredients of quality support and showed how important it was to successful technology integration.

APPLE CLASSROOMS OF TOMORROW

In 1985 the Apple Computer Company initiated the Apple Classrooms of Tomorrow (ACOT) research project. After more than a decade of research, the ACOT project was one of the longest continuing educational studies of its kind. ACOT's mission was to advance the understanding of teaching and learning in global, connected communities of educators and learners. This included investigating how teaching and learning change when people have immediate access to technology as well as helping people better understand how technology can be an effective learning tool and a catalyst for change (ACOT, 1996).

During the 13 years of research, ACOT studied learning, assessment, teaching, teacher development, school design, the social aspects of education, and the use of new technologies in more than 100 elementary and secondary classrooms throughout the country. ACOT classrooms also collaborated with schools internationally to explore constructivism mediated by technology, emphasizing collaboration over the Internet (ACOT, 1996).

In ACOT classrooms, students and teachers had immediate access to a wide range of technologies, including computers, videodisc players, video cameras, scanners, CD-ROM drives, modems, and online communications services. In addition, students could use an assortment of software programs and tools, including word processors, databases, spreadsheets, and graphics packages. In ACOT classrooms, technology was viewed as a tool for learning and a medium for thinking, collaborating, and communicating.

ACOT's research demonstrated that the introduction of technology into classrooms can significantly increase the potential for learning, especially when it is used to support collaboration, information access, and the expression and representation of students' thoughts and ideas (ACOT, 1996).

TECHNOLOGY ADOPTION ISSUES

Rogers (1995) theorized that innovations with the broadest degrees of diffusion exhibited the attributes of relative advantage, compatibility, complexity, trialability, and observability. The relative advantage of technology integration is the degree to which teachers perceive it as being better than traditional classroom instruction. The compatibility of technology integration is the degree to which it is perceived as being consistent with the existing values, past experiences, and needs of teachers. Complexity is the degree to which teachers perceive technology as difficult to understand and use. Trialability is the degree to which technology integration may be experimented with on a limited basis before teachers make a decision to adopt, and observability is the degree to which the results of technology integration are visible to others.

Applying Roger's process of adoption and decision making to schools' and educators' adoption of technology suggests a five-step process: 1) acquiring knowledge of an innovation, 2) forming an attitude toward the innovation, 3) deciding to adopt or reject, 4) implementing the new idea, and finally, 5) confirming the decision (Rogers, 1995).

As individuals progress through the five stages, they seek information to decrease uncertainty about the innovation. At the knowledge stage, there is great interest in innovation-evaluation information, with the most valued source being individuals who have actual experience with the innovation. In the case of schools, this model suggests that teachers who use technology are the best source of information for teachers who have yet to adopt it (Rogers, 1995).

From fieldwork in the late 1960s and early 1970s, Hall and Hord (1987) identified, verified, and operationally defined eight different levels of use of a new innovation. These levels of use are an important feature of the Concerns-Based Adoption

Model (CBAM). When learning to use a new innovation, users move along a spectrum that ranges from no-use to full-use. The Concerns-Based Adoption Model is a conceptual framework that describes, explains, and predicts probable teacher concerns and behaviors throughout the school change process. The three principal diagnostic dimensions of CBAM are:

1. Stages of Concern – Seven different stages of feelings and perceptions that educators experience when they are implementing a new program or practice.
2. Levels of Use – Eight behavioral profiles that describe a different set of actions and behaviors that educators engage in as they become more familiar with and more skilled in using an innovation or adopting a change.
3. Innovation Configurations – Different ways an innovation may be implemented, shown along a continuum from ideal implementation or practice to least desirable practice (Hall & Hord, 1987).

Dooley (1999) combined Roger's adoption theory with the Concerns Based Adoption Model and found: 1) low users of technology had a higher percentage of self concerns, 2) middle users shifted more to task or management concerns, and 3) high users were more concerned about the impact the innovation had on their students or other teachers.

Dooley (1999) also discovered that diffusion of computer technology and telecommunications depended on the willingness of the change facilitators to understand

and collaborate with the teachers in developing training and in-service programs to address their needs. Also, the principals and technology trainers in the schools tended to range between implementation and confirmation on Roger's innovation-decision model. Higher users were also in this range, with middle users closer to the decision stage and low users often only at the knowledge stage (Dooley, 1999).

Sherry (1998) developed a new model that integrated the adoption process with the learning process. As teachers learn about new technologies, specifically email and the World Wide Web via a trainer-of-trainers program, and as they begin to use these new resources in the classroom, they move through four stages of change: 1) learning from their peers; 2) experimenting and adopting; 3) co-learning and co-exploring with their students; and finally 4) reflecting and either rejecting the adoption decision or reconfirming it and continuing the cycle to become the next round of peer trainers. The success of this process is supported by communicating a shared vision among all members of the educational system, including teachers, administrators, parents, the community, and the policy-making bodies (Sherry, 1998).

Moersch (1995, 1999, 2001, 2002) proposed the Levels of Technology Implementation (LoTI) framework, with seven discrete implementation levels teachers experience. Ranging from Nonuse (Level 0) to Refinement (Level 6), as a teacher progresses from one level to the next, a series of changes to the instructional curriculum is observed. The instructional focus shifts from being teacher-centered to being learner-centered where computer technology is employed as a tool that supports and extends students' understanding of the pertinent concepts, processes, and themes involved when using databases, telecommunications, multimedia, spreadsheets, and graphing applications. Traditional verbal activities are gradually replaced by authentic hands-on inquiry related to a problem, issue, or theme. Heavy reliance on textbook and sequential instructional materials is replaced by use of extensive and diversified resources determined by the problem areas under study. Traditional evaluation practices are replaced by multiple assessment strategies that utilize portfolios, open-ended questions, self-analysis, and peer review (Moersch, 1995, 1999, 2001, 2002).

Barriers to Change

Research reveals that teaching and learning with technology has a small, positive effect on student outcomes when compared to traditional instruction (NCREL, 2002), due in part to personal and institutional barriers to change. Becker (2000) identified several factors that describe the exemplary computer-using teacher as: the teacher's goals, frequency of the student's computer use, experience level of student computer users, the relevancy of this computer use compared to the desired outcome of the learning activity, and finally the general functions of the computer in the class or lab setting. Teachers considered by their peers to be exemplary computer users themselves encourage their students to exploit these computers as intellectual tools for writing, analyzing data, and solving problems (Becker, 2004).

Exemplary computer-using teachers worked in a teaching environment that was favorable to encouraging and rewarding computer literacy on the part of teachers. Most importantly, schools where there were found to be a high level of exemplary computer-using teachers were characterized by several factors including: a social network of like-minded computer-using teachers, sustained use of computers for activities not directly related to basic computer skills, and organized support for these teachers in the form of on-site staff (Becker, 2000).

In addition to on-site staff and a supportive social network, funding plays a clear role in supporting high-level and effective computer usage as a tool for increasing student's computer literacy and acceptance. Well-funded computer labs equipped with up-to-date computer hardware and software as well as staff support were key factors in the adoption rate of teachers of computer technology as part of their everyday classroom activities. In addition, teachers found that teacher training in technology must be directly related to their needs. Not only do effective computer-using teachers need up-to-date computer hardware and software and relevant training, but they also require time for experimentation and hands-on training with their computer equipment (Anderson & Becker, 2001).

A study of technology educators in New Mexico found the major barriers to adopting technology education were inadequate budgets, facilities, resources, educational programs, and administrative support (Bussey, Dormody, & VanLeeuwen, 2000). The common change promoters were personal interest, workshops and the ability to visit functional technology education programs, the availability of grant funding, state level support, and the opportunity for professional advancement.

TEACHER QUALITY

Instructional technology integration represents a fundamental shift from teaching to learning (DuFour, 2004), where the role of the qualified teacher becomes crucial (Hord, 1997; DuFour & Eaker, 1998; DuFour, 2004; DuFour, Eaker, & Karhanek, 2004). Sanders and Rivers (1996), using value-added methods to determine the effects of teacher quality on academic achievement, found effective teachers to be the major contributor to student achievement. The study measured achievement growth of students as they progressed through grades 3, 4, and 5. The finding was that students of the most effective teachers assigned to three effective teachers in a row scored at the 83rd percentile in math at the end of fifth grade, while children assigned to three ineffective teachers in a row scored at the 29th percentile (Sanders & Rivers, 1996).

Other researchers found similar results. A study by Darling-Hammond (1999) reported that teacher qualifications accounted for approximately 40 to 60 percent of the variance across states in average student achievement levels, after taking into account student poverty and language background. Rockoff (2003) found statistically significant differences among teachers: a one standard deviation increase in teacher quality raised reading and math test scores by approximately .20 and .24 standard deviations.

LEADERSHIP

The effective integration of technology into the teaching-learning process, similar to the implementation of any innovation within a school, requires both leadership and vision on the part of the principal. For example, research has found that leadership produces both positive and negative impacts on student achievement (Waters, 2003). A 1977 U.S. Senate Committee Report on Equal Educational Opportunity (U.S. Congress, 1970) identified the principal as the single most influential person in a school:

> In many ways the school principal is the most important and influential individual in any school. He or she is the person responsible for all activities that occur in and around the school building. It is the principal's leadership that sets the tone of the school, the climate for teaching, the level of professionalism and morale of teachers, and the degree of concern for what students may or may not become. The principal is the main link between the community and the school, and the way he or she performs in this capacity largely determines the attitudes of parents and students about the school. If a school is a vibrant, innovative, child-centered place, if it has a reputation for excellence in teaching, if students are performing to the best of their ability, one can almost always point to the principal's leadership as the key to success. (p. 56)

Marzano (2005) examined 69 studies involving 2,802 schools, approximately 1.4 million students, and 14,000 teachers, and computed the correlation between the leadership behavior of the principal in the school and the average academic achievement of students in the school to be .25. According to Waters (2003) the achievement gain was produced by leaders with the capabilities to focus on their change initiatives, while assessing the implications of the initiatives for stakeholders.

Ott (2003) identified several leadership acts which play a major role in technology implementation. These acts included:

1) Pre-Planning for Accessibility
2) Onsite Technical Support or Onsite Technical/Instructional Faculty Member
3) Long-Term Professional Development or Ongoing Professional
4) Development in Educational Technology

5) Basic Skills in Equipment Care
6) Curriculum Integration or Curriculum-Driven Software Integration
7) Strategic Allocation of Resources
8) Neighborhood Network Connectivity

The greatest leadership challenges are present in urban and rural districts where there are large concentrations of high-poverty and low-performing schools. The turnover rate for principals is as high as 20% per year in these districts (NGA, 2003). These urban and rural communities often pay lower salaries and receive significantly fewer applicants for open positions (Roza, 2003). As a result, low-performing urban and rural schools are much more likely to end up with inexperienced principals and assistant principals (Papa et al., 2002).

In addition to concerns for the supply and distribution of school leaders, research also suggests that many current and potential principals lack the skills necessary to lead in today's schools. A 2001 Public Agenda report found that 29% of superintendents believe the quality of principals has declined measurably in recent years (Farkas et al., 2001). One likely source of this dissatisfaction is the changing nature of the principalship. Historically, school leaders were expected to perform primarily managerial and political roles (Cuban, 1998). According to the Institute for Educational Leadership, schools of the twenty-first century will require a new kind of principal, one whose main responsibility will be defined in terms of instructional leadership that focuses on strengthening teaching and learning. The challenge for states is to redesign their systems of licensure, preparation, and professional development to produce and reward principals that have these kinds of skills.

According to Hallinger and Heck (2000), school principals exercise a measurable, though indirect, effect on school effectiveness and student achievement. Leadership appears to particularly impact the quality of teaching in schools (Schiff, 2000). School leaders provide focus and direction to curriculum and teaching and manage the organization efficiently to support student and adult learning. Principals also evaluate teachers and make decisions about their classroom assignments. When classroom instruction is weak in underperforming schools, or when large numbers of teachers are teaching out-of-field in these schools, significant responsibility rests with the principal (Ingersoll, 1998).

Elmore (2000) suggests that quality school leaders understand teaching and are respected by their staff. Moreover, these individuals are willing to hold themselves and others responsible for student learning and enhancing the capacity of teachers to meet this goal:

> The job of administrative leaders is primarily about enhancing the skills and knowledge of the people in the organization, creating a common culture of expectations around the use of those skills and knowledge, holding the various pieces of the organization together in a productive relationship with each other, and holding individuals accountable for their contributions to the collective results. (p. 16)

Research suggests three effective modes of leading that the principal engages in to promote student learning. The first effective mode occurs when the principal acts as Entrepreneur. In this role school leaders develop and sustain a focus on instructional improvement and student learning while protecting teachers from the intrusions of the outside environment (Sebring & Bryk, 2000, Knapp et al., 2003). The next effective mode is as Organizer, in which school leaders bring to their schools innovative individuals and innovative ideas, programs, and instructional strategies that can improve teaching while maintaining a coherent reform agenda (Newmann et al., 2001). They also engage teachers, parents, and community members as collaborators and leaders in school improvement efforts (Bryk et al., 1999). Elmore (2002) envisions the Principal as Instructional Leader:

> Effective school leaders build data-driven professional communities that hold all individuals accountable for student learning and instructional improvement. They do this by managing time and financial resources to build teacher professional skills and knowledge. (Elmore, 2002)

PROFESSIONAL DEVELOPMENT

Martin et al. (2010) found student achievement increased when technology professional development focused on aligning instructional problems and key concepts with applicable technology tools. They also uncovered key characteristics which constitute effective professional development: (a) long duration, (b) follow-up support, (c) active engagement in relevant activities, (d) access to new technologies, (e) collaboration and community building among participants, and (f) shared understanding of student achievement (Martin et al., 2010).

The review of the literature suggests problems measuring student outcomes after educators attend effective professional development. Due in part to the lack of obvious alignment between technology PD (which has traditionally focused on software and other electronic resources) and the highly specified content areas teachers need to cover to prepare students for state assessments, measuring the direct impact of PD and showing connections between technology PD and student outcomes has been difficult (Martin et al., 2010).

The challenge is in designing professional development activities that make explicit connections between instruction and technology tools that leads to increased student learning improvements. Martin et al. found two essential elements for effective educator technology professional development:

- Well crafted and targeted professional development helps educators who attend such sessions connect that learning to their curriculum and standards and then provides a sound pedagogical approach to delivering their course content.
- High quality instructional technology professional development takes a great deal of time to create, and that time should not be minimized or underestimated. One can not just throw together a set of 'cool tools' to demonstrate to educators and hope that something effective will emerge from such a session (Martin et al., 2010).

The research makes clear educator technology professional development that works and makes an impact on student achievement is (a) labor intensive, (b) long duration, (c) involves ongoing coaching and support, and (d) has a close connection to the teaching and learning practice (Marzano, 2005; Martin et al., 2010). Educators perceived this form of professional development as producing deeper learning as opposed to traditional workshops that focus on a specific piece of software, hardware, or a set of resources (Martin et al., 2010).

In addition, integrated comprehensive professional development that focused instructional technology on content areas lead to effective technology integration that then had positive outcomes for students (Marzano, 2005; Martin et al., 2010).

ORGANIZATIONAL CONGRUENCE

The concept of organization congruence is derived from organizational research. Organizational congruence refers to the fit, match, similarity, or agreement between two constructs, such as the personal and organizational values (Chatman, 1989; Edward 2007, 2009, 2010), and employee needs and organization goals. Proponents of the organizational fit model view superiors-subordinate congruence as the interaction of personal and situational components, where the person interacts with the organizational environment by actively choosing situations that meet their needs and are congruent with their dispositions.

Person-Organization (P-O) fit occurs when an organization satisfies an individual's consciously held desires that according to Edwards (1996) encompass preferences, interests, motives, and goals. Kristof (1996) defined P-O fit as the compatibility between individuals and organizations and further stated that compatibility between people and organizations can occur when: (a) one provides what the other needs, or (b) similar fundamental characteristics are shared, or (c) both.

Chatman (1989) found person-organizational fit to be useful in predicting the extent to which a person's values will change as a function of organizational membership. Low person-environment fit occurs when strong organizational values and important individual values conflict so that what the organization thinks is important is different from what the individual thinks is important, resulting in three outcomes: (a) the person changes, (b) the organization changes, or (c) the person leaves the organization. Chatman (1989) also posited the concept of crystallization, or the extent to which the members perceive the values system similarly.

The degree of similarity or compatibility between individuals and situational characteristics is what attracts and connects people to organizations and their goals In other words, people are attracted to situations that fulfill their own values. Research has shown that project teams achieved more positive outcomes within group where the P-O fit is more congruent than within less compatible groups (Kristof-Brown & Stevens, 2001).

Progress Monitoring

Prior to the development of the national plan the Texas State Board of Education (SBOE) created a long-range plan for acquiring and using technology in the public school system. The Texas *Long-Range Plan for Technology 2006-2020* (TEA, 2004) provided guidance for integrating technology into the schools by

> ensuring an engaging, relevant, and future-focused system of education for young Texas learners preparing each student for success and productivity as a lifetime learner, a world-class communicator, a competitive and creative knowledge worker, and an engaged and contributing member of the emerging global digital society. (TEA, 2002, p. viii)

Envisioning a twenty-first Century learning environment where digital tools and resources are made available twenty-four hours a day, seven days a week (24/7), the architects of Texas' twenty-first Century schools seek to create computer supported environments where students, parents, and leaders are connected to each other. Within these new cyberspaces, students are to be empowered to perform at higher levels by authentically engaging instruction customized appropriately to their individual strengths, needs, and learning styles. Student engagement rests at the heart of the mission of Texas public education to prepare twenty-first Century learners.

MONITORING THE LEARNING ENVIRONMENTS

Instruction has been traditionally teacher-centered and thought of as what teachers do to students, and resources as the things that support instruction including everything from books to buildings to highly qualified teachers. Within this instructional framework the learner becomes a passive agent and research focuses on relationships between resource allocation and students achievement. Cohen et al. (2003) introduces an alternative view of instruction as consisting of interactions among teachers, students, and content, in environments.

Figure 2.1: Instruction as Interactions of Teachers, Students, and Content in Environments

(Cohen et al., 2003, p.124)

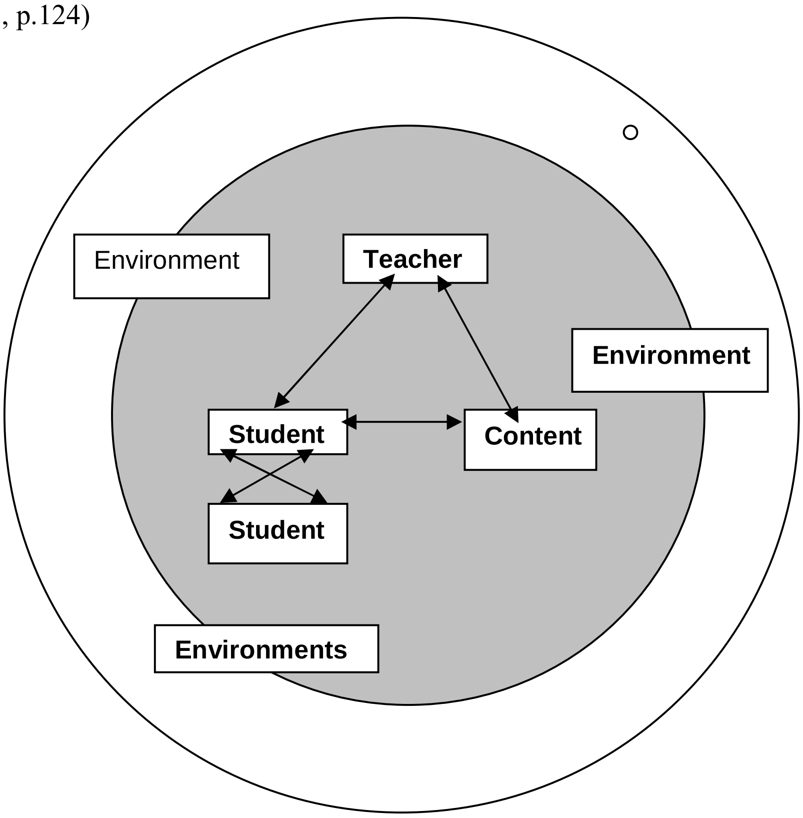


Figure 2.1 depicts the Cohen Instructional Interaction Model. In the Cohen model interaction refers to the connected work of teachers and students on content, in environments where schools become learning environments for teachers and leaders as well as students. In this model instruction is not the sole creation of teachers, or students, or content, but the product of their interactions. The teachers with their knowledge and

skills and the students with their knowledge and experiences define the instructional capacity or instructional resources made available to support students, teachers, and content as they interact (Cohen et al., 2003). Elmore (2004) envisions capacity as the degree of successful interaction of students and teachers around content (p. 118). Elmore adds that capacity is enhanced by:

> There is no way to enhance capacity… than by deliberately investing in the knowledge and skills of teachers and students to do work of learning. This means literally using the school and instructional structure that surrounds it as a mechanism to deliver resources and support to teachers and students to enhance their learning. (Elmore, 2004, p. 222)

STUDENT-CENTERED LEARNING ENVIRONMENTS

The initial approaches of integrating technology into traditional teacher-centered learning environments resulted in little gains in student achievement (Means et al., 1993). That failure to realize meaningful results using technology was due in part to the prevailing teacher-centered learning environments, which were in place in the nation's schools. In comparison to traditional didactic or teacher-centered classrooms, constructivist or student-centered strategies were proven to be better suited to realizing the potential of computer-based educational technology (Ringstaff & Kelly 2002). In the early 1990s, educators and psychologists, as well as groups such as the National Council for Teachers of Mathematics and the National Science Teachers Association, suggested a move toward more constructivist learning strategies, which called for:

- Teaching basic skills within authentic contexts
- Modeling expert thought processes, and
- Providing for collaboration and external supports to permit students to achieve intellectual accomplishments they could not do on their own (Means et al., 1993, p. 2).

