A STUDY OF THE RELATIONSHIP BETWEEN LEVELS OF TECHNOLOGY IMPLEMENTATION (LoTi) AND STUDENT PERFORMANCE ON TEXAS ASSESSMENT OF KNOWLEDGE AND SKILLS (TAKS) SCORES

A Record of Study

by

CATHERINE SPOTSWOOD BERKELEY-JONES

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

August 2012

Major Subject: Educational Administration

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and Student Performance on Texas Assessment of Knowledge and Skills (TAKS) Scores

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Approved by:

Chair of Committee,	Virginia Collier
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ABSTRACT

A Study of the Relationship Between Levels of Technology Implementation (LoTi)
and Student Performance on Texas Assessment of Knowledge
and Skills (TAKS) Scores. (August 2012)

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Chair of Advisory Committee: Dr. Virginia Collier

The purpose of this study was to examine teacher Levels of Technology Implementation (LoTi) self-ratings and student Texas Assessment of Knowledge and Skills (TAKS) scores. The study assessed the relationship between LoTi ratings and TAKS scores of 6th, 7th, and 8th grade students as reported in student records at Alamo Heights Independent School District (AHISD), San Antonio, Texas. The study determined the degree to which teacher LoTi self-ratings were a predictor of success on student TAKS exam scores for English Language Arts and Math, as reported in student records at Alamo Heights Independent School District, San Antonio, Texas. Further, the study examined whether teacher self-reported LoTi ratings were a predictor of success on student TAKS exam scores for the variable of socioeconomic status as reported in student records at Alamo Heights Independent School District, San Antonio, Texas.

For the purpose of this study, school and student performance analysis was restricted to the Alamo Heights Junior School in the Alamo Heights Independent School District, San Antonio, Texas. The student data in the study derived from approximately 825 6^{th}, 7^{th}, and 8^{th} grade students who took the math TAKS test in 2009 and approximately 946 6^{th}, 7^{th}, and 8^{th} grade students who took the English Language Arts (ELA) TAKS test in 2009.

The research findings for this study included:

1. In English Language Arts (ELA), a difference in achievement may be inferred between teacher LoTi levels and ELA TAKS scores.
2. In math, a difference in achievement may be inferred between teacher LoTi levels and math TAKS scores.
3. There was not a statistically significant difference between the teacher LoTi level and student mean scores on ELA TAKS for students in the low SES category.
4. There was not a statistically significant difference between the teacher LoTi level and student mean scores on math TAKS for students in the low SES category.

DEDICATION

I dedicate this work in honor of my family and in memory of my parents and brother. With heartfelt appreciation and profound love to my,

- father, Charles Carter Berkeley, Jr., who was a role model for integrity and steadfast source of wise counsel; and my mother, Elsie Lunasco Berkeley, who was both gracious and graceful in her being.
- brother, Norborn Carter “Skip” Berkeley, that you are at peace.
- husband, Cordell – always and forever.
- son, Landon Tomasson Berkeley, and daughter, Caspin Carter McCord, may you each find that which you love and inspires you to revel in the magic of every moment.

ACKNOWLEDGEMENTS

To all who had a hand in this work, on the front lines or behind the scenes, I wish to express my sincere thanks and genuine gratitude.

A special word of thanks to my advisor, Dr. Virginia Collier, for your understanding, encouragement, and enduring patience as I found my way through many transitions. Additionally, thank you to my committee: Dr. Lynn Burlbaw, Dr. Alvin Larke, and Dr. Mario Torres. Further, I wish to acknowledge those who provided additional guidance and support: Dr. Phil Linerode, a special debt of gratitude to you for your support and kindness throughout. A final thank you to the LoTi crew. To Joyce, I promise no more emails, phone calls, or questions.

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CHAPTER I

INTRODUCTION

Educators are increasingly cognizant of the impact technology is having in both the personal and professional arenas of their lives (King, 2002). Technology, though changing daily, has become inextricably linked to virtually every aspect of our existence, and there is mounting evidence of a trend toward pervasive or ubiquitous computing that presents profound implications for education. As a result, educators are responding to relentless requirements at the national, state, and local levels to integrate technology into teaching and learning (Evans, Bond, & Mehlman, 2002; International Society for Technology in Education (ISTE), 2000; King, 2002; Russell, Bebell, O'Dwyer, & O'Connor, 2003; Sandholtz & Reilly, 2004).

Transforming public education into a high technology, high-performance learning organization that provides opportunities for all students to attain high literacy in multiple areas is a sound investment in the intellectual capital of our citizenry and imperative in the preparation of American learners to acquire the fluencies requisite in the Digital Age (Brand, 1997; Branigan, 2002; Conte, 2000; Fulton, 1997; McKenzie, 2002; North Central Regional Educational Laboratory [NCREL], 2002; Wise, 1997). However, how best to accomplish that transformation, ensure and measure to what degree, if any, the effective use of technology may improve student learning and offer a medium to close the achievement gap is the subject of much discourse and debate

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The style for this dissertation follows that of the *American Educational Research Journal*.

(McNabb, Hawkes, & Rouk, 1999; NCREL, 2004; Russell et al., 2003; Wenglinsky, 2006).

Results of a 2004 survey of 200,000 U.S. students by the Net Day project concluded that students are using technology differently today, and because of the technology they are taking different approaches to their lives and their daily activities (Speak Up 2004 Report, 2005). Given the reality of globalization and rapidly accelerating societal change, today's students are active consumers of technology, digital natives who use cell phones, laptops, MP3 players, pagers, and a variety of social networking venues in their daily activities to instant message, email, blog, chat, game, text, download and listen to music, share images, and browse the web, fully expecting to actively participate in and through their media (Bull, Bull, Garofalo, & Harris, 2002; Greaves Group, 2006; Jenkins, Purushotma, Clinton, Weigel, & Robison, 2007; NCREL, 2002; Prensky, 2004). Further, findings from the Speak Up 2007 survey of over 300,000 students in grades 3-12 representing all 50 states reported that students "consistently identify good tech skills as the number one skill they need to be successful in the 21st century" (Speak Up 2007 Report, 2008, p. 3).

A meta-analysis conducted by researchers at the Mid-Continent Research for Education and Learning [McREL] laboratory concluded that there are a number of instructional strategies that have a high probability to positively impact student achievement (Marzano, Pickering, & Pollock, 2001). The integration of technology to support instruction was listed among the instructional strategies that may have a positive impact on improved student achievement. Promising research on learning theory supported the integration of technology into the curriculum to augment opportunities for learners and indicated that technologies might approach their full potential when used as cognitive learning tools that challenge learners to acquire, develop, and cultivate higher order thinking skills (Otero et al., 2005). Increasingly, researchers are seeking confirmation that meaningful use of technology to support learning increases student success. Further, studies continue to reinforce that teachers must use strategies that address identified student needs in a way that promotes the learners' successful achievement of the required accountability standards (Rochelle, Pea, Hoadley, Gordin, & Means, 2000). Toward that end, literature suggests that the most productive and meaningful uses of technology occur in constructivist settings where the teacher becomes a facilitator and learners use technologies to teach themselves and others in a student-centered context that would not be possible without the technology (Boethel & Dimock, 1999; Bull et al., 2002; Jonassen, Peck, & Wilson, 1999; Ravitz, Becker, & Wong, 2000).

Despite research that the appropriate use of technologies for teaching and learning may facilitate constructivist strategies that lead to increasing student achievement, which, absent the technology, might not otherwise be possible, there is consensus among researchers that the advent of computers in the classroom has not led to a transformation of instructional practices among the vast majority of teachers (Brinkerhoff, 2006; Ferdig, 2006; Halverson & Smith, 2009; Ravitz et al., 2000; Russell et al., 2003; Sandholtz & Reilly, 2004). The expectation that teachers integrate technology into the curriculum adds another dimension of complexity to implementing a student-centered learning environment (Boethel & Dimock, 1999) and for many teachers, the constructivist direction of the research findings are a radical departure from the traditional didactic transmission model characterized by the teacher-centered whole class instruction, tightly prescribed seatwork in which students listen, copy text, and memorize information via drill and practice (Pea, as cited in Becker & Ravitz, 2000).