Research reveals that students that acquire more advanced uses of technology do so in a constructivist learning environment in which the teacher is a facilitator of learning rather than the classroom's only source of knowledge (Trilling & Hood, 1999; Means, 1999). In numerous studies of student learning with technology, teachers have reported that technology encourages them to be more student-centered, more open to multiple perspectives on problems, and more willing to experiment in their teaching (Knapp & Glenn, 1996).

In technology-rich classrooms, students become more engaged and more active learners, and there is typically a greater emphasis on inquiry and less on drill and practice (Sandholtz et al., 1997). Technology also encourages student collaboration, project-based learning, and higher-order thinking (Penuel et al., 2000). According to Means and her colleagues, "Technology supports exactly the kinds of changes in content, roles, organizational climate, and affect that are at the heart" of constructivist educational reform movements (1993, p. 1). (See Table 2.1 for a comparison of traditional and constructivist learning environments).

Table 2.1: Contrasting views of traditional and constructivist learning environments Ringstaff and Kelly (2002).

	Traditional	Constructivist
Classroom activity	teacher-centered	learner-centered
	didactic	interactive
Teacher role	fact teller	collaborative
	always expert	sometimes learner
Student role	listener	collaborator
	always learner	sometimes expert
Instructional emphasis	facts	relationships
	memorization	inquiry and investigation
Concept of knowledge	accumulation of facts	transformation of facts
Demonstration of success	quantity	quality of understanding
Assessment	norm-referenced	criterion-referenced
		portfolios and performances
Technology use	drill and practice	communication, collaboration, information access, expression

Consistent with this trend, moving from teacher-centered to student-centered learning, the Texas School Technology and Readiness survey (T-STaR) captures Texas schools' progression through the stages of technology adoption. According to the Long Range Plan for Technology schools are to transition through four distinct phases of technology readiness: 1) early tech, 2) developing tech, 3) advanced tech, and 4) target tech (TEA, 1988, 1996, 2000, 2006). The four T-STaR levels reflect distinct stages in Texas schools' movement from traditional to constructivist technology environments.

Early Tech classrooms are *teacher-centric* environments where educators use digital content to supplement traditional teaching (CEO, 2001; TEA, 2006). Early Tech teachers are proficient in no more than one of the SBEC Technology Applications Standards, and they attend less than nine hours of technology professional development each year. Most importantly, less than 50% of the Early Tech students had mastered the TA TEKS.

Developing Tech classrooms are *teacher-directed* environments where teachers are beginning to integrate technology into the curriculum. Within these classrooms teachers use technology in three significant ways: 1) to present information to students, 2) to model teacher directed activities, 3) and to complete administrative functions (CEO, 2001; TEA, 2006). In Developing Tech classroom up to 50% of the students have mastered TA TEKS. Additionally Developing Tech teachers are proficient in two or three of the SBEC Technology Applications Standards, and they attend 9-18 hours of technology professional development each year.

Advanced Tech classrooms are ***teacher-facilitated*** places where technology is fully integrated into instruction and used for research, planning, multimedia presentation, simulation, and to correspond and communicate (CEO, 2001; TEA, 2006). Advanced Tech teachers routinely structure classroom learning to student experiences based on inquiry and higher level thinking processes.

In Advanced Tech classrooms technology is readily available for students to choose the best tools to analyze and synthesize data to make informed decisions, communicate knowledge and understanding of content, and share results with peers and others outside the classroom. Advanced Tech teachers receive professional development on how to integrate technology and Technology Applications TEKS into student instruction.

Advanced Tech teachers estimate that up to 85% of students meet the TA TEKS. Also Advanced Tech teachers are proficient in four of the SBEC Technology Applications Standards and they attend 19-29 hours of technology professional development annually. Advanced Tech teachers no longer think about technology separately but use combinations of technologies and instructional methods to improve student outcomes. Another major distinction of Advanced Tech teachers is that they have learned how to teach online.

Target Tech classrooms are *student-centered* environments where students along with teachers, businesses, higher education, and the community work to solve real-world problems. Target Tech teachers and students experience 24/7 access to technology and digital content within the campus, district, home, or community. Target Tech teachers and students also work within collaborative learning communities with students engaged in project-based learning. By the teachers' estimates 86% to 100% of the students have mastered TA TEKS. Target Tech teachers experience professional development based on personal needs and share their experiences and expertise within learning communities. Target Tech teachers are proficient in all five of the SBEC Technology Applications

Standards and they attend 30 or more hours of technology professional development annually. Finally, Target Tech teachers create and teach in online learning environments.

SBEC Technology Applications Standards

The Long-Range Plan for Technology 2006-2020 sets as a goal that all educators who graduate from an educator preparation program know how to use technology effectively in the teaching-learning process as demonstrated by the SBEC Technology Applications Standards:

Standard I. All teachers use technology-related terms, concepts, data input strategies and ethical practices to make informed decisions about current technologies and their applications.

Standard II. All teachers identify task requirements, apply search strategies and use current technology to efficiently acquire, analyze, and evaluate a variety of electronic information.

Standard III. All teachers use task-appropriate tools to synthesize knowledge, create and modify solutions and evaluate results in a way that supports the work of individuals and groups in problem-solving situations.

Standard IV. All teachers communicate information in different formats and for diverse audiences.

Standard V. All teachers know how to plan, organize, deliver and evaluate instruction for all students that incorporates the effective use of current technology for teaching and integrating the Technology Applications Texas Essential Knowledge and Skills (TEKS) into the curriculum. (SBEC, 2003)

These highly qualified technology applications educators are to develop new learning environments that utilize technology as a flexible tool where learning is collaborative, interactive, and customized for the individual learner and ensure full integration of appropriate technology throughout all curriculum and instruction.

In concert with technology literate teachers, school leadership is expected to create the vision and expectations for using technology to transform Texas schools. The Leadership, Administration, and Instructional Support focus of the Texas Long-Range Plan for Technology challenges all leaders to develop, implement, budget for and monitor a dynamic technology plan that aligns resources to improve student learning and support school operations. Leaders are tasked with creating innovative, flexible, and responsive environments to maximize teaching and learning and community involvement. (TEA, 2006a, 2006b).

It is expected that the new technology capable leadership (Waters, 2003) would offer expanded curricular and instructional opportunities to students via online, digital technology, and a variety of distance learning technologies. Texas' vision for school leadership reflects the National Education Technology Plan (2004) as it attempts to:

a) Invest in leadership development programs to develop a new generation of tech-savvy leaders at every level.
b) Retool administrator education programs to provide training in technology decision-making and organizational change.
c) Develop partnerships between schools, higher education, and the community.
d) Encourage creative technology partnerships with the business community.
e) Empower students' participation in the planning process (NEPT, 2004).

Additionally, the new school technology leaders are expected to provide opportunities for sustained, relevant, and timely staff development in a variety of formats and plan appropriate technology use throughout the teaching and learning process as well as throughout administration. Finally, they are expected to use data effectively and appropriately in decision making.

Another element of the Long-Range Plan for Technology is Infrastructure. The purpose is to ensure a system that may provide equitable access to all e-learning technologies through ubiquitous broadband resources 24/7 for all users. The infrastructure would deliver just-in-time technical assistance to support Teaching and Learning. Quality measures would be enforced to assure all data was secure and accurate, and best practice data standards would be followed to support interoperability and accessibility for all users (Marzano, 2005).

Summary

The review of literature suggests that integrating technology into classrooms is an organizational change process. At the heart of the effort are technology-qualified educators, both teachers and leaders. Although the state of Texas proscribes SBEC technology standards for teachers and leaders to ensure baseline technology competence for educators, it is the degree by which teachers perceive themselves as capable users of technology for teaching and learning that ultimately determines whether individual classrooms function at Early-Tech or Target-Tech levels of technology integration.

In addition capable leadership that perceives teachers proficient enough to transform their classrooms support the change process by removing barriers, improving the conditions for learning by providing adequate professional development for teachers, and improving the technology infrastructure and support.

Also, the literature supports the need for leaders to provide effective educator professional development that produces the type of changes in teacher instructional practices that result in greater student achievement.

The state of Texas has implemented the T-STaR and the educational progress monitoring tool. The self-assessment data reflects teachers and campus leaders' perceptions as they progress individually and collectively through the stages of technology adoption. The journey from Early-Tech (teacher-centered) to Target-Tech (learner-centered) environments encompasses all of the four focus areas of the Texas Long-Range Plan for Technology: 1) Teaching and Learning; 2) Educator Preparation and Development; 3) Administration and Support Services; and 4) Infrastructure for Technology. The literature made the case for examining the person-organization congruence of teachers and principals as they perceive their school' technology and readiness. Chapter 3 explains the methods for collecting and analyzing the T-STaR data.

.

CHAPTER THREE: METHODOLOGY

This chapter describes the participants, the setting, and the data that were used in the study. The primary purpose of this study is to determine what factors influence the integration of educational technology as perceived by Texas teachers. The secondary purpose is to examine the relationships between the determinant factors. The research questions are:

1. Are there significant differences in teachers' perception of school technology readiness across grade level and subject area?
2. Are there significant differences in teacher-principal technology readiness congruence across school percentage of economically disadvantaged students?
3. How do teachers' perceived levels of technology readiness predict student mastery of Technology Applications (TA) TEKS?

The Participants

Since the 2005-2006 school year the state of Texas has collected T-STaR data in order to assess the level of technology integration and readiness occurring in the state's school system. This self-report data has produced an invaluable database of teachers and principals perceptions regarding the level of technology integration within their classrooms and throughout their schools.

The Texas Education Agency's Division of Educational Technology maintains the datasets. Participation in T-STaR is mandatory for all Texas schools. Therefore the study participants will be all K-12 teachers (n=185000) and technology leaders, that is the principals, from each campus (n=7500) throughout the state of Texas.

The Instrument

Once each year, Texas teachers complete the online survey and principals, as technology leaders, use the profile annually to gauge their progress in integrating technology into their schools. Campus and district summary data reported to school boards, community groups, and technology planning committees to confirm the schools' alignment with state and local goals, and statewide summary data is reported to state and federal policymakers.

The original Texas School Technology and Readiness (T-STaR) Chart was developed by the CEO Forum on Education and Technology to assess school readiness in using technology (CEO, 2000). Founded in 1996 the CEO Forum was a five-year partnership between business and education leaders.

Guided by the principle of equitable access to technology and highly trained educators equipped to use technology to achieve high academic standards, the CEO Forum was committed to assessing and monitoring progress toward integrating technology in the nation's schools. Based on the CEO Forum's STaR, the Texas School Technology and Readiness (T-STaR) Chart was designed to help campuses and districts determine their progress toward meeting the goals of the *Long-Range Plan for Technology 1996-2010*, and to measure the impact of federal, state, and local efforts to improve student learning through the use of technology.

The T-STaR Chart has been developed around the four key areas of the Long-Range Plan for Technology, 2006-2020: Teaching and Learning; Educator Preparation and Development; Leadership, Administration, and Instructional Support; and Infrastructure for Technology. The T-STaR Chart is designed to help teachers, campuses, and districts determine their progress toward meeting the goals of the Long-Range Plan for Technology, as well as meeting the goals of their district (TEA, 1988, 1996, 2000, 2006).

The T-STaR Chart measures the impact of state and local efforts to improve student learning through the use of technology as specified in No Child Left Behind, Title II, Part D. It also can identify needs for on-going professional development and raise awareness of research-based instructional goals (TEA, 1988, 1996, 2000, 2006).

The T-STaR Chart is used to help teachers answer the following critical questions:

1) What is my current educational technology profile in the areas of Teaching and Learning and Educator Preparation and Development?
2) What is my knowledge of online learning, technology resources, instructional support, and planning on my campus?

3) What evidence can be provided to demonstrate my progress in meeting the goals of the Long Range Plan for Technology and No Child Left Behind, Title II, Part D?
4) In what areas can I improve my level of technology integration to ensure the best possible teaching and learning for my students?
5) What are the technology standards required of all beginning teachers and recommended for all current Texas teachers? (TEA, 1988, 1996, 2000, 2006).

In addition to assisting teachers in assessing their personal development the T-STaR Chart assists technology leaders in:

- Determining professional development needs based on a current educational technology profile.
- Providing data that feeds into the T-STaR Chart so that more accurate school information is gained and documented.
- Determining funding priorities based on teacher and classroom needs.
- Providing data that can support the need for grants or other resources.
- Helping conceptualize the campus or district vision of technology.
- Assisting campuses in documenting the use of No Child Left Behind, Title II, Part D formula, and discretionary funds (TEA, 1988, 1996, 2000, 2006).

The Texas School Technology and Readiness survey (T-STaR) captures Texas schools' progression through the stages of technology adoption. According to the Long Range Plan for Technology schools are to transition through four distinct phases of technology readiness: 1) early tech, 2) developing tech, 3) advanced tech, and 4) target tech (TEA, 1988, 1996, 2000, 2006).

Data Acquisition

Data will be acquired from the Texas Education Agency (TEA) T-STaR database. Since 2004 data has been collected through the Texas STaR Chart system.

Figure 3.1: T-STaR Submission Process

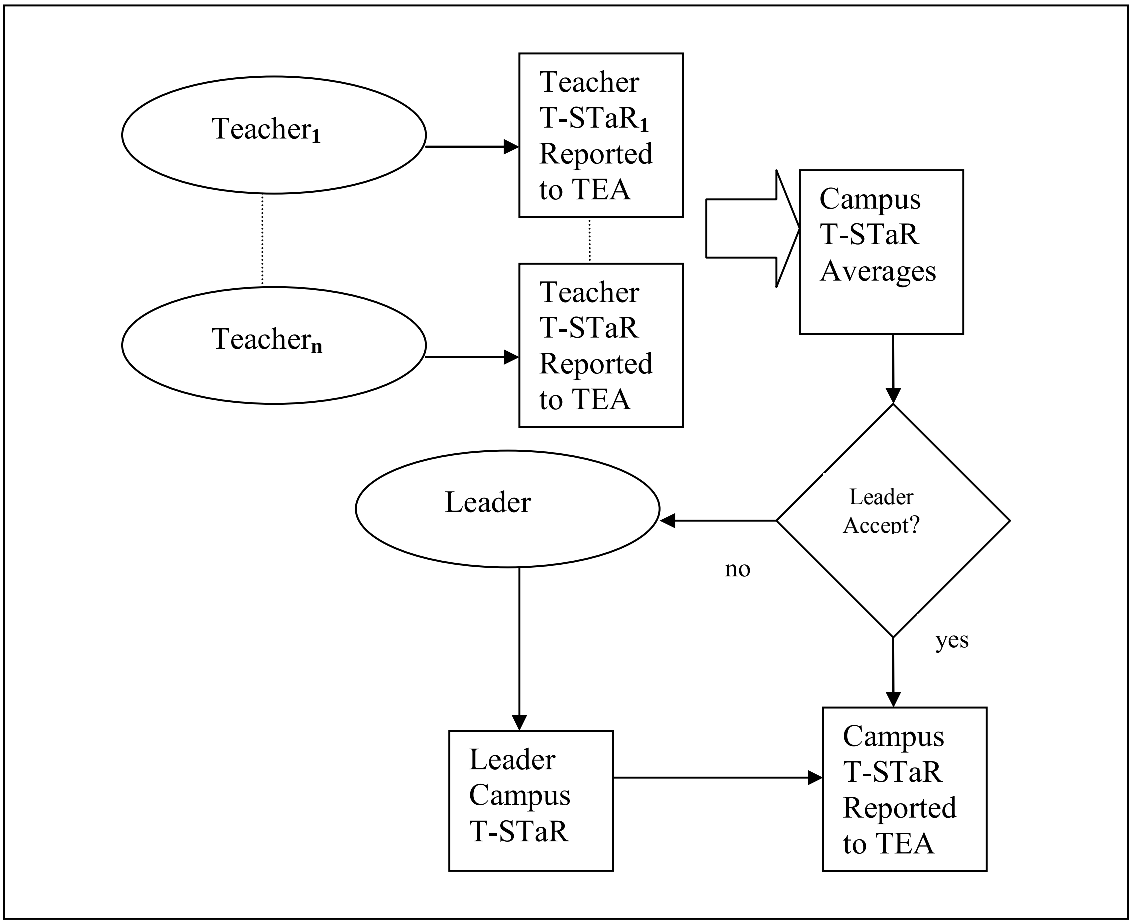


Figure 3.1 depicts the T-STaR submission process. The online survey system collects the technology readiness assessments from teachers and principals. The Teacher

STaR Chart was voluntary when it was first introduced at the end of the 2004-2005 school year. Over 172,039 teachers completed the original assessments. Beginning with the 2006-2007 school year all Texas teacher were required to complete the Texas Teacher STaR Chart annually.

The campus principal, as technology leader, is responsible for completing the Campus STaR Charts. While the system allows the principal to view the "Campus Average for Teacher STaR Chart", it does provide the principal with access to the scores of individual teachers. The principal, as the designated campus technology leader, either 1) accepts the teachers' averages for each of the twenty-four T-STaR items or 2) overrides the teachers' averages for any of the twenty-four T-STaR items. From each Texas school campus T-STaR collects assessments from each teacher and principal. The campus averages are then grouped by district.

The twenty-four T-STaR items are equally divided into four groups of six data elements which correspond to the four focus areas of the *Long Range Plan for Technology* which are 1) teaching and learning, 2) educator preparation and development, 3) leadership, administration, and instructional support, 4) and infrastructure.

The first six T-STaR indicators captures teachers self-perceptions of *teaching and learning* and are used to track the patterns of classroom use of educational technology (tl1); frequency and design of instructional settings using digital content (tl2); content area connections (tl3); technology applications (TA) TEKS implementation (TAC Chapter 126) (tl4); student mastery of technology applications (TA) TEKS (tl5); and online learning (tl6).

The next six items track educator preparation and development and are used to measure professional development experiences (ep1); models of professional development (ep2); capabilities of educators (ep3); technology professional development participation (ep4); levels of understanding and patterns of use (ep5); and capabilities of educators with online learning (ep6).

The next six T-STaR items record teacher self-ratings for leadership, administration, and instructional support and are used to measure leadership and vision (l1); planning (l2); instructional support (l3); communication and collaboration (l4); budget (l5); and leadership and support for online learning (l6).

The last six T-STaR items rate the campus infrastructure and are used to measure students per classroom computers (inf1); Internet access connectivity speed (inf2); classroom technology (inf3); technical support (inf4); local area network wide area network (inf5); and distance learning capacity (inf6).

Data Analysis

The Texas School Technology and Readiness survey (T-STaR) annually captures Texas schools' progression through the stages of technology adoption. Data was acquired from the Texas Education Agency (TEA) T-STaR database for the 2008-2009 academic year. The T-STaR consisted of twenty-four items equally divided into four groups of six data elements corresponding to the four focus areas of the Texas Long Range Plan for Technology which are 1) teaching and learning, 2) educator preparation and development, 3) leadership, administration, and instructional support, 4) and infrastructure.

RESEARCH QUESTION 1

> Are there significant differences in teacher perceptions of school technology and readiness across grade level and subject area?