Ferdig (2006) noted that one must judge the effectiveness of technology in the context for which it is meant and further that the value of the innovation must be evaluated pedagogically as it relates to goals and assessments (p. 749). Additionally, Ferdig made the distinction between supporting teachers with pedagogically sound technology and a teachers' ability to make technology pedagogically sound. Fostering the appropriate use of technology as an instructional tool to positively impact student achievement is beyond the scope of strong content knowledge and must include strong pedagogy and pedagogical content knowledge (Margerum-Leys & Marx, 2004; Otero et al., 2005).

Statement of the Problem

Student achievement is the focus of national and state accountability systems and schools are charged with the responsibility of ensuring that all students meet or exceed standards in their respective areas. In an effort to address the national mandate for student achievement goals under NCLB Title II, Part D, Texas, along with numerous other states has incorporated technology elements in the state curriculum. The Texas Long-Range Plan for Technology (TLRPT), 1996-2010 and Chapter 32 of the Texas Education Code made explicit the expectation that all high school graduates are computer literate. The Texas Essential Knowledge and Skills (TEKS), which outlined what each student was expected to know and be able to do at various stages of their education was the basis for the standardized testing instrument, the Texas Assessment of Knowledge and Skills (TAKS). The Technology Application TEKS (TA TEKS), initially formed the basis for the Technology Applications courses, however, in support of the TLRPT, the 78th Legislative Regular Session in 2003 drafted SP 815, signed into law by Governor Rick Perry, which mandated that all school districts in Texas use the TA-TEKS when teaching the entire required curriculum. Teachers were also expected to meet minimum technology standards as delineated in the Texas State Board of Educator Certification (SBEC) requirements (Texas Education Agency [TEA], 2006c). These mandates, in conjunction with a district report card issued by the state that identified the percentage of students in each demographic area that met the passing standard on the TAKS, provided incentive for districts to examine instructional strategies that would increase the passing rates of all students, particularly those who were identified as 'at risk' of failure and by and large comprised the population of victims of the achievement gap.

The education world was quick to adopt the promise of technology and computing. Anticipating the potential of increasing student achievement and a respective role in contributing to the booming economy in the 1990's, schools invested significant amounts of their discretionary funds in hardware, software, and an infrastructure to support the use of digital technologies. Spending increased from $21 to $729 million dollars between 1995 and 2001 and current information estimates billions of dollars spent on technology in schools (Daggett, 2010; Jones & Paolucci, 1998; Trotter, 2007). One report from the U. S. Department of Education (USDOE) noted that in 1998 alone, $7.3 billion of all educational disbursements went to technology and related services, approximately 2.7% of the total expenditures in education for that year; while the average school spent $113 per annum per student on technology, only $22.50 was spent to support teachers (Anderson & Becker, 2001). In the wake of significant expenditures on educational technology one dilemma is whether, and to what degree, technology impacts student achievement. The problem is that a review of existing literature in journals specific to education and technology reveals a paucity of research studies that link technology and student learning outcomes. This record of study contributes to the research on the relationship between the level of technology implementation, as characterized by teachers employing digital-age literacy tools in an instructional setting and the corresponding level of student achievement in math and reading as measured by student scale scores on TAKS, the state standardized testing instrument.

Purpose of the Study

The purpose of this study was to examine Levels of Technology Implementation (LoTi) teacher self-ratings and Texas Assessment of Knowledge and Skills (TAKS) student scores. The study examined to what degree, if any, a relationship exists between LoTi ratings reported by teachers and TAKS scores of 6th, 7th, and 8th grade students obtained from the Public Education Information Management System (PEIMS) and reported in student records at Alamo Heights Junior School in Alamo Heights Independent School District (AHISD), San Antonio, Texas. The study assessed the degree to which teacher self-reported LoTi ratings are a predictor of success on TAKS scores as reported in student records at Alamo Heights Independent School District, San Antonio, Texas. In addition, the study analyzed differences in student performance using economic status as a selected demographic variable as reported in student records at Alamo Heights Independent School District, San Antonio, Texas.

Research Questions

This study was guided by the following research questions:

1. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6th, 7th, and 8th graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?
2. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores among 6th, 7th, and 8th graders whose status is identified as economically disadvantaged in student records at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

Operational Definitions

The findings of this study are to be reviewed within the context of the following definitions of operational terminology that may include interpretation by the author:

Academic Excellence Indicator System (AEIS): Statewide system database that compiles specific information regarding the broad operations and achievements of all Texas state independent school districts and their respective public campuses. The AEIS database includes quantitative reporting on student performance from the Texas Assessment of Knowledge and Skills (TAKS) in the form of scale scores and information from the Public Education Information Management System (PEIMS) (TEA 2011a).

Academic Excellence Indicator System-Improving TAKS (AEIS-IT): An acronym for a comprehensive test data analysis tool developed by the Education Service Center Curriculum Cooperative and available to districts for the purpose of disaggregating TAKS and student demographic data.

DataDirector: A comprehensive data repository of student information and test scores and extensive data analysis tool purchased by AHISD as an ancillary to and ultimately to replace AEIS-IT.

Demographic Variables: Economically disadvantaged status.

Economically Disadvantaged: Student who is eligible for free or reduced-price meals under the National School Lunch and Child Nutrition Program, meets requirements for Title II of the Job Training Partnership Act (JPTA), receives food stamp benefits, or qualifies for other public assistance. In addition, if the student is under the parental or custodial care of a family with an annual income at or below the official federal poverty line regardless of public assistance, are also identified as economically disadvantaged.

Educational Technology: The use of technology to enhance the teaching and learning process.

Levels of Technology Implementation (LoTi): A term referring to a framework designed by Dr. Christopher Moersch in 1994 as a research tool to assess the level of authentic classroom technology implementation. The framework focuses on the use of technology as a tool within the context of student based instruction with an emphasis on higher order thinking. The LoTi framework has been used as a statewide technology use survey, a district school improvement model, and classroom walkthrough tool. Three scores are gleaned from teacher responses to questions designed to measure Current Instructional Practice (CIP), Personal Computer Use (PCU), and Levels of Technology Implementation (LoTi).

Predictor: An item from which one may state, tell about, or make known in advance.

Public Education Information Management System (PEIMS): A statewide data management system for public education information in the state. Student demographic data for Alamo Heights ISD was reported to the state and obtained from the PEIMS database for the purposes of this study (TEA, 2011b).

Relationship: A connection between a dependent and an independent variable as determined by a given statistical test.

Socioeconomic Status: The Texas Education Agency (TEA) categorizes student socioeconomic status as economically disadvantaged or not economically disadvantaged. Students who qualify for the free or reduced-price meal program under the National School Lunch and Child Nutrition Program are classified as economically disadvantaged.

Technology: Examples of technology in an instructional setting include but are not limited to computer work stations with laptop or desktop computers, digital video or still cameras, probes, scanners, digital projection devices, document cameras, wireless slates, televisions, CD-DVD or VCR players, and programmable calculators.

Technology Integration: The use of technology and technology-based practices in the daily routine, administration, and work of a public school institution.

Texas Assessment of Knowledge and Skills (TAKS): Measures student mastery of the Texas Essential Knowledge and Skills (TEKS), the statewide curriculum, in reading at Grades 3-9 and in mathematics at Grades 3-11.

Texas Education Agency (TEA): Comprised of the commissioner of education and agency staff. The TEA and the State Board of Education (SBOE) guide and monitor activities and programs related to public education in Texas. Under the leadership of the commissioner of education, the TEA administers the statewide assessment program, maintains the Public Education Information Management System (PEIMS), a database of information on public schools used for a variety of purposes and operates research and information programs among numerous other duties. The TEA operational costs are supported by both state and federal funds.

Assumptions

1. The administration of the LoTi survey by the Alamo Heights Junior School was managed according to recommended guidelines for administration of the survey.