To answer the first research question a one-way analysis of variance (ANOVA) was performed in SPSS to test for group differences for the variables teacher grade level and subject area, on the four focus area composite subscale scores:

- Teaching and Learning subscale score
- Educator Preparation and Development subscale score
- Infrastructure for Technology subscale score
- Leadership, Administration, and Instructional Support subscale score

Composite scale scores were computed for each of the four focus areas. Higher scores indicated greater level of teacher school technology and readiness. Internal consistency for each of the scales was examined using Cronbach's alpha. Overall reliability refers to the consistency in scores over repeated administrations of the test (Pagano, 1994). Reliability can also be measured within each of the individual subscales. The current overall and individual subscale reliability statistics are listed in Table 3.1. This table includes pilot questions in the final calculation. Table 3.1 is the reliability alphas for the subscales. Cronbach's Alpha is considered acceptable at values of .70 or greater (Reynaldo & Santos, 1999). While this is a well-documented acceptability threshold, ideally overall test reliability will remain above .80.

The alphas were moderately high—.81 for Teaching and Learning (6 items), .86 for Development (6 items), .90 for Leadership, (6 items), and .78 for Infrastructure (6 items). No substantial increases in alpha for any of the scales were achieved by eliminating more items.

Table 3.1: T-STaR Subscale Reliability Analysis

Subscale	# of Items	Reliability Alpha
Overall	22	.82
Teaching and Learning	6	.81
Educator Preparation and Development	6	.86
Leadership Administration and Instructional Support	6	.90
Infrastructure for Technology	6	.78

T-STaR Teaching and Learning Variables

The first six T-STaR items capture teachers' perceptions of teaching and learning and are used to track: patterns of classroom use of educational technology (tl1); frequency and design of instructional settings using digital content (tl2); content area connections (tl3); technology applications (TA) TEKS implementation (TAC Chapter 126) (tl4);student mastery of technology applications (TA) TEKS (tl5); and online learning (tl6);

Table 3.2: Teaching and Learning Item Frequencies

Item	Early	Developing	Advanced	Target	Mean	S.D.	N
tl1	21.1%	44.3%	31.1%	3.2%	2.17	0.790	185082
tl2	17.1%	36.3%	36.7%	10.0%	2.40	0.883	185082
tl3	6.2%	41.7%	45.7%	6.4%	2.52	0.709	185082
tl4	17.8%	47.3%	29.5%	5.4%	2.22	0.799	185082
tl5	30.3%	39.7%	23.6%	6.3%	2.06	0.889	185082
tl6	43.6%	40.3%	12.1%	4.0%	1.77	0.813	185082

Cronbach's Alpha=0.885
Early (1);
Developing (2);
Advanced (3);
Target (4 points);
The mean is out of 4 points;
S.D. - Standard Deviation;
N - Number of respondents

T-STaR Educator Preparation and Development Variables

The next six items track educator preparation and development and are used to measure professional development experiences (ep1); models of professional development (ep2); capabilities of educators (ep3); technology professional development participation (ep4); levels of understanding and patterns of use (ep5); and capabilities of educators with online learning (ep6).

Table 3.3: Educator Preparation and Development Item Frequencies

Item	Early	Developing	Advanced	Target	Mean	S.D.	N
ep1	18.9%	42.0%	32.9%	6.1%	2.26	0.833	185082
ep2	24.0%	45.8%	24.2%	6.0%	2.12	0.841	185082
ep3	28.3%	42.5%	19.4%	9.8%	2.11	0.926	185082
ep4	46.0%	40.1%	10.0%	3.8%	1.72	0.796	185082
ep5	13.4%	39.5%	39.5%	7.6%	2.41	0.814	185082
ep6	48.7%	40.3%	7.4%	3.6%	1.66	0.766	185082

Cronbach's Alpha=0.885
Early (1);
Developing (2);
Advanced (3);
Target (4 points);
The mean is out of 4 points;
S.D. - Standard Deviation;
N - Number of respondents

T-STaR Leadership, Administration, and Instructional Support Variables

The next six T-STaR items record teacher self-ratings for leadership, administration, and instructional support and are used to measure leadership and vision (l1); planning (l2); instructional support (l3); communication and collaboration (l4); budget (l5); and leadership and support for online learning (l6).

Table 3.4: Leadership, Administration, and Instructional Support Item Frequencies

Item	Early	Developing	Advanced	Target	Mean	S.D.	N
l1	15.2%	37.1%	29.8%	17.9%	2.50	0.955	185082
l2	10.1%	48.7%	27.5%	13.8%	2.45	0.851	185082
l3	16.2%	48.4%	24.0%	11.4%	2.31	0.874	185082
l4	5.2%	30.7%	40.1%	24.0%	2.83	0.852	185082
l5	18.5%	40.5%	28.3%	12.6%	2.35	0.922	185082
l6	8.8%	38.6%	35.4%	17.1%	2.61	0.870	185082

Cronbach's Alpha=0.902
Early (1);
Developing (2);
Advanced (3);
Target (4 points);
The mean is out of 4 points;
S.D. - Standard Deviation;
N - Number of respondents

T-STaR Infrastructure Variables

The last six T-STaR items rate the campus infrastructure are used to measure students per classroom computers (inf1); Internet access connectivity speed (inf2); classroom technology (inf3); technical support (inf4);: local area network wide area network (inf5); and distance learning capacity (inf6).

Table 3.5: Infrastructure Item Frequencies

Item	Early	Developing	Advanced	Target	Mean	S.D.	N
inf1	31.8%	53.9%	8.8%	5.5%	1.88	0.782	185082
inf2	1.9%	8.4%	44.6%	45.1%	3.33	0.709	185082
inf3	30.3%	34.5%	24.5%	10.8%	2.16	0.977	185082
inf4	22.2%	32.9%	21.1%	23.9%	2.47	1.082	185082
inf5	19.2%	26.2%	34.7%	19.9%	2.55	1.015	185082
inf6	28.1%	37.5%	23.2%	11.2%	2.17	0.964	185082

Cronbach's Alpha=0.778
Early (1);
Developing (2);
Advanced (3);
Target (4 points);
The mean is out of 4 points;
S.D. - Standard Deviation;
N - Number of respondents

RESEARCH QUESTION 2:

> Are there significant differences in teacher-principal technology readiness congruence across school percentage of economically disadvantaged students?

To answer the second research question one-way analysis of variance (ANOVA) was performed in SPSS, to test for group differences for the variable school percentage of economically disadvantaged students on teacher-principal school technology and readiness perceptual congruence:

Teacher-principal technology readiness perception congruence was calculated for each of the twenty-four T-STaR items using the McCrae Coefficient of Profile Agreement (McCrae, 1993, 2008), a coefficient of pattern similarity for cross-observer agreement—R_{pa}; that is, a coefficient of agreement between two or more observers of the same phenomena or person.

Accordingly, McCrae (1993, 2008) proposed

$$r_{pa} = \frac{I_{pa}}{\sqrt{(m-2) + I_{pa}^{2}}}$$

, where:

$$I_{pa} = \frac{m + 2\sum M^2 - \sum d^2}{\sqrt{10m}}$$

, where a profile of m elements is considered, the sum will have a mean of -m and a variance of 10m, M is the mean of two ratings for each profile element, and d, as in rp, is the difference between standardized ratings. McCrae (1993, 2008) called I_{pa} the index of profile agreement and R_{pa} the coefficient of profile agreement. McCrae (1993, 2008) claims that R_{pa} has approximately the same statistical significance of the Pearson correlation coefficient based on the same number of cases. McCrae (1993, 2008): conducted an empirical study to compare R_{pa} with other indices of profile similarity, in this case raw distance, Euclidean distance, and vector distance. R_{pa} was consistent across the empirical test and tended to be intermediate in value among the other distance measures. An R_{pa} value was computed on each teacher principal dyad across the four T-STaR focus areas.

RESEARCH QUESTION 3:

How do teachers' perceived levels of technology readiness predict student mastery of Technology Applications (TA) TEKS?

To answer the third research question the T-STaR data was analyzed using path analysis to provide estimates of the magnitude and significance of hypothesized causal connections between sets of variables.

Path analysis is an extension of the regression model, used to test the fit of the correlation matrix against two or more causal models, which are being compared by the researcher. The model is usually depicted in a circle-and-arrow figure in which single arrows indicate causation. A regression is done for each variable in the model as a dependent on others, which the model indicates, are causes. The regression weights predicted by the model are compared with the observed correlation matrix for the variables, and a goodness-of-fit statistic is calculated. The researcher selects the best fitting of two or more models as the best model for advancement of theory.

Figure 3.2: T-STaR Focus Areas Effects Model

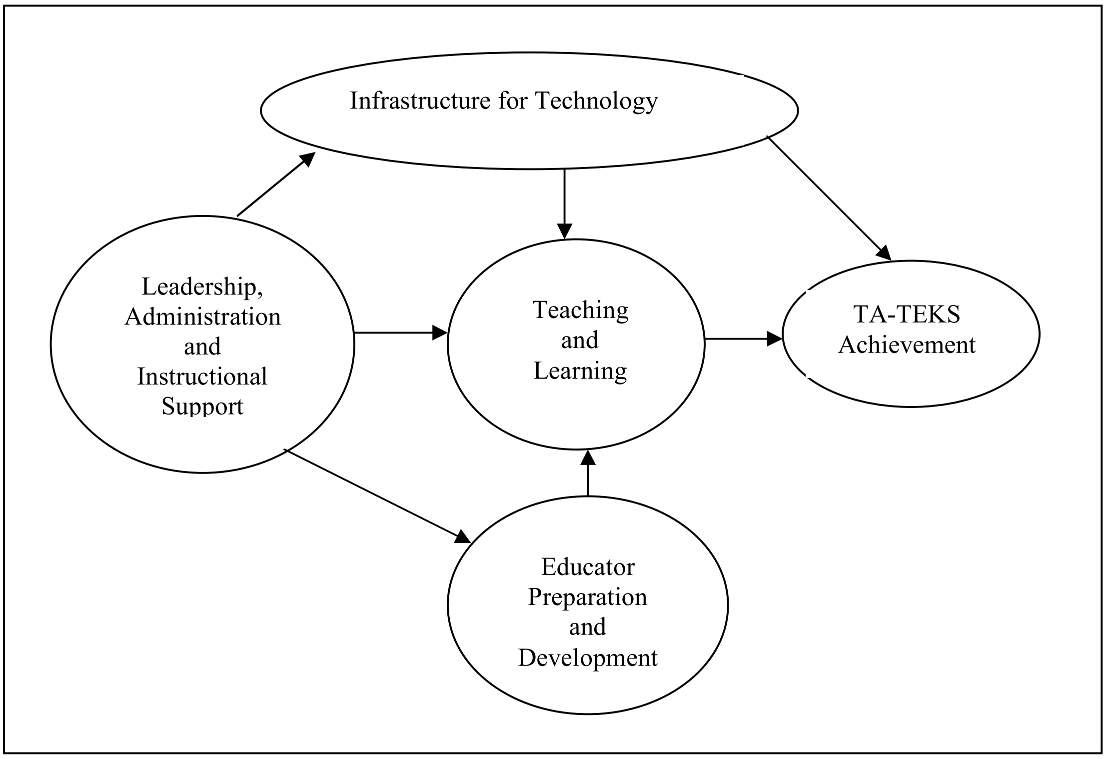


Figure 3.2 depicts the theoretical effects of the four T-STaR focus areas on student TA-TEKS achievement. The model predicts that Leadership, Administration, and Instructional Support, will have direct effects on Teaching and Learning, Educator Preparation and Development, and Infrastructure, which in turn will indirectly effect Student Achievement. The teacher self-report data is from a statewide assessment of campuses that received Technology Allotment funds during the school year.

Prior research has confirmed that professional development, leadership, and infrastructure lead to changed teacher behavior, which resultantly impact student achievement. Such research is usually called process-product (or process-outcome) research (Brophy, 1986, Brophy & Good, 1986). The process-product paradigm has been utilized over the past 50 years in studies that reported causal relationships between teacher behaviors and student achievement (Brophy & Good, 1986). The hypothesized structural model of the effects of the four T-STaR focus areas on student technology applications achievement will be used to:

1) Determine whether the relationships hypothesized are supported by the T-STaR data, and
2) Develop estimates of the strength of these relationships.

Path Analysis

Path analysis is a subset of Structural Equation Modeling (SEM) dealing with measured and latent variables. A measured variable is a variable that can be observed directly and is measurable. A latent variable is a variable that cannot be observed directly and must be inferred from measured variables. Latent variables are implied by the covariances among two or more measured variables. They are also known as factors, constructs, or unobserved variables. SEM is a combination of multiple regression and factor analysis. Path analysis deals only with measured variables (Ullman, 1996).

The goal in building a path diagram or other structural equation model is to find a model that fits the data well enough to serve as a useful representation of an explanation of the data. There are five steps involved in SEM construction:

1) Model Specification
2) Model Identification
3) Model Estimation
4) Testing Model Fit
5) Model Manipulation

The Model Specification is the process of formally stating a model. It is the step in which parameters are determined to be fixed or free. The choice of which parameters are free and which are fixed in a model is up to the researcher. This choice represents the researcher's a priori hypothesis about which pathways in a system are important in the generation of the observed system's relational structure (Ullman, 1996).

Model Identification determines whether a unique value for every free parameter can be obtained from the observed data. It depends on the model choice and the specification of parameters. Models are identified in order to test the hypotheses about relationships among variables.

Model Estimation involves choosing free parameters by the researcher from prior information, by computer programs used to build SEMs, or from multiple regression analysis. The goal of estimation is to produce a $\Sigma(\theta)$ that converges upon 1) the observed population covariance matrix, S, 2) and with the residual matrix (the difference between

$\Sigma(\theta)$ and S) being minimized. Two commonly used estimation methods are Generalized Least Squares (GLS) and Likelihood (ML) (Ullman 1996).

Testing Model Fit is determining the confidence in the goodness of fit. A model with good fit processes a fitting function value of close to 0 where the ratio between X^2 and degrees of freedom is less than two, (Ullman 1996). To achieve confidence in the goodness of fit test, a sample size of 100 to 200 is recommended. In general a model should contain 10 to 20 times as many observations as variables. An accepted good fit is usually a number between 0 and 1, with 0.90 or greater.

Model Manipulation is used whenever the results estimated by the model does not match the sample data. At that point the hypotheses are adjusted and the model retested. To adjust a model, new pathways are added or original ones are removed. The common procedures used for model modification are the Lagrange Multiplier Index (LM) and the Wald test. The LM determines whether addition of free parameters increases model fitness and uses forward stepwise regression. The Wald Test determines whether deletion of free parameters increases model fitness using backward stepwise regression (Ullman 1996).

Limitations and Advantages of Path Analysis

Path analysis cannot test directionality in relationships. The directions of arrows in the model represent the researcher's hypotheses of causality within a system. The researcher's choice of variables and paths limits the technique's ability to explain the observed covariance and variance patterns. In fact, there may be several models that fit the data equally well. Despite this limitation researchers have successfully used the SEM approach in understanding relational data in multivariate systems. SEM will be used in the study for its abilities to distinguish between indirect and direct relationships between variables and to analyze relationships between latent variables without random error (Ullman 1996). This capability differentiates SEM from other simpler, relational modeling processes.

T-STaR Key Indicators

The T-STaR is comprised of twenty-four indicators, which are used to measure campus and teacher progress toward target level technology integration in the classroom. The study will use 24 variables, which correspond to the twenty-four indicators that are equally divided among the four focus areas of the *Long Range Plan for Technology*, (TEA, 2006):

The four focus area composite scale scores variables were analyzed using the Mplus statistical package that allows researchers to conduct path analysis. Mplus analyzes both cross-sectional and longitudinal data, single-level and multilevel data, and data that come from different populations (Muthen & Muthen, 1998). Mplus provides complete analyses for observed variables which are continuous, censored, binary, ordinal, nominal, or combinations of these variable types. Mplus also has special features for missing data, complex sample data, and multilevel data (Muthen & Muthen, 1998).

Limitations

The following limitations were presented in this study. Generalizations of this study were based on the sample of respondents, which was limited to the T-STaR survey of Texas principals and teachers during the 2008-2009 school year. T-STaR data are self reported. Therefore the responses represent the perceptions of principals and teachers.

Summary

Procedures in Chapter Three described the design and methods for collecting and analyzing data regarding the School Technology and Readiness (T-STaR) perceptions for principals and teachers in Texas. The chapter included information about the population and sample, instruments used in the study, and procedures for collecting and analyzing the data. Additionally, the chapter ended with limitations for the study. Using the procedures detailed in this chapter, Chapter Four identifies the results of the study.

CHAPTER FOUR: RESULTS

This chapter describes the results from the data analyses which were conducted in the study. The primary purpose of this study is to determine what factors influence the integration of educational technology as perceived by Texas teachers. The secondary purpose is to examine the relationships between the determinant factors. The research questions are:

1. Are there significant differences in teachers' perception of school technology readiness across grade level and subject area?
2. Are there significant differences in teacher-principal technology readiness congruence across school percentage of economically disadvantaged students?
3. How do teachers' perceived levels of technology readiness predict student mastery of Technology Applications (TA) TEKS?

Research Question 1

Are there significant differences in teacher perceptions of school technology and readiness across school grade level and subject area?

H1: There are no differences between teacher technology readiness focus area composite scores across grade levels.

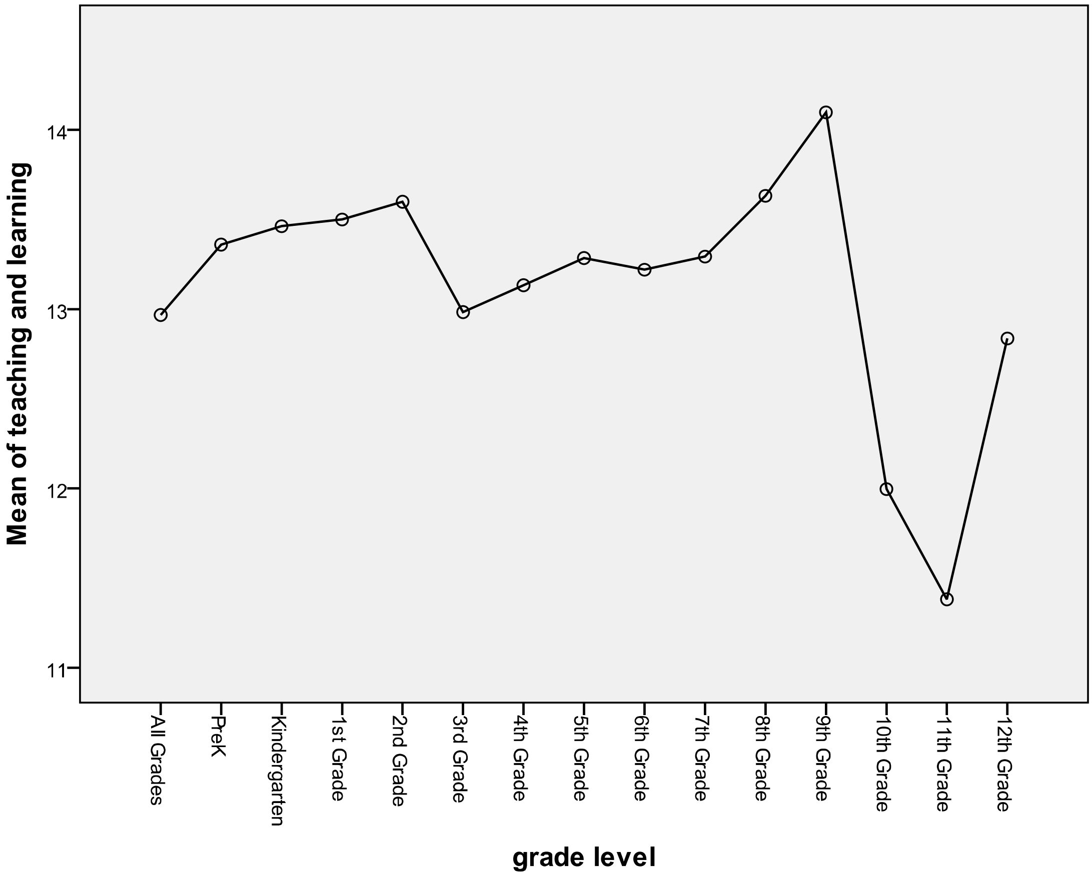
A one-way analysis of variance (ANOVA) was performed in SPSS to test for group differences for the variable teacher grade level on the four composite scale scores:

- Teaching and Learning subscale score
- Educator Preparation and Development subscale score
- Infrastructure for Technology subscale score
- Leadership, Administration, and Instructional Support subscale score

Table 4.1 Descriptive statistics for Teaching and Learning composite scores by school grade level

		N	Mean	Std. Deviation
teaching and learning	All Grades	1809	12.97	3.617
	PreK	1655	13.36	3.631
	Kindergarten	1772	13.46	3.695
	1st Grade	1722	13.50	3.436
	2nd Grade	1491	13.60	3.668
	3rd Grade	1403	12.98	3.642
	4th Grade	1404	13.13	3.661
	5th Grade	1301	13.29	3.739
	6th Grade	905	13.22	3.471
	7th Grade	662	13.29	3.532
	8th Grade	508	13.63	3.643
	9th Grade	276	14.10	3.837
	10th Grade	1231	12.00	4.084
	11th Grade	761	11.38	3.632
	12th Grade	1633	12.84	3.786
	Total	18533	13.10	3.708

Figure 4.1 Teaching and Learning composite score means by school grade level

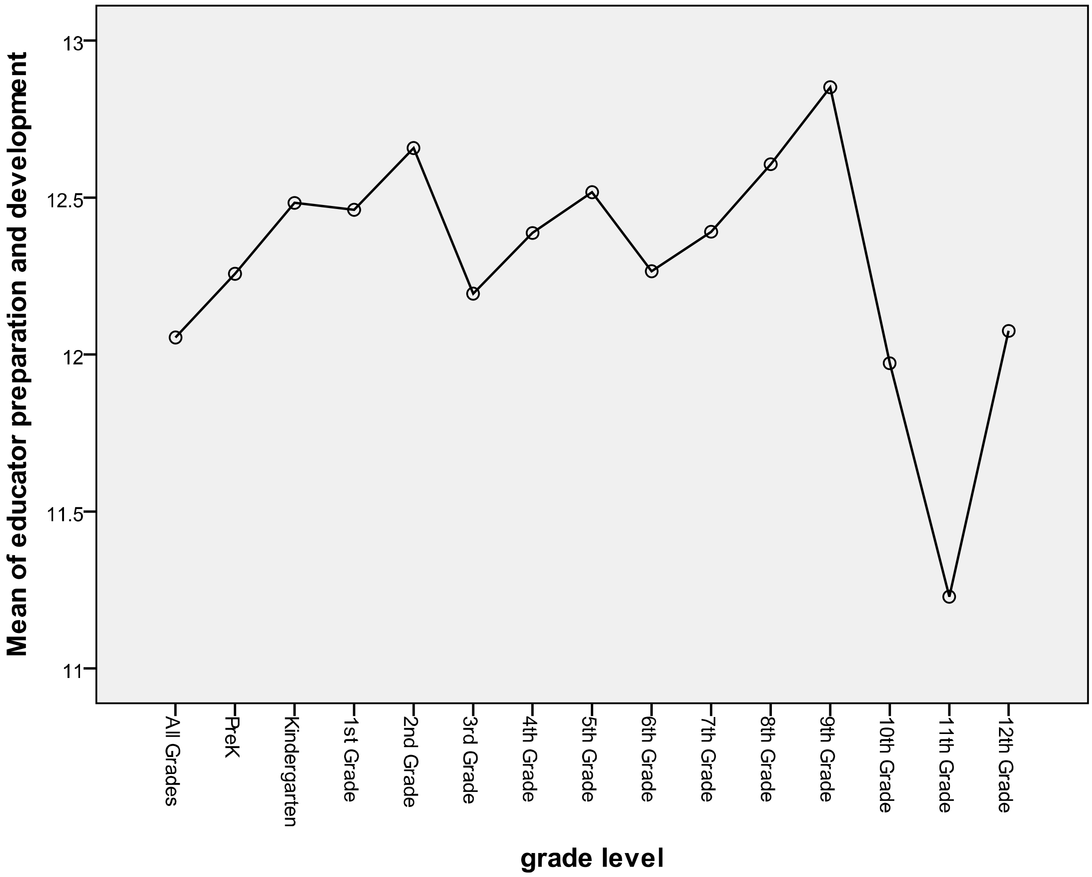


There were significant differences of school grade level on Teaching and Learning at the $p<.0001$ level for the grade levels [$F(14, 18532) = 386.224$, $p = 0.000$]. Post hoc comparisons using the Bonferonni test indicated that the mean score for the 9th grade teachers Teaching and Learning subscale scores (M=14.10, SD=3.87) were significantly higher than all other grades. The Teaching and Learning subscale scores for 10th grade teachers (M=11.78, SD=3.54), 11th grade teachers (M=11.38, SD=3.63) , and 12th grade teachers (M=12.84, SD=3.79) were significantly lower than all other grades.

Table 4.2 Descriptive statistics for Educator Preparation and Development composite scores by school grade level

		N	Mean	Std. Deviation
educator preparation and development	All Grades	1809	12.05	3.614
	PreK	1655	12.26	3.722
	Kindergarten	1772	12.48	3.810
	1st Grade	1722	12.46	3.599
	2nd Grade	1491	12.66	3.775
	3rd Grade	1403	12.19	3.710
	4th Grade	1404	12.39	3.840
	5th Grade	1301	12.52	3.833
	6th Grade	905	12.27	3.769
	7th Grade	662	12.39	3.584
	8th Grade	508	12.61	3.980
	9th Grade	276	12.85	4.048
	10th Grade	1231	11.97	4.030
	11th Grade	761	11.23	3.708
	12th Grade	1633	12.08	3.727
	Total	18533	12.28	3.771

Figure 4.2 Educator Preparation and Development composite score means by school grade level



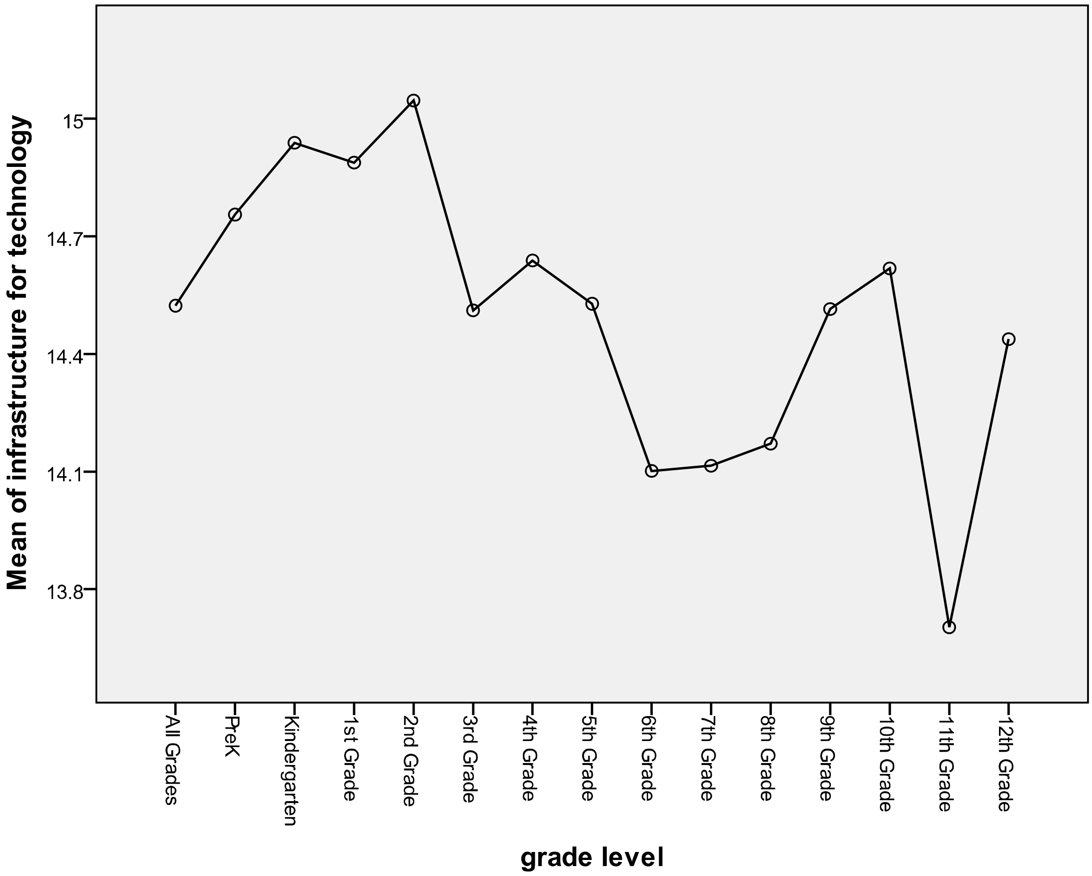
There were significant differences of school grade level on Educator Preparation and Development at the $p<.0001$ level for the grade levels [$F(14, 18532) = 122.441$, $p = 0.000$]. Post hoc comparisons using the Bonferonni test indicated that the mean Educator Preparation and Development score for the 9th grade teachers (M=12.85, SD=4.09) were significantly higher than all other grades. The Teaching and Learning subscale scores for

10th grade teachers (M=11.97, SD=4.03), 11th grade teachers (M=11.23, SD=3.71), and 12th grade teachers (M=12.08, SD=3.73) were significantly lower than all other grades.

Table 4.3 Descriptive statistics for Infrastructure for Technology composite scores by school grade level

		N	Mean	Std. Deviation
infrastructure for technology	All Grades	1809	14.52	3.715
	PreK	1655	14.76	3.758
	Kindergarten	1772	14.94	3.714
	1st Grade	1722	14.89	3.646
	2nd Grade	1491	15.05	3.736
	3rd Grade	1403	14.51	3.914
	4th Grade	1404	14.64	3.999
	5th Grade	1301	14.53	4.033
	6th Grade	905	14.10	3.797
	7th Grade	662	14.11	3.921
	8th Grade	508	14.17	3.701
	9th Grade	276	14.51	4.063
	10th Grade	1231	14.62	4.143
	11th Grade	761	13.70	3.840
	12th Grade	1633	14.44	3.957
	Total	18533	14.59	3.858

Figure 4.3 Infrastructure for Technology composite score means by school grade level



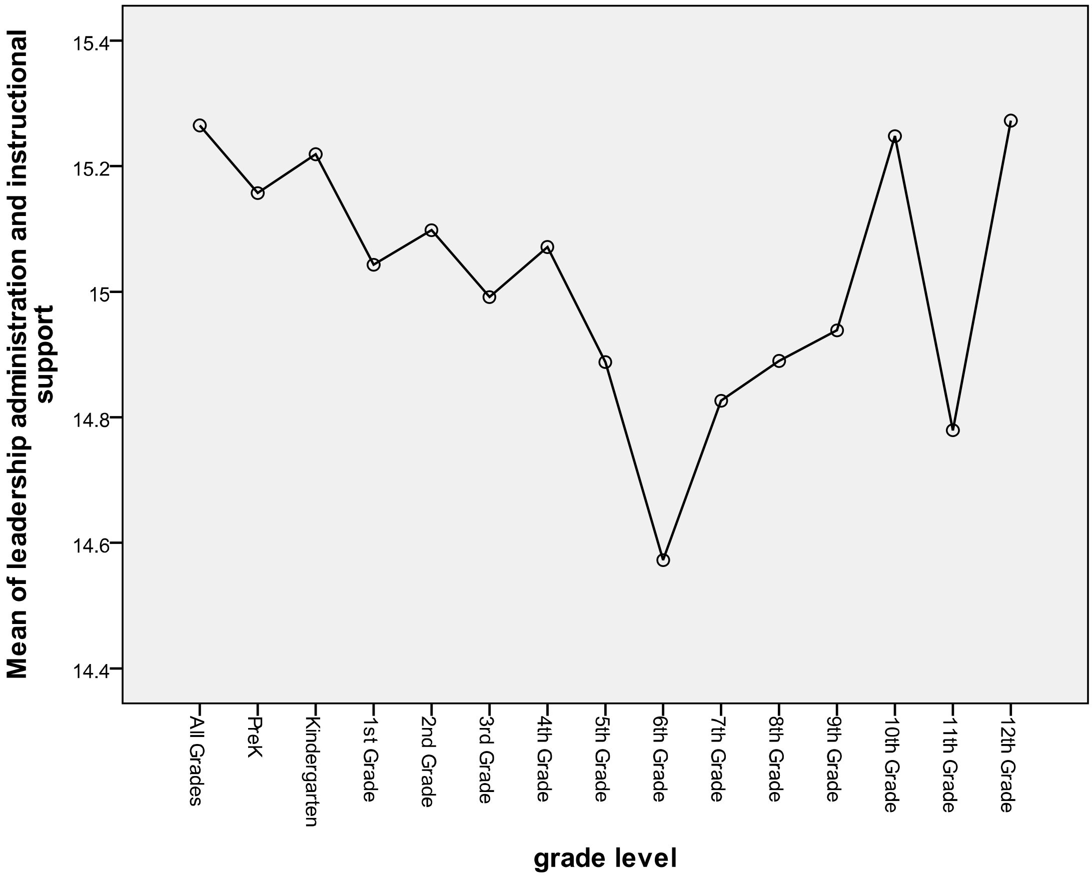
There were significant differences of teacher-school grade level on Infrastructure for Technology subscale scores at the $p<.0001$ level for the five school grade levels [$F(14, 18532) = 131.582$, $p = 0.0001$]. Post hoc comparisons using the Bonferonni test indicated that the mean score for the 2nd grade teachers (M=15.05, SD=3.74) was significantly higher than all other teachers. 11th grade teachers (M=13.70, SD=3.84) were significantly lower than all other grades.

.

Table 4.4 Descriptive statistics for Leadership, Administration, and Instructional Support composite scores by school grade level

		N	Mean	Std. Deviation
leadership administration and instructional support	All Grades	1809	15.26	4.343
	PreK	1655	15.16	4.399
	Kindergarten	1772	15.22	4.410
	1st Grade	1722	15.04	4.200
	2nd Grade	1491	15.10	4.310
	3rd Grade	1403	14.99	4.314
	4th Grade	1404	15.07	4.320
	5th Grade	1301	14.89	4.309
	6th Grade	905	14.57	4.131
	7th Grade	662	14.83	4.255
	8th Grade	508	14.89	4.268
	9th Grade	276	14.94	4.417
	10th Grade	1231	15.25	4.545
	11th Grade	761	14.78	4.420
	12th Grade	1633	15.27	4.503
	Total	18533	15.07	4.352

Figure 4.4 Leadership, Administration, and Instructional Support composite score means by grade level



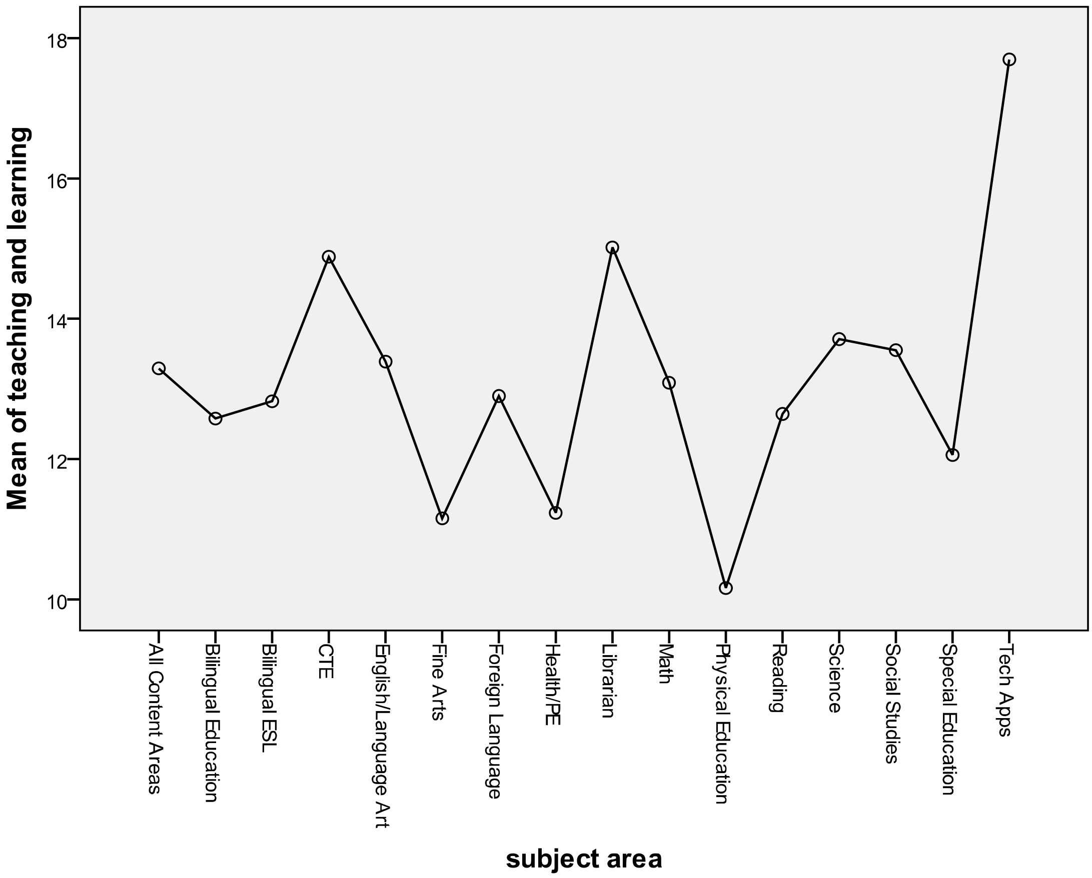
There were significant differences of school grade level on Leadership, Administration, and Instructional Support at the $p<.05$ level for the fifteen teacher-school grade levels [$F(14, 18532) = 44.979$, $p = 0.003$]. Post hoc comparisons using the Bonferonni test indicated that the mean scores for the 6th grade teachers (($M=14.57$, $SD=4.13$)) and 11th grade teachers ($M=14.78$, $SD=4.42$) were significantly lower than all other grade levels, and 12th grade teachers ($M=15.05$, $SD=3.74$) were significantly differ than all other teachers.

H2: There are no differences between teacher technology readiness focus area composite scores across subject areas.

Table 4.5 Descriptive statistics for Teaching and Learning composite scores by subject area

		N	Mean	Std. Deviation
teaching and learning	All Content Areas	6660	13.29	3.683
	Bilingual Education	819	12.58	3.756
	Bilingual ESL	312	12.82	3.522
	CTE	145	14.88	4.377
	English/Language Art	2406	13.39	3.569
	Fine Arts	490	11.15	3.631
	Foreign Language	128	12.90	3.724
	Health/PE	168	11.23	3.527
	Librarian	125	15.02	3.614
	Math	2239	13.09	3.489
	Physical Education	335	10.16	3.386
	Reading	815	12.64	3.862
	Science	1345	13.71	3.514
	Social Studies	1329	13.55	3.501
	Special Education	1102	12.06	3.629
	Tech Apps	115	17.70	3.835
	Total	18533	13.10	3.708

Figure 4.5 Teaching and Learning composite score means by subject area

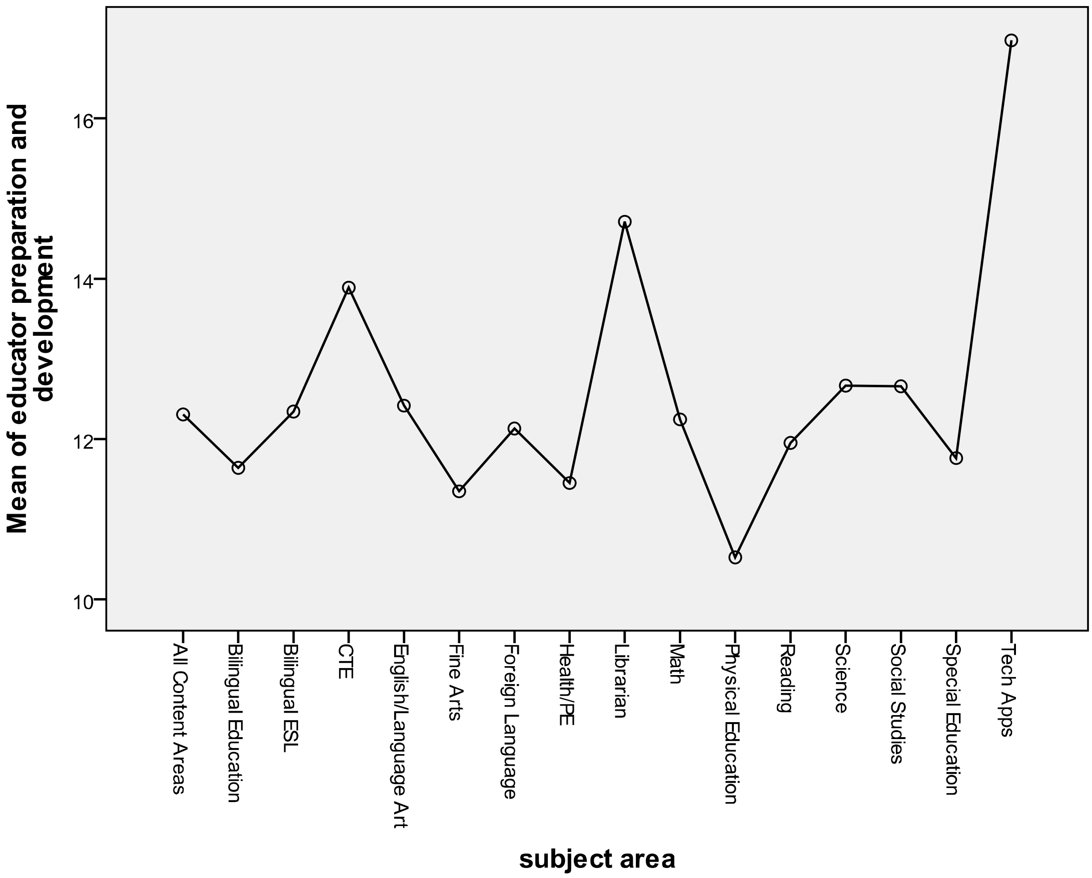


There were significant differences of subject area on Teaching and Learning at the $p<.0001$ level [$F(15, 18532) = 768.220$, $p = 0.000$]. Post hoc comparisons using the Bonferonni test indicated that the mean Teaching and Learning subscale scores for Tech App teachers (M=17.70, SD=3.84) and Librarians (M=15.02, SD=3.61) were significantly higher than all other subject areas. The Teaching and Learning subscale scores for Physical Education teachers (M=10,16, SD=3.87) were significantly lower than all other subject areas.