2. The respondents surveyed understood the scope of the study, the language of the instrument, were competent in self-reporting, and responded objectively and honestly to report a true reflection of their use of technology.
3. The methodology proposed and described here offered a logical and appropriate design for this particular research project.

Limitations

1. The study was limited to teachers at the Junior School in the Alamo Heights Independent School District in San Antonio, Texas.
2. The study was limited to the information acquired from the literature reviews, achievement data on TAKS, and the teacher self-report on the LoTi survey instrument.

Significance of the Study

The intent of this study was to determine whether there was a relationship between a LoTi level based on teachers' self-report and the TAKS scores of 6^{th}, 7^{th}, and 8^{th} grade students in Alamo Heights Independent School District. There is an abundance of research on technology in schools; however, due to inherent challenges in the nature of the studies, there is a paucity of studies that provide quantitative data to address the relationship between teacher levels of technology implementation and the impact of education technology on student achievement (Wenglinsky, 1998). In *A Retrospective of Twenty Years in Education Technology Policy*, Culp, Honey, and Mandinach (2003) noted in their findings that:

> The call for research on the impact of educational technology on schools and teaching and learning activities is a final constant theme over the past twenty years of reports. Every report recommends, at minimum, some sort of research or evaluation of the impact of education technology on students. (p. 15)

This study focused on a specific population, 6^{th}, 7^{th}, and 8^{th} grade teachers, and students in Alamo Heights Independent School District to investigate instructional practices as they related to technology implementation and student achievement as measured by state standardized test scores. Through a review of results of teacher responses to the LoTi, Level of Technology Implementation survey, and student results on TAKS, this research offers information to district leaders about how to allot resources to optimize potential for improving student achievement and contributes to existing literature to determine appropriate points of entry for further study on the impact of specific instructional practices that include fluency in utilizing digital-age tools and resources, levels of technology implementation, and student achievement.

Organization of the Record of Study

The record of study is segmented into five major areas of focus. Chapter I includes the introduction, a statement of the problem, the purpose for the study, research questions, operational definitions, assumptions, limitations, and statement of significance. Chapter II contains a review of the literature relevant to the integration of technology. Chapter III outlines the methodology and procedures of the research and report for the record of study to include a description of the population and instrumentation as elements of the study. Chapter IV is guided by the research questions and details the analysis and comparison of the data collected during the study. Chapter V highlights the researcher’s findings comprising implications, conclusions, and recommendations for further study.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this portion of the study is to highlight germane elements of research and this review of literature encompasses five areas. Section one outlines the characteristics of multimedia savvy 21st century learners and posits the potential of a public school system that provides a technology-rich learning environment. Its purpose is to frame the milieu in which the integration of technology in classrooms became imperative. Section two traces the historical evolution and inherent challenges of government and institutional policies that shape integrating technology in education as a tool to enhance student learning. Section three addresses current national and state standards of technology accountability and efforts at the state and local district level to comply. Further, this section speaks to various methods used to measure compliance with national and state technology standards. Section four targets the problematic nature of distinguishing between the roles of technology and pedagogical practice in student achievement.

Specifically, this section describes the Levels of Technology Implementation (LoTi) process as a means for assessing teachers' perceptions of their progress toward implementing technology in their classroom providing the contextual basis for this record of study. Section five explores research on the integration of technology tools in the classroom as it relates to an increase in student achievement. As schools clamor to increase levels of student achievement, the paucity of research in the field linking technology integration to that goal is evident (Culp et al., 2003).

Characteristics of 21st Century Learners

Communities and schools across North America advocate the infusion of technology tools into the national educational system so that all students reap the benefits of a technologically sophisticated learning environment and become fluent in multiple, layered literacies to include digital, visual, informational, textual, and technological. Many believe these skills to be tantamount to providing a quality education in the 21st century that promotes global awareness; financial, economic, and business acumen; as well as civic responsibility, and participatory citizenship (American Association of School Librarians [AASL], 2007; Box, Burkhardt, Fadel, Hurley, Trilling, & Wilson, 2009; Brand, 1997; Lemke, Coughlin, Thadani, & Martin, 2003; Salpeter, 2003; Szuba, Rogers, & Malitz, 2005; U.S. Department of Labor (USDL), 1991).