Table 4.6 Descriptive statistics for Educator Preparation and Development composite scores subject area

		N	Mean	Std. Deviation
educator preparation and development	All Content Areas	6660	12.31	3.734
	Bilingual Education	819	11.64	3.696
	Bilingual ESL	312	12.34	3.750
	CTE	145	13.89	4.569
	English/Language Art	2406	12.42	3.651
	Fine Arts	490	11.35	3.744
	Foreign Language	128	12.13	3.858
	Health/PE	168	11.45	3.551
	Librarian	125	14.71	3.667
	Math	2239	12.25	3.630
	Physical Education	335	10.53	3.394
	Reading	815	11.95	3.941
	Science	1345	12.67	3.741
	Social Studies	1329	12.66	3.768
	Special Education	1102	11.76	3.765
	Tech Apps	115	16.97	4.092
	Total	18533	12.28	3.771

Figure 4.6 Educator Preparation and Development composite score means by subject area



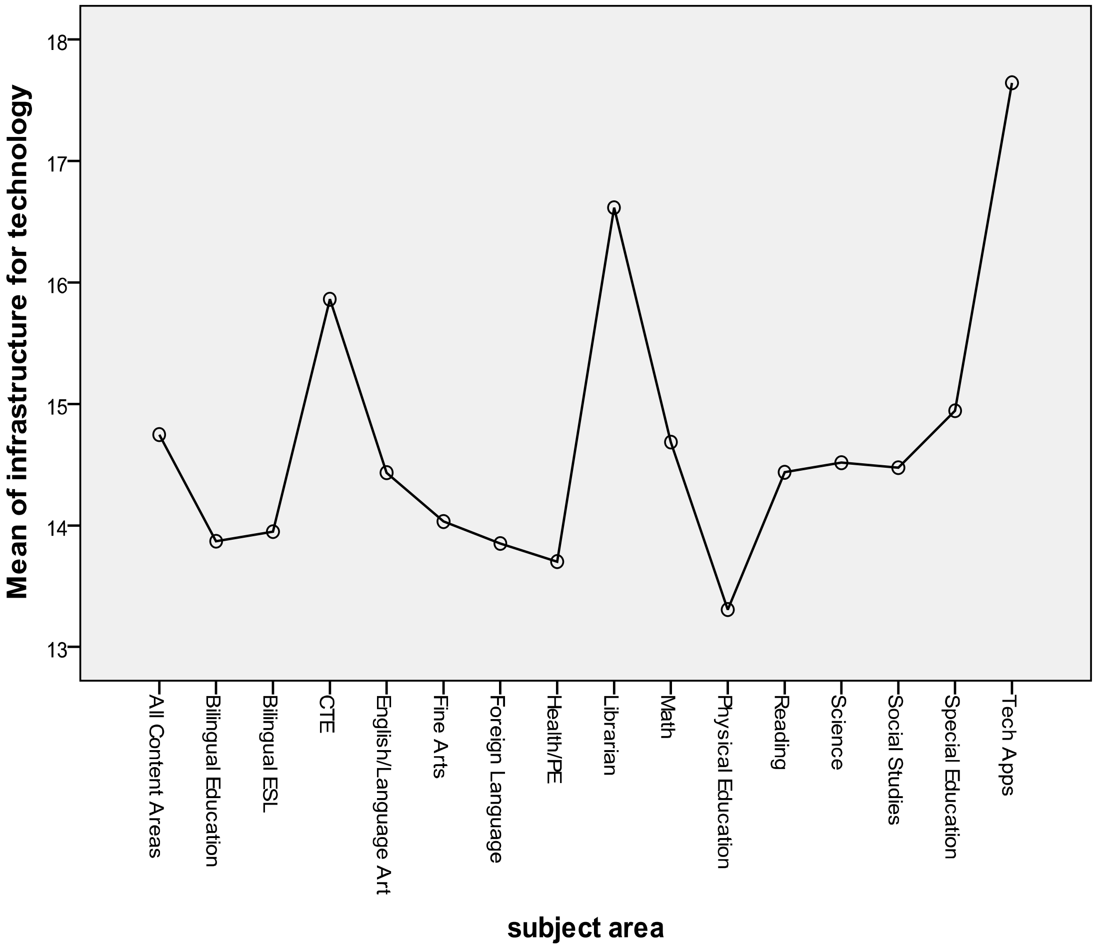
There were significant differences on Educator Preparation and Development at the $p<.0001$ level for the teacher subject areas [$F(15, 18532) = 425.774$, $p = 0.000$]. Post hoc comparisons using the Bonferonni test indicated that the mean Educator Preparation and Development score that the mean Educator Preparation and Development subscale scores for Tech App teachers ($M=16.97$, $SD=4.09$) and Librarians ($M=14.71$, $SD=3.67$)

were significantly higher than all other subject areas. The Teaching and Learning subscale scores for Physical Education teachers (M=10,53, SD=3.39) were significantly lower than all other subject areas.

Table 4.7 Descriptive statistics for Infrastructure for Technology composite scores by subject area

		N	Mean	Std. Deviation
infrastructure for technology	All Content Areas	6660	14.75	3.814
	Bilingual Education	819	13.87	3.806
	Bilingual ESL	312	13.95	3.623
	CTE	145	15.86	4.496
	English/Language Art	2406	14.43	3.749
	Fine Arts	490	14.03	4.155
	Foreign Language	128	13.85	4.008
	Health/PE	168	13.70	4.038
	Librarian	125	16.62	3.737
	Math	2239	14.69	3.758
	Physical Education	335	13.31	4.379
	Reading	815	14.44	3.907
	Science	1345	14.52	3.827
	Social Studies	1329	14.48	3.788
	Special Education	1102	14.94	3.864
	Tech Apps	115	17.64	4.264
	Total	18533	14.59	3.858

Figure 4.7 Infrastructure for Technology composite score means by subject area



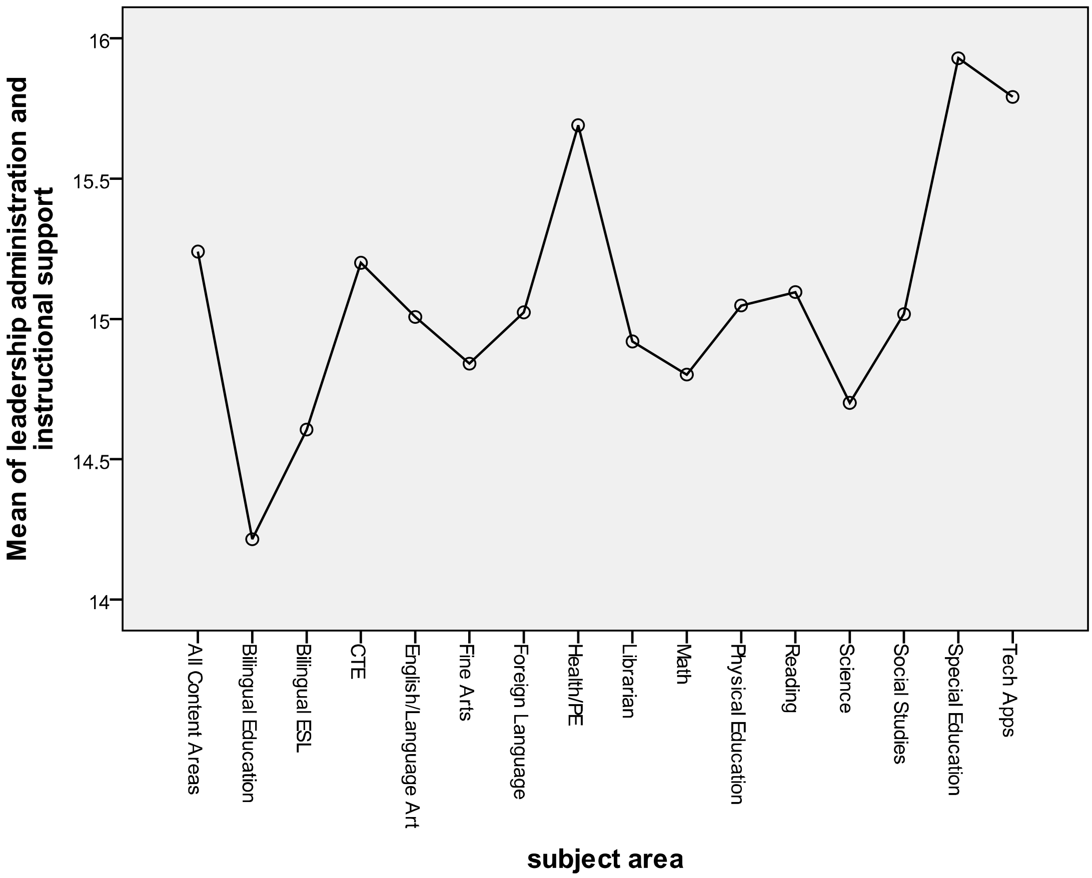
There were significant differences on Infrastructure for Technology subscale scores at the p<.0001 level for the teacher subject areas [F(15, 18532) = 246.947, p = 0.0001]. Post hoc comparisons using the Bonferonni test indicated that the mean Educator Preparation and Development score that the mean Educator Preparation and Development subscale scores for Tech App teachers (M=17.64, SD=4.26) and Librarians (M=16.62, SD=3.74) were significantly higher than all other subject areas. Educator

Preparation and Development subscale scores for Physical Education teachers (M=13.31, SD=4.38) were significantly lower than all other subject areas.

Table 4.8 Descriptive statistics for Leadership, Administration, and Instructional Support composite scores by subject area

		N	Mean	Std. Deviation
leadership administration and instructional support	All Content Areas	6660	15.24	4.394
	Bilingual Education	819	14.21	4.399
	Bilingual ESL	312	14.61	4.193
	CTE	145	15.20	4.590
	English/Language Art	2406	15.01	4.323
	Fine Arts	490	14.84	4.539
	Foreign Language	128	15.02	4.736
	Health/PE	168	15.69	4.121
	Librarian	125	14.92	4.685
	Math	2239	14.80	4.147
	Physical Education	335	15.05	4.487
	Reading	815	15.10	4.486
	Science	1345	14.70	4.249
	Social Studies	1329	15.02	4.143
	Special Education	1102	15.93	4.394
	Tech Apps	115	15.79	4.749
	Total	18533	15.07	4.352

Figure 4.8 Leadership, Administration, and Instructional Support composite score means by subject area



There were significant differences on Leadership, Administration, and Instructional Support at the $p<.05$ level for the five teacher-school grade levels [F(15, 18532) = 145.750, p = 0.003]. Post hoc comparisons using the Bonferonni test indicated that the mean scores for the Special Education teachers (M=15.93, SD=4.14) were significantly higher than all other subject areas, and Bilingual Education teachers (M=14.21, SD=4.40). were significantly lower than all other teachers.

Research Question 1 Results Summary

Taken together, these results suggest that teacher grade levels and subject area do have an effect on the four focus area of school technology and readiness. Specifically, the results suggest that teachers who instruct in grades from PreK to 8^{th} grade report increasing higher perceptual levels of School Technology and Readiness. The analysis also reveals that a drop in perceived School Technology and Readiness occurs with 10^{th}, 11^{th}, and 12^{th} grade teachers. This is most evident between the 9^{th} grade teachers with the highest ratings and 11^{th} grade teachers who reported the lowest School Technology and Readiness ratings.

Also, Tech App, Librarians, and CTE teachers consistently rated their School Technology and Readiness higher than all other subject areas. Physical Education, Health, and Bilingual Education teachers had lower School Technology and Readiness ratings.

Research Question 2:

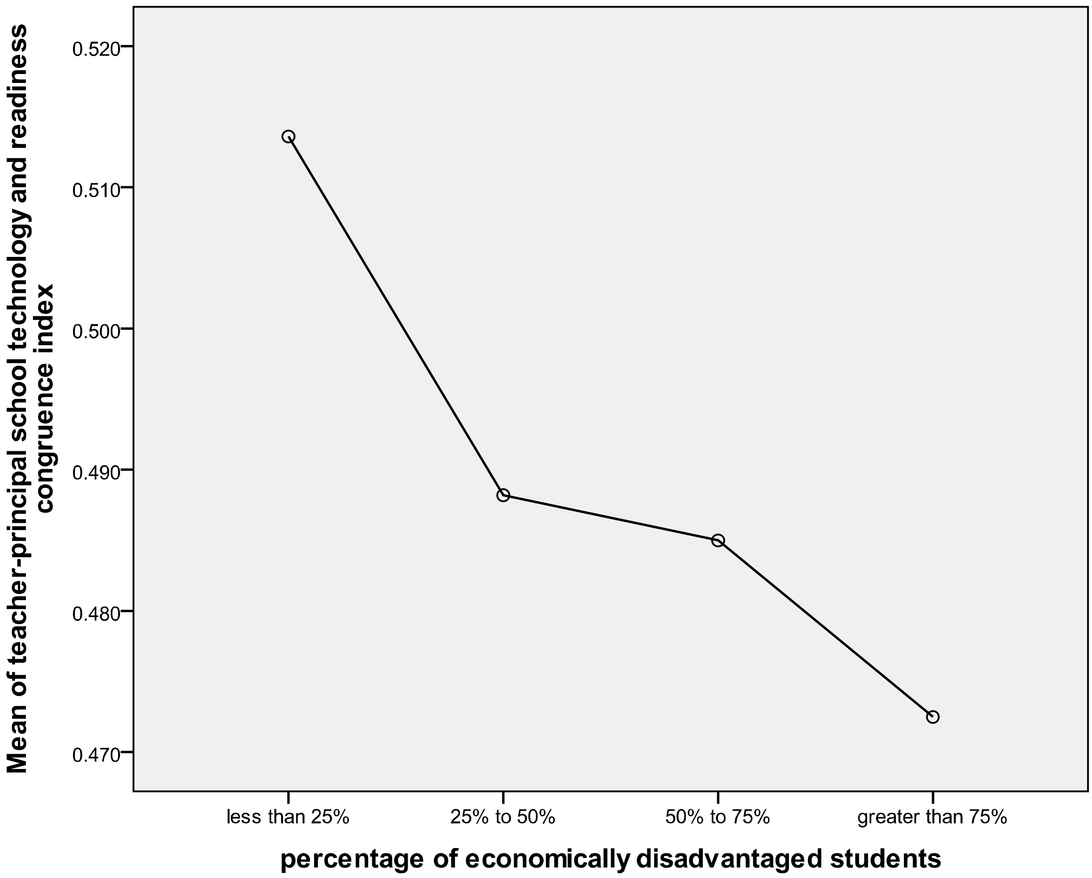
Are there significant differences in teacher-principal technology readiness congruence across school percentage of economically disadvantaged students?

H3: There are no teacher-principal technology readiness perception congruence differences between teachers and principals across school percentage of economically disadvantaged students.

Table 4.9 Descriptive statistics for Teacher-Principal School Technology and Readiness congruence by school percentage of economically disadvantaged students

	N	Mean	Std. Deviation
less than 25%	2630	.51360	.051389
25% to 50%	3945	.48819	.049089
50% to 75%	4982	.48499	.048859
greater than 75%	6976	.47249	.050912
Total	18533	.48503	.051787

Figure 4.9 Teacher-Principal School Technology and Readiness congruence by school percentage of economically disadvantaged students



There were significant differences on Teacher-Principal School Technology and Readiness congruence scores at the $p<.0001$ level for the school percentage of economically disadvantaged students [$F(3, 18532) = 436.953$, $p = 0.0001$]. Post hoc comparisons using the Bonferroni test indicated that the mean Educator Preparation and

Development score that the mean Teacher-Principal School Technology and Readiness congruence scores for schools with less than 25% of economically disadvantaged students (M=0.514, SD=0.054) were significantly lower than schools with 25% to 50% economically disadvantaged students (M=0.489, SD=0.049) and schools with 50% to 75% economically disadvantaged students (M=0.485, SD=0.051). Schools with 75% economically disadvantaged students (M=0.472, SD=0.051) possessed the lowest levels of Teacher-Principal School Technology and Readiness congruence. In summary, the higher the percentage of economically disadvantaged students in the school the lower the school technology and readiness profile agreement between teachers and their principals.

Research Question 3

How do teachers' perceived levels of technology readiness predict student mastery of Technology Applications (TA) TEKS?

The T-STaR data was analyzed using path analysis to answer the fourth research question. Path analysis provides estimates of the magnitude and significance of hypothesized causal connections between sets of variables.

Table 4.10: Summary of Model-Fit Statistics

Test of Model Fit	χ2	Df	p-value	CFI	TLI	RMSEA
T-School Technology and Readiness Model Individual Level of Analysis	38855.074	6	0.0000	0.947	0.868	0.000

Figure 4.10: Texas Teacher Technology and Readiness Effects Model

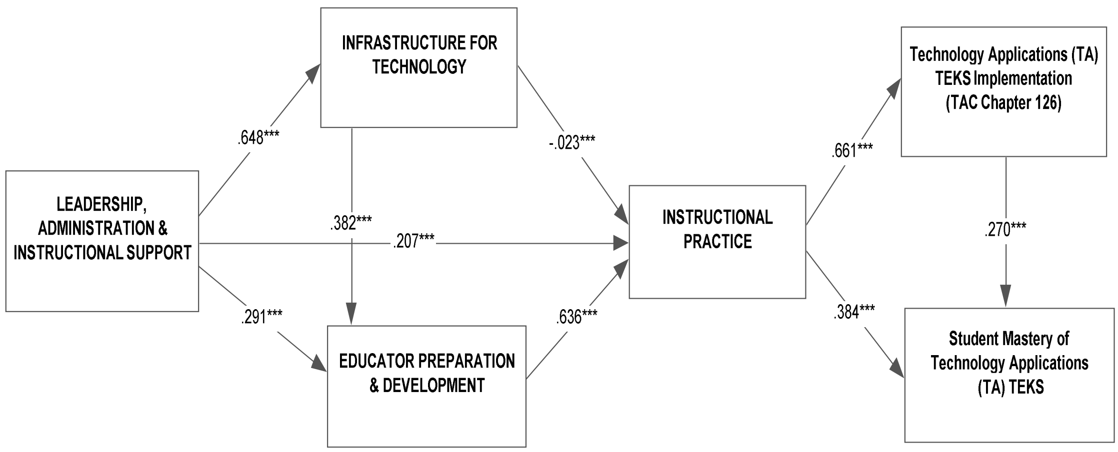


Figure 4.10 presents standardized betas only following King's (1989) recommendation that standardized betas are a more useful estimate of path coefficients because they represent the degree of change in a dependent variable given a single unit of change in the explanatory variable. Therefore standardized path loadings are reported for the path model presented above in Figure 4.10, along with their measures of statistical significance.

Table 4.11: Path Coefficients in the Texas Teacher Technology and Readiness Effects Model

	Standard Beta Coefficients	Standard Error	Critical Ratio	Sig
Dependent: Student Mastery				
TA TEKS	0.27	0.002	128.469	p<.0001
Instructional Practice	0.384	0.002	189.687	p<.0001
Dependent: TA TEKS				
Instructional Practice	0.661	0.001	586.455	p<.0001
Dependent: Instructional Practice				
Educator Preparation and Professional Development	0.636	0.001	432.178	p<.0001
Infrastructure for Technology	-0.023	0.002	-12.843	p<.0001
Leadership Administration & Instructional Support	0.207	0.002	118.476	p<.0001
Dependent: Educator Preparation and Professional Development				
Infrastructure for Technology	0.382	0.002	185.486	p<.0001
Leadership Administration & Instructional Support	0.291	0.002	142.542	p<.0001
Dependent: Infrastructure for Technology				
Leadership Administration & Instructional Support	0.648	0.001	552.455	p<.0001

Decomposition of the direct and indirect effects in the model of teamwork is presented next in Table 4.11. The direct effects represent a standardized estimate of the effect of the predictor variables on the dependent variables and may be used as path coefficients.