In a world that is changing at a seemingly frenetic pace, high-performing organizations that will prepare learners to thrive in an environment that is technologically rich and dynamic and empower United States citizens to maintain status as a viable world presence are required. Education must, therefore, undergo systemic transformation and educators face the daunting challenge of meeting the needs of this generation of learners who have grown up with digital technologies and learn differently than their predecessors (Barnes, Marateo, & Ferris, 2007; Daggett, 2005; Halverson & Smith, 2009; Tapscott, 1998; TEA, 2008; USDL, 1991, 1992). Data from the Speak Up 2009 Report (2010a) indicated that students envision their learning environment to be social-based, un-tethered, and digitally rich. Consequently, students are using advanced communications and collaboration tools seamlessly in many aspects of their technology-infused lives.

Anticipating potential changes to the current educational system to accommodate learners' ever-increasing access to technologies is an immense undertaking, and integrating technology into the instructional setting requires a commensurate investment in building a human infrastructure to support the endeavor (Brown, 2000; Brown & Adler, 2008; Council of Chief State School Officers (CCSSO), 2006; Ertmer, 1999; MacArthur Foundation, 2006; USDOE, 2010). Yet, the integration of technology into the national education system is imperative in the preparation of American learners to become fluent in the skills and knowledge of those technologies that are essential in adapting and meeting 21st century challenges in a global information age (Brand, 1997; Conte, 2000; McKenzie, 1998; NCREL, 2002). As integration efforts continued, former Secretary of Education, Richard W. Riley noted, "we are far enough along in the technological revolution and its application to learning that it is time for systematic review and analysis of what works best" (McNabb et al., 1999, opening page). He went on to state that the appropriate integration of technologies into education was one possible means of achieving the necessary changes. In the introduction to Project Red, the former Governor of Maine, Angus King (as cited in Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010) pointedly noted, "A person's economic future depends on brains, not brawn, and the best brains, or maybe more accurately, the best trained brains, will win….The modern world needs citizens who are 'learning learning' and can do what they were not taught" (forward). King (as cited in Greaves et al., 2010) advised that ubiquitous technology, well-prepared and well-led teachers are required elements of successful transformation.

Beginning in 2012, the National Assessment of Educational Progress (NAEP), widely known as the Nation's Report Card, will include a framework for measuring students' technology acumen, along with measuring their proficiency in math, science, history, reading and other subjects, marking the first time students' technology literacy will be assessed on a national scale ("On the Way," 2008). The NAEP is the only nationally representative database of academic performance for American students and taking this step affirms the imperative to ensure their ability to understand and use the immensely powerful technology tools that are an integral component of the international domain in which they will compete.

> Reading, math and science are the foundations of student achievement. But to compete and win in the global economy, today's students and tomorrow's leaders need another set of knowledge and skills. These 21st century skills include the development of global awareness and the ability to collaborate and communicate and analyze and address problems. And they need to rely on critical thinking and problem solving to create innovative solutions to the issues facing our world. Every child should have the opportunity to acquire and master these skills and our schools play a vital role in making this happen. (Dell, as cited in Box et al., 2009, p. 4)

Technology is fast becoming a vital component of mainstream education and the integration of technologies as information and instructional tools may significantly enhance student learning. Teachers today must make strategic decisions about how to make the best use of instructional time and educational objectives must clearly align with local, state, and national standards that now include significant technology elements. Unfortunately, all too often new technologies, if used at all, are being used to support traditional teaching practices (Apple, 2002; Learning for the 21st Century, 2002; McKenzie, 1998; Means, 2010; Rogers, 2001; Vannatta & Fordham, 2004; Wise, 1997) or may be marginalized or banned to preclude the perceived threat of disruption to the learning environment (Christensen, Johnson, & Horn, 2008). In that context, technologies become mere productivity and management tools that, though they may assist teachers in working more efficiently to develop and deliver lesson plans, communicate with students and the extended learning community, and continue professional growth, the technologies fall short as tools to transform current practice and enhance learning (Fadel & Lemke, 2006; Fishman, Marx, Blumenfeld, Krajcik, & Soloway, 2004; Fulton, 1997). Though a conventional approach may be appropriate in many cases, the use of technology tools may significantly augment what teachers are able to do, providing options that are not possible without the technology (Bull et al., 2002). Rogers (2001) of the Global SchoolNet Foundation observed that