Question three of this study examined the fit of the model in Figure 1 to data from a sample of teachers. Results of the path analyses indicated that the model of Technology Readiness representing the relationships between the T-STaR Focus Areas was supported as the proposed Model was plausible in the in the teacher sample and the data collected in this study fit the model.

It was hypothesized that the model in Figure 4.10 would provide a good fit to the data. The overall indices of fit support the plausibility of the model in the sample data. Arrows in the path model represented a hypothesized causal relationship in the direction of the arrow. All relationships specified in Figure 4.10 that were hypothesized to be significant were confirmed.

Based on the joint criteria of fit, the Teacher Technology Readiness Path Model predicting Student TAKS Mastery met the cutoff of fit indices and the model appeared to fit very well as judged by the fit indices. As it is an exploratory analysis, the model needs to be further tested with new samples before drawing more definitive conclusions.

Summary

Analysis of the data reveals relationships exists between teacher grade level, subject area, and teacher technology readiness. In particular the higher the teacher grade level and the more technical the subject area, the higher the reported technology readiness. Also, Tech App, Librarians, and CTE teachers consistently rated their School Technology and Readiness higher than all other subject areas. Physical Education, Health, and Bilingual Education teachers had lower School Technology and Readiness ratings.

The data analysis also uncovered relationships between percentage of economically disadvantaged students and teacher technology readiness as well as teacher-principal technology readiness congruence. As the percentage of economically disadvantaged student increase in a school the teachers report lower levels of technology readiness and lower levels of congruency between their perceived technology readiness and their principals' ratings of teachers' technology readiness.

Lastly, path analysis confirmed that the proposed Texas Teacher Technology and Readiness Effects Model provided a good fit for the 2008-2009 Texas Teacher Technology and Readiness dataset.

Martin et al. (2010) found student achievement increased when technology professional development focused on aligning instructional problems and key concepts with applicable technology tools. They also found characteristics which constitute effective professional development: long duration, follow-up support, active engagement in relevant activities, access to new technologies, collaboration and community building among participants, and shared understanding of student achievement (Martin et al., 2010).

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides a brief summary of chapters one, two, and three as well as a discussion of the study's most important findings. It presents the conclusions and discusses the implications of the exploratory study for theory and practice. The limitations of this study are discussed and the needs for further research are identified.

Summary

The primary purpose of this study was to determine what factors influence the integration of educational technology as perceived by Texas teachers. The secondary purpose was to examine the relationships between the determinant factors. Three research questions guided the work: (a) are there significant differences in teachers' perception of school technology and readiness across grade level and subject area? (b) are there significant differences in teacher-principal perceptions of school technology and readiness congruence based upon school percentage of economically disadvantaged students? and (c) to what extent do teachers' perceived levels of school technology and readiness predict student mastery of Technology Applications (TA) TEKS?

To answer the research questions quantitative procedures were employed. Data from the 2008-2009 Texas School Technology and Readiness (T-STaR) survey, with self-report ratings from more than 185,000 teachers and over 7500 campus principals, was analyzed to determine if significant relationships existed among the variables of teacher school technology and readiness and teacher-principal school technology and readiness congruence and the variables of grade level, subject area, and school percentage of economically disadvantaged students.

The three research questions that guided the study were answered using multiple methods. Finally, a theorized Teacher School Technology and Readiness Effects Model was validated by the data.

Discussion

The study examined data from the 2008-2009 Texas School Technology and Readiness survey (T-STaR). The survey captured Texas schools' progression through the stages of technology adoption. According to the Long Range Plan for Technology schools are to transition through four distinct phases of technology readiness: 1) early tech, 2) developing tech, 3) advanced tech, and 4) target tech (TEA, 1988, 1996, 2000, 2006). Figure 5.1 depicts the current state of Texas campus level school technology and readiness

The participants' School Technology and Readiness (T-STaR) data indicate that very few teachers have progressed to the Target Tech level of classroom technology integration. Within the focus area of Teaching and Learning, the T-STaR area which measures instructional practice, relatively few Texas educators, 3%, have reached the Target Tech level. Likewise in the focus area of Educator Preparation and Development, a mere 3% of Texas teachers rate their preparation and continuous professional development at the Target Tech level, and the Infrastructure for Technology at 7%. While a larger percentage of the participant teachers, 13%, perceive their Leadership, Administration, and Instructional Support at the Target Level, the study found gaps between the current school technology and readiness capacity and the statewide goals.

Figure 5.1: 2008-2009 Teacher T-STaR Focus Area Ratings

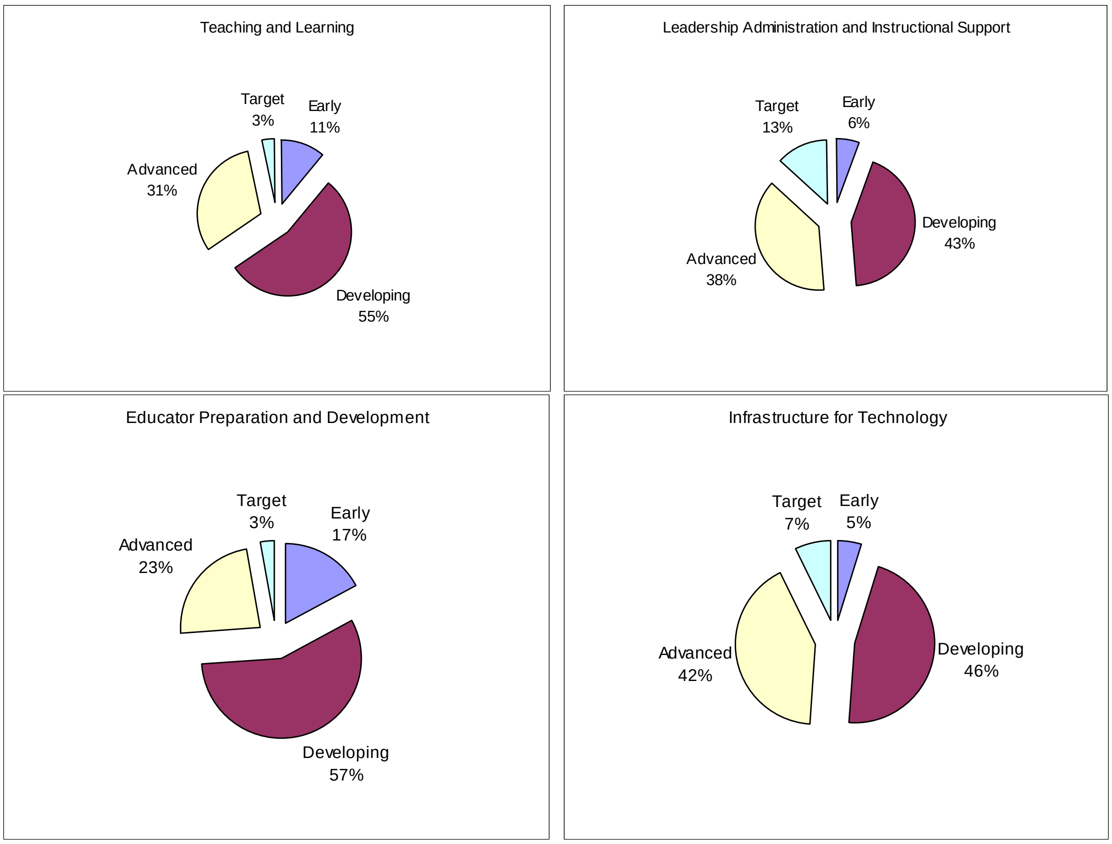


Table 5.1: 2008-2009 Teacher T-STaR Focus Area Counts.

	Early	Developing	Advanced	Target
Teaching and Learning	20,540	100,421	58,042	6,079
Leadership Administration and Instructional Support	11,001	79,067	70,510	24,504
Educator Preparation and Development	31,816	104,736	43,364	5,166
Infrastructure for Technology	8,822	85,752	77,234	13,274

The goal of the Texas Long Range Plan for Technology is to transform Texas schools from a traditional learning environment into a constructivist learning environment which enable students to develop twenty-first century skill though the effective integration of technology and curriculum (TEA, 2006). Target Tech classrooms were envisioned to be student-centered environments where

- Students along with teachers, businesses, higher education, and the community work to solve real-world problems.
- Teachers and students experience 24/7 access to technology and digital content within the campus, district, home, or community.
- Teachers and students also work within collaborative learning communities with students engaged in project-based learning.
- Teachers estimates 86% to 100% of the students have mastered TA TEKS.
- Teachers experience professional development based on personal needs and share their experiences and expertise within learning communities.

- Teachers are proficient in all five of the SBEC Technology Applications Standards and they attend 30 or more hours of technology professional development annually.
- Teachers create and teach in online learning environments (TEA, 2006).

The study finding of low percentages of teachers experiencing Target level school technology and readiness in the key focus areas of Teaching and Learning and Educator Preparation and Development reveals a gap in the availability of technology-qualified teachers and progress toward achievement of the statewide educational technology goals. Research reveals that students that acquire more advanced uses of technology do so in a constructivist learning environment in which the teacher is a facilitator of learning rather than the classroom's only source of knowledge (Trilling & Hood, 1999; Means, 1999). Other studies of student learning with technology found that technology encourages teachers to be more student-centered, more open to multiple perspectives on problems, and more willing to experiment in their teaching (Knapp & Glenn, 1996). However the results of this study show relatively low percentages of teachers are using constructivist pedagogies proactively.

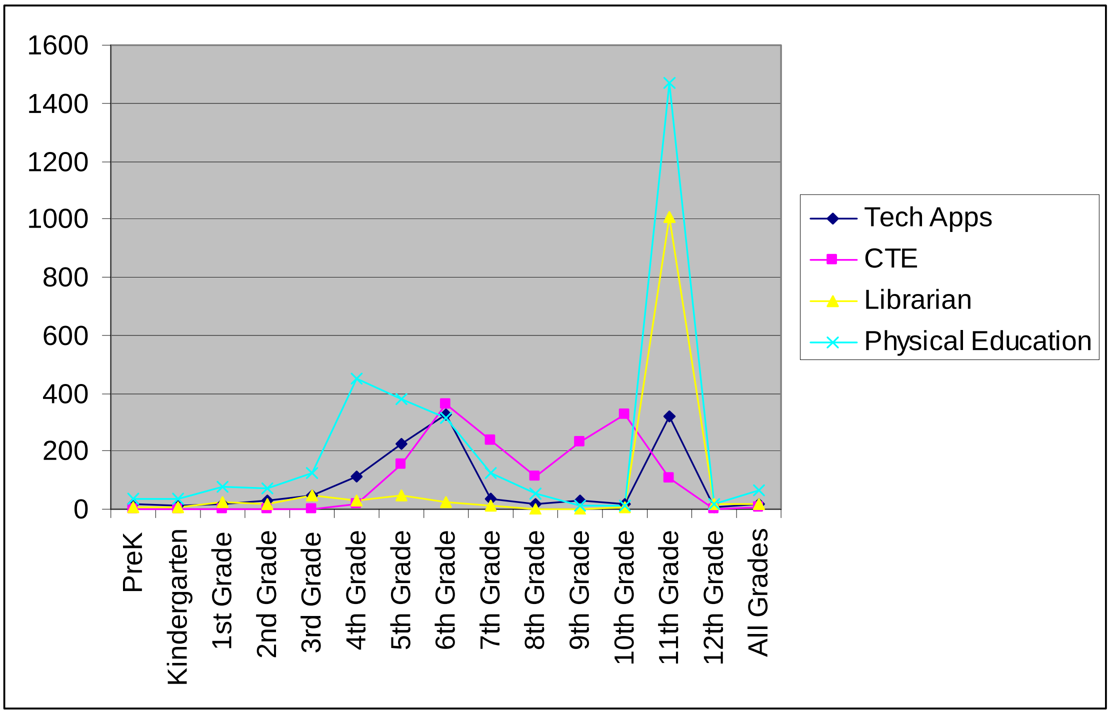
In technology-rich classrooms, students become more engaged and more active learners, and there is typically a greater emphasis on inquiry and less on drill and practice (Sandholtz et al., 1997). Technology also encourages student collaboration, project-based learning, and higher-order thinking (Penuel et al., 2000). According to Means and her colleagues, "Technology supports exactly the kinds of changes in content, roles, organizational climate, and affect that are at the heart" of constructivist educational reform movements (1993, p. 1). The results suggest that both teacher preparation and professional development of existing teachers require an increased focus on student-centered teaching and learning

In addition to finding low percentages of school technology and readiness Target level teachers, the study found that teacher perceptions of school technology and readiness differed significantly depending on grade level and subject area.

To address the first research question, "Are there significant differences in teacher technology readiness across grade level and subject area?" a one-way analysis of variance (ANOVA) was performed to test for group differences for the variables grade level and subject area on teacher school technology readiness ratings.

Specifically, the higher the grade level and the more the technical nature of the subject taught, the higher the reported level of school technology and readiness. 10^{th} and 12^{th} grade teachers reported the highest levels of school technology and readiness along with a surprising drop in teachers' school technology and readiness for 11^{th} grade teachers. Figure 5.2 provides a possible explanation for the phenomenon of the drop in teacher school technology and readiness in 11^{th} grade: almost half of the Physical Education teachers in the study were also 11^{th} grade teachers. Physical Education and Health teachers reported significantly lower school technology and readiness ratings than all other subject areas. This resulted in a precipitous drop in overall teacher perceived school technology and readiness for the 11^{th} grade.

Figure 5.2 Subject area teachers by grade levels



Another study finding was that participants were assignable to three tiers of school technology and readiness according to subject area. The first tier, lo-STaR, were the teachers who perceived their school technology and readiness at significantly lower levels than all other subject area teachers. The lo-STaR teachers were the Physical Education and Health teachers. The second tier, mid-STaR, consisted of the majority of subject area teachers, and their school technology and readiness levels remained consistently within the Developing/Advanced T-STaR stages. The mid-STaR group was made up of teachers who taught All Content Areas, Bilingual Education, English/Language Art, Fine Arts, Foreign Language, Math, Reading, Science, Social Studies, and Special Education. The third tier, hi-STaR teachers, reported higher perceptions of school technology and readiness than all other subject area teachers. The hi-STaR group was comprised of CTE teachers, Tech Apps teachers, and Librarians.

The hi-STaR teachers reported Target level ratings for the key focus area of Teaching and Learning. A key indicator for Target level Teaching and Learning is that over 80% of student in the classroom have mastered the Texas Technology Applications Texas Essential Knowledge and Skills (TA-TEKS). This means that hi-STaR teachers' classrooms are most likely to be constructivist learning environments (Ringstaff and Kelly, 2002; Elmore 2001) where

- Teacher and students use appropriate technologies as a natural and necessary way of gaining knowledge and understanding. Students have increased control of their learning. Students work with teachers, businesses, higher education, and the community to solve real-world problems (TEA, 2006).
- Teacher and students have anytime/anywhere access to technology and digital content within the campus, district, home, or community (TEA, 2006).
- Teacher and students focus on cross-curricular learning using developmentally appropriate instructional strategies and skills that are integrated into the collaborative work of a community (TEA, 2006).

- Teacher uses a variety of technology tools to seamlessly integrate curriculum TEKS and TA TEKS in content-based learning (TEA, 2006).
- Teacher estimates 86 to 100% of his/her students have mastered TA TEKS. The state provides instructional materials to support the teaching and evaluation of K-8 TA TEKS and 9-12 TA courses. For other 9-12 courses, teachers should evaluate TA TEKS mastery through students' ability to use technology in the course to acquire information, solve problems, and communicate. TA Guidelines are available for PreK students (TEA, 2006).
- Teacher has integrated into curriculum TEKS-aligned online lessons that include class content such as explanations, examples, links to online resources, enrichment, and reinforcement; class is communicating and interacting online (TEA, 2006).

The hi-STaR teachers also reported Target level ratings for the Educator Preparation and Professional Development focus area. According to the Texas Long Range Plan for Technology (2001, 2006), the profiles for an educator in the Target Educator Preparation and Professional Development level is a teacher who:

- Continues to participate in professional development experiences but expands his/her influence by collaborating, mentoring, and training others. Teacher encourages the development of student led learning environments (TEA, 2006).

- Actively pursues additional professional development opportunities based on personal needs and shares within expanded learning communities (TEA, 2006).
- Is proficient in all five of the SBEC Technology Applications Standards (TEA, 2006).
- Attends 30 or more hours of technology professional development annually (TEA, 2006).
- Uses technology tools in new ways where learning becomes more collaborative, interactive, and customized. Teacher provides opportunities for students to extend their learning with project-based, individualized activities as the norm, resulting in increased student independence and sophisticated products (TEA, 2006).
- Has taken professional development on how to create and integrate web-based lessons using TEKS-based content, resources, and learning activities (TEA, 2006).

In contrast to hi-STaR teachers, the lo-STaR teachers reported Early level ratings for the key focus areas of Teaching and Learning and Educator Preparation and Professional Development. This means that lo-STaR teachers' classrooms are most likely to resemble traditional, teacher-centric, learning environments where educators use digital content to supplement traditional teaching (CEO, 2001; TEA, 2006). The lo-STaR teachers are more likely to be proficient in no more than one of the SBEC Technology

Applications Standards, and they attend less than nine hours of technology professional development each year. Most importantly, less than 50% of the Early Tech students would have mastered the TA TEKS (TEA, 2006).

To address the second research question, “Are there significant differences in teacher-principal technology readiness congruence across schools with varied percentages of economically disadvantaged students?” an analysis of variance (ANOVA) was performed to test for group differences for the variable of percentage of economically disadvantaged students on teacher technology readiness congruence as measured by McCrae’s R_{pa}. The study found significant differences in teacher-principal perceptions of school technology and readiness congruence and percentage of economically disadvantaged students.

The results showed that school percentage of economically disadvantaged students does have an effect on teacher-principal technology readiness congruence. Specifically, the results suggest that as school percentage of economically disadvantaged students decreases, there is greater congruence between teacher and principals profiles of school technology and readiness. The difference is most evident between schools with the highest percentage of economically disadvantaged students (greater than 75%) and school with the lowest percentage of economically disadvantaged students (less that 25%). The data shows that schools with the highest percentage of economically disadvantaged students tend to be in urban and rural districts where there are large concentrations of high-poverty and low-performing schools.

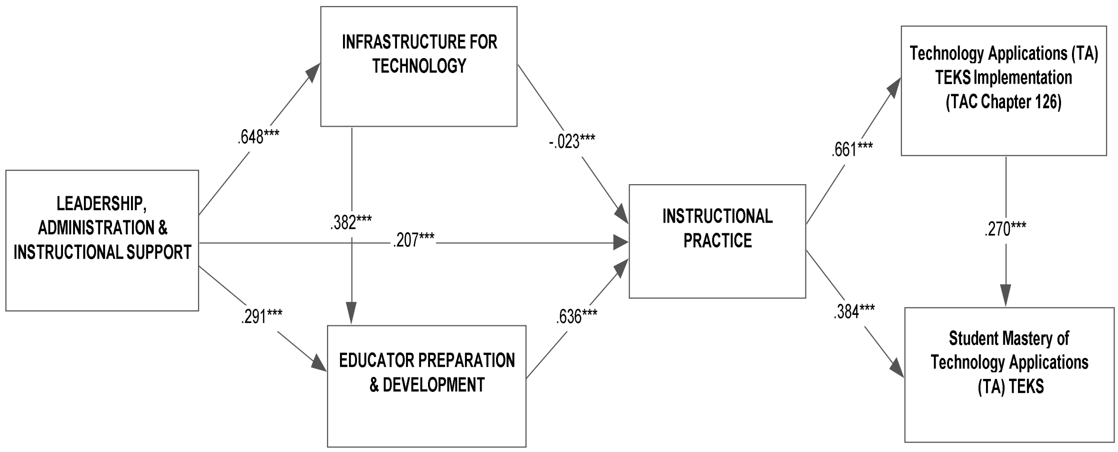
The lack of congruence in perceptions of level of school technology and readiness by teachers may not only reflect the need for improved communication within the school community, but it may also serve as a barrier toward helping the school and district to move forward in addressing the technology and instructional needs of the school. It will also be important to understand the extent to which the level of congruence in perceptions is affected by campus characteristics, e.g., the percentage of economically disadvantaged students.

Factors that may contribute to the lack of congruence in teacher-principal perceptions of school technology and readiness may be attributed to a number of factors encountered in high poverty and low-performing school districts. The turnover rate for principals is as high as 20 percent per year in these districts (NGA, 2003). These urban and rural communities often pay lower salaries and receive significantly fewer applicants for open positions (Roza, 2003). As a result, low-performing urban and rural schools are much more likely to end up with inexperienced principals and assistant principals and teachers (Papa et al., 2002). The instability and turbulence within schools with greater percentages of economically disadvantaged students may be contributing factors to the lower teacher-principal congruence in perceptions of school technology and readiness observed in the results of the present study.

To answer the third and final research question, “How do teachers’ perceived levels of technology readiness predict student mastery of Technology Applications (TA) TEKS?”, path analysis was employed to examine the fit of the model in Figure 4.10 to data from the complete sample of 2008-2009 Teacher School Technology and Readiness

(T-STaR) survey. Results of the path analyses indicated that the model of Technology Readiness representing the relationships between the T-STaR Focus Areas was, as shown in Figure 5.3, plausible in that the data collected in this study fit the model.

Figure 5.3: Texas Teacher Technology and Readiness Effects Model



It was hypothesized that the model in Figure 5.3 would provide a good fit to the data. The overall indices of fit supported the plausibility of the model in the sample data. All relationships specified in Figure 1 that were hypothesized to be significant were found. The model has one primary driver (Leadership Administration and Instructional Support), three intermediate drivers (Infrastructure for Technology, Educator Preparation and Development and Instruction Practice), and two outcomes (Technology Applications Implementation, and Student Mastery of Technology Applications).

The primary driver Leadership Administration and Instructional Support had direct effects on the three intermediated drivers by contributing 65% to Infrastructure for Technology, 29% to Educator Preparation and Development, and 21% to Instruction Practice.

The role of Leadership Administration and Instructional Support is in accord with other studies underscoring the importance of leadership in the integrations of technology and with leadership identified as an essential condition by ISTE (2009) for effective use of technology to enhance student learning. Elmore (2000) points out the importance of leadership in fostering shared understanding and creating a common culture of expectations. He suggests that quality school leaders understand teaching and are respected by their staff, and they are willing to hold themselves and others responsible for student learning and enhancing the capacity of teachers to meet this goal:

> The job of administrative leaders is primarily about enhancing the skills and knowledge of the people in the organization, creating a common culture of expectations around the use of those skills and knowledge, holding the various pieces of the organization together in a productive relationship with each other, and holding individuals accountable for their contributions to the collective results. (p. 16)

These elements of leadership may equally apply to helping a school move forward in the integration of technology into the teaching and learning process.

The first intermediate driver Infrastructure for Technology, contributed 38% to the second intermediate driver Educator Preparation and Development, and surprisingly, -2% to the third intermediate driver Instruction Practice. Analysis of the 2008-2009 T-

STaR campus data (Fig. 5.1) reveals that more than 92% of campuses rated their technology infrastructure at the higher Advanced-Tech and Target-Tech levels. Indeed progress has been made in the area of Infrastructure. However, less than 32% of Texas schools are effectively implementing teaching and learning practices at the Developing and Target Tech levels. Texas Teacher Technology and Readiness Effects Model (Fig. 5.2) reveal the greatest the probability for improving Instructional Practice is not through providing more Infrastructure for Technology but rather by providing more sustained Educator Preparation and Professional Development, which contributed 64% to Instructional Practice.

Martin et al. (2010) found consensus characteristics which constitute effective educational technology professional development. Namely (a) long duration, (b) follow-up support, (c) active engagement in relevant activities, (d) access to new technologies, (e) collaboration and community building among participants, and (f) shared understanding of student achievement.

The Instructional Practice element of the model was comprised of the T-STaR Teaching and Learning variables which captures teachers' perceptions of their professional development experiences, models of professional development, capabilities as educators, technology professional development participation, levels of understanding and patterns of technology use, and online learning capabilities.

Although prior research (Martin et al., 2010) found measuring student outcomes as a result of educators attending educational technology professional development to be problematic, the study model showed the direct contribution of the Instructional Practice diver to the two outcome elements to be 64% for Technology Applications TEKS Implementation and 34% for Student Mastery of Technology Applications TEKS. The view of the importance of professional development as a key factor in improving student performance is the basis for all schools to commit resources to provide professional development opportunities to the instructional staff. The finding of professional development as a driver to student technology competency outcomes is one that supports the importance of professional development as a key factor in helping teachers to effectively integrate technology into their teaching practices.

Implications for Practice and Policy

Researchers have recently turned to the study of technology leadership in terms of technology's support of school reform (Anderson & Dexter, 2005; Bailey & Lumley, 1994). Application of leadership skills necessary for school leaders to help their institutions apply technology in beneficial ways and prepare their schools for the twenty-first century is the meaning of technology leadership. Researchers have stated that building principals' technology leadership is essential in schools; principals must model effective technology leadership (Matthews, 2002; Ross & Bailey, 1996; Scott, 2005).

In this study, effective technology leadership of principals has been defined and measured as one construct comprising six key T-STaR items: leadership and vision (l1); planning (l2); instructional support (l3); communication and collaboration (l4); budget (l5); and leadership and support for online learning (l6). The method used in this study, Path Analysis, offers a theorized model on the effect of technology leadership on student achievement.

In this case, effective technology leadership of principals was quite well defined and well measured. A technology leader is one who leads the school in improvement on restructuring, and uses emerging technologies as the core resources for educational change. More importantly, the role of principal is now evolving to that of a technology leader.

To be an effective technology leader, a principal should develop and implement a technology vision and long-range technology plan in the school. A principal requires a sense of vision, since technology leadership is the ability to develop and articulate a vision of how technology can produce change. Moreover, a principal should encourage faculty development in technology. Principals should plan and design staff development activities for their school settings. Beyond that, advocating technological support, ensuring that facilities for technology use are adequate, and evaluating school and district technology plans are the roles and responsibilities of the principal as technology leader.

The present study is important in making progress in the effective use of technology to improve learning in Texas schools since numerous technology literacy-training initiatives have been implemented for teachers in Texas during the past decade. With relatively few studies specifically addressing evaluation of building principals' technology leadership in Texas, this is an area that necessitates future exploration so that current and future leaders can be prepared to deal more effectively with technology and can be expected to successfully implement technology policy.

Much current research (Bridges, 2003; Hughes & Zachariah, 2001; ISTE, 2005; Matthews, 2002; Seay, 2004) notes that the principal's role has evolved to that of an effective technology leader. Moreover, researchers have shown that principals' technology leadership is essential in schools. As this study indicates, principals as technology leaders must develop and implement a school vision and technology plan, encourage teacher technology development and training, provide adequate infrastructure and technology support, and develop an effective school evaluation plan. Principals who embrace their evolving role as technology leaders can effectively lead and prepare their schools.

More than ever, principals must lead their schools in acquiring and using new and emerging technologies as educational resources for enhanced student engagement and learning. The technology leadership dimension examined in this study provides principals with the knowledge and skills necessary to use technology and enhance their effectiveness as school leaders.

The T-STaR instrument may provide educational administrators with substantive information to enhance the recruitment and selection of principals as technology leaders. As a result of this evaluation and assessment information, the state of Texas could sponsor preparation programs providing professional development for principals to improve classroom technology use, evaluate teacher and student strengths and needs in technology, and develop a practical and useful technology plan. Increased student learning and achievement through the application of new and emerging educational technologies is the primary goal.

The role of the classroom teacher is the crucial factor in the full development and use of technology in the schools (NCSES, 2000; OTA, 1995; Trotter, 1999). According to the CEO Forum (1999), the transformation of classroom technology from hardware, software, and connections into tools for teaching and learning depends on knowledgeable and enthusiastic teachers who are motivated and prepared to put technology to work on behalf of their students However, many teachers do not have the technical knowledge or skills to recognize the potential for technology in teaching and learning. Just knowing how to use a computer is not enough. Instead, teachers must become knowledgeable about technology and self-confident enough to integrate it effectively in the classroom. Teachers, in other words, must become confident in their use of technology and empowered by the many opportunities it offers.

While most teachers want to learn to use educational technology effectively, they lack the time, access, and support necessary to do so (Guhlin, 1996). What are needed are professional development opportunities where teachers are introduced to instructional technology in authentic learning environments. To reach the goal of preparing teachers for effective technology use, well-designed professional development programs are essential. Professional development in a technological age requires new definitions and new resources. It cannot take the traditional forms of individual workshops or one-time training sessions. Instead, it must be viewed as an ongoing and integral part of teachers' professional lives.

Professional development for technology use should contain essential components that research has found to be important. These components include the following: a connection to student learning (Lockwood, 1999; Speck, 1996), hands-on technology use (Fatemi, 1999), variety of learning experiences (David, 1996; Guhlin, 1996), curriculum-specific applications (Byrom, 1998), new roles for teachers (Kupperstein, Gentile, & Zwier, 1999). collegial learning (Lockwood, 1999), active participation of teachers (Lockwood, 1999; Speck, 1996), ongoing process (Speck, 1996), sufficient time (Lockwood, 1999), technical assistance and support, administrative support, adequate resources, continuous funding, and built-in evaluation (Lockwood, 1999).

In this study I found that Physical Education teachers perceived their school technology and readiness at significantly lower levels than all other subject area teachers. The data reveals that the PE class has become the no-tech period for most students, where educators and parents seek to increase students' physical activity in an attempt to counter-balance the less healthful effects of students' increased use of technologies, such as TV and video games.. However research conducted by Castelli and Fiorentino (2008) has shown that technology can be used to increase physical activity and enhance learning about health, fitness, and technology. Teachers trained in the Castelli and Fiorentino methodology (2008) learned how to use technology to understand and promote key concepts related to physical activity, and were able to meet the technology standards established by the International Society for Technology in Education (ITSE 2004). In addition the physical educators improved their technology competencies by:

- Using technology to assess physical fitness, monitor student progress toward personal goals, refine motor skills, comprehend new concepts, and increase enjoyment of physical activity,

- Selecting from numerous activities that promote learning and healthy physical activity choices through the integration of technology,
- Drawing on technologies that enhance learning and increase teacher efficiency, and
- Building professional portfolios through activities that help teachers immediately (Castelli and Fiorentino, 2008).

This type of relevant and authentic professional development is recommended for Texas Physical Education and Health Education teachers to move the Lo-STaR PE/Health educators to Target level perceptions of school technology and readiness. In addition, the Castelli and Fiorentino curriculum enables both teachers and students to engage in activities that fulfill more of the Texas TA-TEKS requirements such as:

- Conducting time and motion data acquisition using PDAs and accelerometers,
- Creating personal fitness charts and graphs, and
- Developing online content using, desktop publishing software, and advanced editing and multimedia production equipment.

Conclusions

In this study, I found evidence that teacher perceptions of their school technology and readiness varied according to teacher grade level and subject area. Lo-STaR, teachers who perceived their school technology and readiness at lower levels, were primarily Physical Education and Health teachers, and they tended to be concentrated in the 11th grade. In contrast to the lo-STaR teachers, the hi-STaR teachers, mostly Tech Apps, Career and Technology (CTE), and Librarians, perceived school technology and readiness at significantly higher levels.

In addition I found that teacher-principal school technology and readiness perceptual congruence was affected by the percentage of economically disadvantaged students within the school where the higher the percentage of economically disadvantaged students in the school, the lower the level of teacher-principal school technology and readiness congruence.

Further Research

Research on school technology and readiness is crucial if we are to understand the barriers that confront Texas teachers as they progress through the Early, Developing, Advanced, and Target school technology and readiness levels. This study investigated the school technology and readiness perceptions teachers and the level of perceptual congruence of school technology and readiness with their principals. Also, the path analysis in the study presented a model that supports prior research on the effects of leadership, professional development, infrastructure, and teaching and learning have on student outcomes. Based on the literature review and findings from this study, the following are recommendations for future research:

1. Further studies using a qualitative or mixed method research approach should be explored, with a range of campuses at different levels of school technology and readiness, to address some of the questions generated by this study. This type of research would allow for more in-depth discussions with teachers and principals to understand more fully the factors relating to levels of school technology and readiness. Topics that might be addressed include:
    a. What are the barriers to reaching Target level technology and readiness for each T-STaR item?
    b. What are the facilitators to help increase levels of school technology and readiness?

2. Similar studies could investigate the effect of periodic 360 assessments on teacher-principal school technology and readiness congruence. Such a study would explore ways of increasing perceptual congruence by holding a focus group of teachers to review their anonymous ratings and discussing the differences. At the conclusion of the focus group, the

participants would re-rate themselves. The study would investigate whether the ratings converge or diverge over time.

Researcher's Reflection

As stated in the introduction, wanting to learn how principals and teachers perceived school technology and readiness prompted the focus of this study. Having worked with teachers in schools with high rates of children living in poverty, I struggled to recognize practices that would provide support and help them integrate technology in their classrooms. The learning curve from traditional teacher-centered teaching with technology to student-centered teaching with technology was great, and I witnessed very few examples of schools that made the successful transition from Early school technology and readiness to Target level Tech. This study identified factors that influence principal and teacher school technology and readiness. Below, I identified some of these.

The study validated the importance of leadership. Specific attention and consideration must be given when creating the environments where leaders, teachers, and students seamlessly use technology to teach and learn. As mentioned earlier, commitment of time and clear expectations about professional development are critical to the successful development of effective leaders. In my experience as a technology support specialist, campus technology support personnel are typically overwhelmed with maintaining the systems and often incapable of providing the support I believed that educators needed to develop high levels of technology literacy in students. Therefore, I encouraged teachers to look for other support systems, such as a network of teachers on campuses with similar student demographics who could be consulted for advice and support. Additionally, online communities of practices were created for each initiative that I was assigned to support. It was through these communities that teachers found critical friends. The National School for Reform Faculty (NSRF, 2001) defines critical friends as a learning community that examines practices, provides usable feedback, and encourages diverse experiences and perspectives. Through reflective discourse, critical friends develop a trusting environment to share work and take risks. The network of informal, critical friends understood struggles of technology integration and, together, strategies were generated for the needs of particular campuses. These collaborative opportunities allowed teachers to problem solve challenging areas of their work.

APPENDICES

Appendix A: Consent Form

Title: A Study of Teachers' and Principals' and Perceptions of School Technology and Readiness

IRB PROTOCOL #

Conducted By: Willie Adams Of The University of Texas at Austin: Curriculum and Instruction;
Telephone: (512) 278-0399

Dr. Paul Resta Of The University of Texas at Austin: Curriculum and Instruction;
Telephone: (512) 471-4014

The Texas Education Agency (TEA) is being asked to participate in a research study. This form provides TEA with information about the study. The person in charge of this research will also describe this study to the agency and answer all of the agency's questions. Please read the information below and ask any questions the agency might have before deciding whether or not to take part. The Texas Education Agency's participation is entirely voluntary. The agency can refuse to participate without penalty or loss of benefits to which the agency are otherwise entitled. The agency can stop your participation at any time and your refusal will not impact current or future relationships with UT Austin or participating sites. To do so simply tell the researcher you wish to stop participation. The researcher will provide the TEA with a copy of this consent for your records.

The purpose of this study is to determine what factors influence the integration of educational technology as perceived by Texas teachers.

If you agree to be in this study, we will ask you to provide the following:
A comma delimited file of the 2008-2009 school year Teacher and Campus Texas School Technology and Readiness Chart (T-STaR) data: The 2008-2009 T-STaR data elements requested for the study are:
Campus Identifier.
District Identifier
School Population
Region Number
School Type Code (i.e. elementary, middle, high)
Role Code (i.e. principal, administrator, teacher)

Grade Teaching (0 if not applicable i.e. principal or administrator)
Subject Teaching (None if not applicable i.e. principal or administrator)
Years Teaching
TL1 - the patterns of classroom use of educational technology
TL2 - frequency and design of instructional settings using digital content
TL3 - content area connections
TL4 - technology applications (TA) TEKS implementation (TAC Chapter 126)
TL5 - student mastery of technology applications (TA) TEKS
TL6 - online learning
L1 - leadership and vision
L2 - planning
L3 - instructional support
L4 - communication and collaboration
L5 - budget
L6 - leadership and support for online learning
EP1 - professional development experiences
EP2 - models of professional development
EP3 - capabilities of educators
EP4 - technology professional development participation
EP5 - levels of understanding and patterns of use
EP6 - capabilities of educators with online learning
INF1 - students per classroom computers
INF2 - internet access connectivity speed
INF3 - classroom technology
INF4 - technical support
INF5 - local area network wide area network
INF6 - distance learning capacity

Total estimated time to participate in study is 40 hours.

Risks of being in the study
The risk associated with this study is no greater than everyday life.

Benefits of being in the study
Greater understanding of the factors which influence school technology integration.

Compensation:
None

Confidentiality and Privacy Protections:
The data resulting from your participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the

data will contain no identifying information that could associate you with it, or with your participation in any study.

The records of this study will be stored securely and kept confidential. Authorized persons from The University of Texas at Austin, members of the Institutional Review Board, and (study sponsors, if any) have the legal right to review your research records and will protect the confidentiality of those records to the extent permitted by law. All publications will exclude any information that will make it possible to identify you as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:
If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw your participation call the researchers conducting the study. Their names, phone numbers, and e-mail addresses are at the top of this page. If you have questions about your rights as a research participant, complaints, concerns, or questions about the research please contact Jody Jensen, Ph.D., Chair, The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects at (512) 232-2685 or the Office of Research Support at (512) 471-8871 or email: orsc@uts.cc.utexas.edu.
You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read the above information and have sufficient information to make a decision about participating in this study. I consent to participate in the study.

Signature: ____ Date: __________________

____ Date: ___________________
Signature of Person Obtaining Consent

Signature of Investigator: __________________________ Date: __________________

Appendix B: Texas School Technology and Readiness (T-STaR) Performance Descriptions

EARLY TECH

TL1. Teacher uses technology to complete tasks such as grade book and attendance; e-mail; produce documents; manage curriculum and administrative tasks; and present electronic information to students.

TL2. Teacher has limited access and use of technology for students. Technology settings and tools for students must be scheduled or shared with multiple users.

TL3. Teacher and students may use technology, but use is not directly related to content objectives.

TL4. Teacher at K-8 is aware of TA TEKS and adopted instructional materials for all students. (www.tea.state.tx.us/technology/ta) Teacher at 9-12 is aware that TA is a required curriculum and that there are adopted instructional materials for TA courses.

TL5. Teacher estimates up to 25% of his/her students have mastered TA TEKS. The State provides instructional materials to support the teaching and evaluation of K-8 TA TEKS and 9-12 TA courses. For other 9-12 courses, teachers should evaluate TA TEKS mastery through students' ability to use technology in the course to acquire information, solve problems, and communicate. TA Guidelines are available for PreK students.

TL6. Teacher has developed supplemental instruction such as reinforcement or enrichment activities and made those available to students through a location on the web.

EP1. Teacher has received training in skills including basic operations skills, electronic attendance, grade book, e-mail, and integrated learning systems.

EP2. Teacher attends large group professional development to learn basic technology skills with little or no follow-up.

EP3. Teacher knows about the SBEC Technology Applications Standards and meets at least one of these standards (www.sbec.state.tx.us/SBECOnline/standtest/standards/techapp.pdf) .

EP4. Teacher attends less than 9 hours of technology professional development annually.

EP5. Teacher has introductory knowledge, skills, and understanding of concepts related to technology. Teacher attends introductory word processing, e-mail basics, operating system training, and integration awareness sessions.

EP6. Teacher has taken professional development on the use of web-based or online learning.

DEVELOPING TECH

TL1. Teacher uses technology to present information to students, to model teacher directed activities, and to complete administrative functions. Teacher directs students to use productivity software applications for technology integration projects with assistance from adopted TA instructional materials. Teacher uses available online library databases and digital diagnostic/assessment tools.

TL2. Students have regular weekly access to desktop computers, laptops, or handheld devices in the classroom, library or labs.

TL3. All students use the same technology tools and participate in the same activities such as writing process activities, research on the Internet and produce projects to reinforce content regardless of their level of knowledge or understanding of the curriculum. Preliminary alignment made between technology and subject areas.

TL4. Teacher occasionally selects and implements TA TEKS appropriate for content area. The adopted TA instructional materials are used to assist in the teaching of the technology knowledge and skills and the integration into the content area (K-8).

TL5. Teacher estimates up to 50% of his/her students have mastered TA TEKS. The State provides instructional materials to support the teaching and evaluation of K-8 TA TEKS and 9-12 TA courses. For other 9-12 courses, teachers should evaluate TA TEKS mastery through students' ability to use technology in the course to acquire information, solve problems, and communicate. TA Guidelines are available for PreK students.