> If we consider their impact on the normal life of the average American classroom, without question computers have failed to deliver the transformation in learning that has been promised and promoted over the past fifteen years. Walk into most any classroom in most any school in America today and you'll walk into a time warp where the basic tools of learning have not changed in decades….Teachers simply have not embraced the computer as a basic tool of learning. (p. 1)

In addition to changing how people learn, technology also affects what they need to learn. Promising research on learning theory supports the integration of technology into the curriculum to augment opportunities for learners. Further, research indicates that technologies might approach their full potential capacity when used as "mindtools" or cognitive learning tools that challenge learners to acquire, develop, and cultivate cognitive skills while distributing expectations for outcomes to learners or technologies respectively according to which would most appropriately accomplish the task at hand (Jenkins et al., 2007; Jonassen, 1994; Salomon, Perkins, & Globerson, 1991). Goodlad (as cited in Coughlin & Lemke, 1999) has stated that “The biggest mistake we could make…is to assume that the challenge is to prepare teachers to do the usual things better” (p. 4). If our schools fail, then our society and the greater global society will fail. Whatever it costs, the price of failure will be greater than the price of education. Our children are worth it. Our planet is worth it (Costa, 1996).

Despite the technological advances in American society, teachers in general tend to continue practicing in a traditional classroom context often using outdated paradigms. Teacher-centered instructional delivery systems, though appropriate at times, do not include models such as those promoting a student-centered construction of knowledge that could amplify opportunities for learners via the appropriate integration of technologies (Brogden & Couros, 2007; Cuban, 2000; Jonassen et al., 1999; McKenzie, 1991; Rogers, 2001; Wise, 1997). Robertson (2003) cautioned, “the task of the educational system should be to embrace the future and empower children to learn with the tools available to them” (p. 292). It is important to remember that technologies are tools and with their use comes the incumbent responsibility of communities and districts to evaluate all available resources to determine and implement appropriate methods and contexts within which to improve students’ learning.

A glaring irony in public education is exposed when one examines the pedagogy and methodology in classrooms across America to find that computers and information technologies are not an integral part of the teaching process. By and large, in contrast to the rapidly advancing global technological innovations surrounding them, teachers and learners in American public schools are far from being accustomed to the appropriate and efficient integration of instructional and information technologies into classrooms and curricula thereby creating a “digital disconnect” (McHale, 2005; Sherry & Jesse, 2000). There is a gap between increasingly technology savvy students and their schools as the revolution that was anticipated to take place in classrooms as a result of new technologies took place outside the schools as students used their own mobile devices that were often banned in school (Halverson & Smith, 2009).

Seemingly, learning outdated 20th century skills while living in the innovative 21st century is shortchanging students of the “Media Generation,” the “media multitaskers” who have access to, and are immersed in, a vast and expanding array of media to which they have become accustomed (Roberts & Foehr, 2008; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010a). Conventional wisdom may indicate that traditional models of schools are culturally and institutionally entrenched or that current accountability systems reinforce a teacher-directed, whole-class delivery style though there is a growing body of knowledge suggesting that improved professional development may contribute to bridging the gap (Hill, Reeves, & Heidemeier, 2000; Lemke, Coughlin, & Reifsneider, 2009; Levin & Arafeh, 2002; Prensky, 2008; Russell et al., 2003). In this context, many posit the challenge of envisioning and instituting a 21st century school system (Pearlman, 2009; Salpeter, 2003).