TL6. Teacher has created more than two online lessons that include TEKS aligned content such as explanations, examples, links to online resources, additional activities; class communicates and interacts online.

EP1. Teacher receives professional development on how to integrate technology into the curriculum, help with classroom management skills, and increase teacher productivity.

EP2. Teacher attends and actively participates in large group sessions. Follow-up activities and support are offered to give feedback or coaching in the classroom.

EP3. Teacher is profi cient in two or three of the SBEC Technology Applications Standards (www.sbec.state.tx.us/SBECOnline/standtest/standards/techapp.pdf) . EP4. Teacher attends 9-18 hours of technology professional development each year.

EP5. Teacher modifies instruction through the use of technology (e.g., Internet research to locate contemporary sources, use of word processors for student writing and editing, etc.).

EP6. Teacher has taken professional development on the way classroom content can be adapted from web-based content or for online delivery.

ADVANCED TECH

TL1. Teacher structures classroom learning to student experiences based on inquiry and higher level thinking processes using age appropriate graphics, animation, multimedia, and/or video. Curriculum activities are integrated with technology allowing all students to solve problems and make decisions.

TL2. Students and teachers identify appropriate technology tools; then access and use tools weekly in a variety of flexible settings such as the classroom, libraries, labs, and mobile technologies.

TL3. Technology is available for students to choose the best tools to analyze and synthesize data to make informed decisions, communicate knowledge and understanding of content, and share results with peers and others outside the classroom.

TL4. Teacher consistently integrates Technology Applications TEKS into student instruction, selects and implements TA TEKS appropriate for content area. The adopted TA instructional materials are used to assist in the teaching of the technology knowledge and skills and the integration into the content area.

TL5. Teacher estimates up to 85% of his/her students have mastered TA TEKS. The State provides instructional materials to support the teaching and evaluation of K-8 TA TEKS and 9-12 TA courses. For other 9-12 courses, teachers should evaluate TA TEKS mastery through students' ability to use technology in the course to acquire information, solve problems, and communicate. TA Guidelines are available for PreK students.

TL6 Teacher has created many online lessons that include TEKS aligned content such as explanations, examples, links to online resources, and additional activities; class communicates and interacts online.

EP1. Teacher receives professional development on how to integrate technology to enhance and advance instruction in new ways (i.e., student collection, analysis, and presentation of real-world data, use of edited digital video to synthesize related concepts, cross curricular activities in various content areas, and vertical alignment across grade levels to connect concepts).

EP2. Teacher actively participates in multiple forms of ongoing professional development focused on specific interests (i.e., study groups on a single topic, problem-solving within a content area, modeling, and mentoring other teachers, etc.).

EP3. Teacher is profi cient in four of the SBEC Technology Applications Standards (www.sbec.state.tx.us/SBECOnline/standtest/standards/techapp.pdf) .

EP4. Teacher attends 19-29 hours of technology professional development annually.

EP5. Teacher achieves mastery of technology and uses it to advance higher order thinking skills and thought processes. Teacher no longer thinks about technology separately but uses a variety of technologies and instructional methods in combination to accomplish instructional outcomes.

EP6. Teacher has taken professional development on how to create web-based lessons or how to teach online.

TARGET TECH

TL1. Teacher and students use appropriate technologies as a natural and necessary way of gaining knowledge and understanding. Students have increased control of their learning. Students work with teachers, businesses, higher education, and the community to solve real-world problems.

TL2. Teacher and students have anytime/anywhere access to technology and digital content within the campus, district, home, or community.

TL3. Teacher and students focus on cross-curricular learning using developmentally appropriate instructional strategies and skills that are integrated into the collaborative work of a community.

TL4. Teacher uses a variety of technology tools to seamlessly integrate curriculum TEKS and TA TEKS in content-based learning.

TL5. Teacher estimates 86 to 100% of his/her students have mastered TA TEKS. The State provides instructional materials to support the teaching and evaluation of K-8 TA TEKS and 9-12 TA courses. For other 9-12 courses, teachers should evaluate TA TEKS mastery through students' ability to use technology in the course to acquire information, solve problems, and communicate. TA Guidelines are available for PreK students.

TL6. Teacher has integrated into curriculum TEKS-aligned online lessons that include class content such as explanations, examples, links to online resources, enrichment, and reinforcement; class is communicating and interacting online.

EP1. Teacher continues to participate in professional development experiences but expands his/her influence by collaborating, mentoring, and training others. Teacher encourages the development of student led learning environments.

EP2. Teacher actively pursues additional professional development opportunities based on personal needs and shares within expanded learning communities.

EP3. Teacher is profi cient in all fi ve of the SBEC Technology Applications Standards (www.sbec.state.tx.us/SBECOnline/standtest/standards/techapp.pdf) .

EP4. Teacher attends 30 or more hours of technology professional development annually.

EP5. Teacher uses technology tools in new ways where learning becomes more collaborative, interactive, and customized. Teacher provides opportunities for students to extend their learning with project-based, individualized activities as the norm, resulting in increased student independence and sophisticated products.

EP6. Teacher has taken professional development on how to create and integrate web-based lessons using TEKS-based content, resources, and learning activities.

REFERENCES

Anderson, R., & Becker, H. J. (2001). School investment in instructional technology: teaching, learning, and computing: 1998 National survey.

Archer, J. (1999, February 3). Teachers Suggest the Need for Better Training. *Education Week*, 18(21), 12.

Baker, E., Gearhart, M., & Herman, J. (1990). The Apple classrooms of tomorrow: 1990 UCLA evaluation study (Report to Apple Computer). Los Angeles: UCLA Center for the Study of Evaluation.

Becker, J. D. (1998). Internet use by teachers (report no.1). Teaching, Learning, & Computing.

Becker, H. J. (2000a). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. Contemporary Issues in Technology and Teacher Education [Online serial], 1(2). (Originally published in Journal of Research on Computing in Education, 26(3), 291-321.).

Becker, H. J. (2000b). Findings from the teaching, learning and computing survey: Is larry cuban right? *Education Policy Analysis Archives*, 8(51).

Brophy, J. (1986). Teacher influences on student achievement. *American Psychologist*, 41, 1069-1077.

Brophy, J., & Good, T. (1986). Teacher behavior and student achievement. In M. Wittrock (Ed.), *Third handbook of research on teaching* (pp. 328-375). New York: Macmillan.

Bussey, J., Dormody, T., & VanLeeuwen, D. (2000). Some Factors Predicting the Adoption of Technology Education in New Mexico Public Schools. *Journal of Technology and Teacher Education*, 12(1), 4–17.

CEO Forum on Education and Technology (1997). *School technology and readiness report: From pillars to progress*. Washington, DC: CEO Forum.

CEO Forum on Education and Technology (2000). *The CEO Forum school technology and readiness report. The power of digital learning integrating digital content.* Washington, DC.

Chatman, J. A. (1989). Improving interactional organizational research: A model of person-organization fit. *Academy of Management Review*, 14, 333-349.

Chatman, J. A. (1991). Matching people and organizations: Selection and socialization in public accounting firms. *Administrative Science Quarterly*, 36, 459-484.

Cheung, G. W. (2009). Introducing the latent congruence model for improving the assessment of similarity, agreement, and fit in organizational research. *Organizational Research Methods*, 12(1), 6-33.

Cohen, D. K., Raudenbush, S. W., & Ball, D. L. (2003). Resources, Instruction, and Research. *Educational Evaluation and Policy Analysis*, 25(2), 119-142.

Consortium for School Networking (2003). A School Administrator's Guide To Planning for the Total Cost of New Technology.

Cuban, L. (1986). Teachers and Machines: *The Classroom Use of Technology Since 1920*. New York: Teachers College Press.

Cuban, L. (2000). So much high-tech money invested, so little use and change in practice: How come? In Paper presented at the Council of Chief State School Officers' Annual Technology Leadership Conference, Washington, D.C., January 2000.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: explaining an apparent paradox. *American Educational Research Journal*, 38, 4, 813-834.

Cuban, L. (2003). *Oversold and Underused*: Computers in the Classroom. Harvard University Press.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining and apparent paradox. *American Educational Research Journal*, 38(4): 813-834.

Cuban, L., & Pea, R. (1998). The pros and cons of technology in the classroom. Paper presented at the Funder's Learning Community Meeting Palo Alto, CA, February.

Darling-Hammond, L. (1999). Teaching and Knowledge: Policy issues posed by alternate certification for teachers. Seattle, Washington: Center for the Study of Teaching and Policy, University of Washington.

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

Davis, T., Fuller, M., Jackson, S., Pittman, J., & Sweet, J. (2007). *A National Consideration of Digital Equity*. Washington, D.C.: International Society for Technology in Education.

Demetriadis et al., 2003 S. Demetriadis, A. Barbas, A. Molohides, G. Palaigeorgiou, D. Psillos, & I. Vlahavas et al., Culture in negotiation: Teachers' acceptance/resistance attitudes considering the infusion of technology into schools, *Computers & Education* 41(2003), pp. 19-37.

DuFour, R. (2004). What is a "professional learning community"? *Educational Leadership*, 61(8), 6-11.

DuFour, R., & Eaker, R. (1998). *Professional learning communities at work: best practices for enhancing student achievement.* 1st ed. Alexandria, VA: National Educational Service.

DuFour, R., DuFour, R., Eaker, R., & Karhanek, G. (2004). *Whatever it takes: how professional learning communities respond when kids don't learn.* 1st ed. Bloomington, IN: National Educational Service.

Edwards, J. R. (1993). Problems with the use of profile similarity indices in the study of congruence in organizational research. *Personnel Psycholog*y, 46, 641-665.

Edwards, J. R. (1994). The study of congruence in organizational behavior research: Critique and a proposed alternative. *Organizational Behavior and Human Decision Processes*, 58, 51-100.

Edwards, J. R. (1995). Alternatives to difference scores as dependent variables in the study of congruence in organizational research. **Organizational Behavior and Human Decision Processes**, 64, 307-324.

Edwards, J. R. (1996). An examination of competing versions of the person-environment fit approach to stress. *Academy of Management Journal*, 39(2), 292-339.

Elmore, R. F. (2004). *School Reform from the Inside Out: Policy, Practice, and Performance*. Cambridge: Harvard Education Publishing Group.

Ely, D. (1990). Conditions that facilitate the implementation of educational technology innovations. *Journal of Research on Computing in Education*, 23(2), 298-305.

Ely, D. P., (1999). Conditions that facilitate the implementation of educational technology innovations. *Educational Technology* (39)6, pp. 23-27.

Fullan, M. G. (1992). Visions that blind. *Educational Leadership*, 19-20.

Fulton, K. P. (2003). Redesigning schools to meet 21st century learning needs. *T.H.E. Journal, 30*(9), 30-32,34,36.

Gibson, I. (2001). The role of school administrators in the process of effectively integrating educational technology into school learning environments: New research from the mid-west. In C. Crawford et al. (Eds.), Proceedings of Society for Information Technology and Teacher Education International Conference 2001 (pp. 502-506). Chesapeake, VA: AACE.

Goals 2000: Educate America Act of 1993, S 1150, 103rd Cong., 1st Sess. (1993).

Goor, J., Melmed, A., & Farris, E. Student Use of Computers in Schools. Fall 1980: A Survey of Public School Districts. Fast Response Survey System, Report No. 12. Washington, D.C.: National Center for Education Statistics, 1982.

Granger, C., Morbey, M., Lotherington, H., Owston, R., & Wideman, H. (2002). Factors contributing to teachers' successful implementation of IT. *Journal of Computer Assisted Learning*, 18(4), 480-488.

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

Haberman, M. (2004). Can star teachers create learning communities? *Educational Leadership*, 61(8), 52-56.

Hanushek, E. A. (1989). "The impact of differential expenditures on school performance," *Educational Researcher* 62(May), 45-51.

Hoffman, E. S. (2001). Technology planning and implementation: A study of effective change efforts in Michigan public school districts (Doctoral dissertation, Eastern Michigan University, 2001). Dissertation Abstracts International, A 62/05, 1808.

Hord, S. M. (1997). Professional learning communities: What are they and why are they important?. *Issues About Change*, 6(1).

Hoyle, R. H. (ed.) 1995. *Structural Equation Modeling.* SAGE Publications, Inc. Thousand Oaks, CA.

Hu & Bentler (1999). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives, *Structural Equation Modeling*, 6, 1-31.

Huang, C., & Yang, H. (2005). A Study on the Factors Influencing Technology Readiness for Junior High School Teacher. In C. Crawford et al. (Eds.), Proceedings of Society for Information Technology and Teacher Education International Conference 2005 (pp. 3567-3573). Chesapeake, VA: AACE.

Kirkpatrick, H., & Cuban, L. (1998). Computers make kids smarter—right? *Technos*, 7(2): 26-31.

Kristof, A. L. (1996). Person-organization fit: An integrative review of its conceptualizations, measurement, and implications. *Personnel Psychology*, 49, 1-49.

Kristof-Brown, A. L., & Stevens, C. K. (2001). Goal congruence in project teams: Does the fit Relationship Between P-E Fit and Outcomes between members' personal mastery and performance goals matter? *Journal of Applied Psychology*, 86, 1083-1095.

Marzano, R. J. (2000). *A New Era of School Reform: Going Where the Research Takes Us*. Aurora, CO: Mid-continent Research for Education and Learning.

Marzano, R. J., Waters, T., & McNulty, B. A. (2005). *School Leadership That Works: From Research to Results.* Alexandria, VA: Association for Supervision and Curriculum Development.

Martin, W., Strother, S., Beglau, M., Bates, L., Reitzes, T., Culp, K. M. (Fall 2010). Connecting instructional technology professional development to teacher and student outcomes. *Journal of Research on Technology in Education*, 43, 1. p.53(22).

Means, B., Blando, J., Olson, K., Middleton, T., Morocco, C. C., Remz, A. R., & Zorfass, J. (1993). Using technology to support education reform. Washington, DC: U.S. Government Printing Office.

Mitchell, R. J. (1993). Path analysis: pollination. In: Design and Analysis of Ecological Experiments (Scheiner, S.M. and Gurevitch, J., Eds.). Chapman and Hall, Inc. New York, NY. pp. 211-231.

Moersch, C. (1997). Computer efficiency: Measuring the instructional use of technology. *Learning and Leading With Technology*, pp. 52-56.

Muthen, L. K., & Muthen, B. O. (1998). *Mplus User's Guide*, Los Angeles, CA: Muthen & Muthen.

National Education Technology Plan: Toward a New Golden Age in American Education (2004).

National Research Council (1999). *Making Money Matter: Financing America's Schools*. Washington DC: National Academy Press.

Mooij, T., & Smeets, E., 2001. Modeling and supporting ICT implementation in secondary schools. *Computers & Education* 36, pp. 265-281.

NCES (2003). National Center for Education Statistics, Technology in Schools: Suggestions, Tools and Guidelines for Assessing Technology in Elementary and Secondary Education, Washington, D.C., 2003 l.

NEPT (2004). U.S. Department of Education, Office of Educational Technology, Toward A New Golden Age in American Education: How the Internet, the Law and Today's Students Are Revolutionizing Expectations, Washington, D.C., 2004.

NETS (2008). Essential conditions to make it happen.

NCREL (nd). Critical Issue: Promoting Technology Use in Schools.

Ott, B. C. (2003). The acts of leadership in technology implementation in rural and economically disadvantaged school districts: Selected district personnel perceptions. Ed.D. dissertation, The University of Texas at Austin, United States -- Texas. Retrieved October 4, 2010, from Dissertations & Theses @ University of Texas - Austin.(Publication No. AAT 3110719).

Pagano, R. R. (1994). *Correlation. Understanding statistics in the behavioral sciences* (4th ed., pp. 137-171). St. Paul, MN: West Publishing Company.

Pelavin Research Institute (1997). Investing in School Technology: Strategies to Meet the Funding Challenge. Report prepared for the U.S. Department of Education.

Penuel, W. R., Kim, D. T., Michalchik, V., Lewis, S., Means, B., Murphy, R., Korbak, C., Whaley, A., & Allen, J. E. (2002). Using technology to enhance connections between home and school: A research synthesis. Planning and Evaluation Service, U. S. Department of Education, DHHS Contract #282-00-008-Task 1.

Picciano, A. G. (2002). *Educational leadership and planning for technology* (2nd ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Ravitz, J. L., Wong, Y. T., & Becker, H. J. (1999). Teaching, learning, and computing: Report to participants. Irvine, CA: Research Institute on the Integration of Technology.

Riel, M. M. and Becker, H. J. (2000). The beliefs, practices, and computer use of teacher leaders. In Revised version of a paper presented at the 2000 meeting of the American Educational Research Association.

Ringstaff, C., & Kelley, L. (2002). The Learning Return on our Educational Investment. WestEd.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.

Rockoff, J. E. (2004). The impact of individual teachers on student achievement: evidence from panel data. *American Economic Review* 94(2): 247-252.

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in schools with computer-based technology. *Children and Computer Technology,* 10(2):76-101.

Sanders, W., & Rivers, J. (1996, November). Cumulative and Residual Effects of Teachers on Future Student Academic Achievement. Knoxville, TN.: University of Tennessee Value-Added Research and Assessment Center.

Sandholtz, J. (2001). Learning to Teach with Technology: A Comparison of Teacher Development Programs. *Journal of Technology and Teacher Education*. 9(3), pp. 349-374. Norfolk, VA: AACE.

Reynaldo, J., & Santos, A. (1999). Cronbach's Alpha: A tool for assessing the reliability of scales. *Journal of Extension*, 37(2), 1-5.

Schumacker, R. E., & R. G. Lomax. (1996). *A Beginner's Guide to Structural Equation Modeling.* Lawrence Erlbaum Associates, Inc. Mahwah, NJ.

Sherry, L. (1998). An Integrated Technology Adoption and Diffusion Model. *International Journal of Educational Telecommunications*, 4 (2/3), 113-145.

Smeets, E., Mooij, T., Bamps, H., Bartolome, A., Lowyck, J., Redmond, D., & Steffens, K. (1999). *The impact of information and communication technology on the teacher*. Nijmegen, The Netherlands: ITS.

Solomon, G., & Resta, P. (eds.). (2003). *Toward digital equity: Challenges of bridging the divide in education*. Boston: Allyn and Bacon.

Texas State Board for Educator Certification (2003). Technology Applications Standards,

Texas Education Agency (1988). 1988-2000 Long-Range Plan for Technology of the Texas State Board of Education. Austin, TX: Texas Education Agency.

Texas Education Agency (1996a). The Long-Range Plan for Technology, 1996-2010. Austin, TX: Texas Education Agency.

Texas Education Agency. (1996b). Long-range plan for technology1996-2010: A report to the 75th Texas Legislature from the State Board of Education (GE7 214 01). Austin, TX: Author.

Texas Education Agency (2000a). Progress report on the Texas Long-Range Plan for Technology, 1996-2010. Austin, TX: Texas Education Agency.

Texas Education Agency. (2000b). Academic Excellence Indicator System, State Performance report.

Texas Education Agency. (2001a). Snapshot 2001 School District Profiles State Performance report.

Texas Education Agency. (2001b, December). Progress report on the long-range plan for technology, 1996–2010: A report to the 77th Texas Legislature from the TEA. Austin, TX: Author.

Texas Education Agency (2002). 2002 Update to the long-range plan for technology, 1996-2010: A report to the 78th Texas Legislature from the Texas Educational Agency. Austin, TX: Texas Education Agency.

Texas Education Agency (2004). Texas Teacher STaR Chart. Austin, TX: Texas Education Agency, Educational Technology Unit, Division of Curriculum.

Texas Education Agency (2006). The Long-Range Plan for Technology, 2006-2020. Austin, TX: Texas Education Agency.

Trilling, B., & Hood, P. (1999). Learning, technology, and education reform in the knowledge age or “We’re wired, webbed, and windowed, now what?” *Educational Technology*, 39(3), 5-18.

Ullman. J. B. (2001). *Structural equation modeling (In: Using Multivariate Statistics*, Third Edition, B.G. Tabachnick and L.S. Fidell, Eds.). HarperCollins College Publishers. New York, NY. pp. 709-819.

U.S. Congress, Office of Technology Assessment (1988). Power on: New tools for teaching and learning. Washington, DC: Government Printing Office.

U.S. Congress, Office of Technology Assessment (1995). Teachers and technology: Making the connection. Report Summary. Washington, DC: U.S. Government Printing Office. OTA-EHR-616.

Waters, J. T., Marzano, R. J., & McNulty, B. A. (2003). Balanced leadership: What 30 years of research tells us about the effect of leadership on student achievement. Aurora, CO: Mid-continent Research for Education and Learning.

This dissertation was typed by the author.