Transcending the current model of traditional practice necessitates a paradigm shift from a conventional model toward a more constructivist orientation if indeed students are to be at the center of their own learning and capable of taking full advantage of the new environments for learning afforded by technologies (NCREL, 2002; Pearlman, 2009; Salpeter, 2003; Stein, McRobbie, & Ginns, 2002; Windschitl & Sahl, 2002). A student-centered model for learning applies to pupils of all ages. Resurgent and emerging research reflects an emphasis on self-directed learning for both students in the form of constructivist models and teachers in the form of redesigned approaches to professional development (Beatty, 1999; Birman, Desimone, Porter, & Garet, 2000; Mizell, 2001). Promising research confirming the requisite transformation compels the examination and refinement of professional development models to reflect the evolving context of teaching and learning (Becker & Ravitz, 2000; Culp et al., 2003; King, 2002; Russell et al., 2003). Self-directed professional development embedded within the job and supported by a framework of collegiality and reflection is proving to be a solid foundation both for personal and institutional growth (Bybee & Loucks-Horsley, 2000; Guskey, 2000; Putnam & Borko, 2000; Schrum, 1999).

Historical Evolution of Technology Integration in the Classroom

The National Commission on Excellence in Education (NCEE) was created in 1983 by then Secretary of Education, T. H. Bell, with a directive to examine the quality of education in the United States and issue a report on the findings. In the wake of the now infamous diatribe, an open letter to the American people in the form of *A Nation at Risk*, the commission cited deficiencies in virtually every aspect of the American educational system to include: (a) curricular content, (b) teacher expectations, (c) time spent in and out of the classroom, and (d) the shortage of teachers and the inadequate preparation of those who teach. Among the recommendations that followed from the now defunct report, The National Commission on Excellence in Education (1983) suggested that new instructional materials include the most recent uses of technology in appropriate curriculum areas. A myriad of responses ensued across the country, both supporting and refuting the findings. Nonetheless, education and educators received increasing scrutiny amidst widespread calls for reform.

In March of 1994, the Goals 2000: Educate America Act (P.L. 103-227) was signed into law for the purpose of providing resources to ensure that students would ultimately acquire the knowledge and skills necessary to live and work in the 21st century (NCREL, 1994). The imperative to integrate technology into the United States educational arena began in earnest with, then U.S. Secretary of Education, Richard W. Riley's announcement in 1996 that $23 million dollars would be allocated in the form of Challenge Grants for Technology in Education.

The Texas State Board of Education (SBOE) had authored an initial long-range plan for technology in November of 1988 that required biennial reports to the governor and legislature detailing progress toward the implementation of the plan (TEA, 1988). Fourteen years hence, changes in the technology landscape and legislation mandated a revision of the original plan. In 1996, the Texas State Board of Education developed a revised Long-Range Plan for Technology 1996-2010 (LRPT) for review by the Texas legislative body. The revised Texas Long-Range Plan for Technology included attention to the continuing modifications to practice in the areas of Teaching and Learning, Educator Preparation and Development, Administration and Support Services, and Infrastructure for Technology, and their respective effect on students and learning.

In 2001, the No Child Left Behind Act (NCLB) (USDOE, 2002) was instituted and in 2002 the Texas Long Range Plan for Technology, 1996-2010 was revised in an effort to align the Texas goals and objectives with the national NCLB plan to guarantee federal funds for technology for the students of Texas. Title II, Part D of the NCLB, referred to as the “Enhancing Education Through Technology Act of 2001,” specifically addressed as its primary goal, the intent to improve academic achievement of both elementary and secondary students through a comprehensive system that utilizes technology effectively. Additionally, Title II, Part D encouraged states to seek partnerships with public or private entities and to develop an infrastructure to increase access to technology in schools, promote initiatives to increase the capacity for technology integration, enhance further professional development of teachers and administrators via electronic means, and to utilize electronic networks and innovative methods of curriculum delivery. Further, the plan promoted family involvement in the education of their children and included a call for rigorous evaluation of federally funded programs specific to the area of student achievement (USDOE, 2004).

In 2002, the U.S. Department of Education provided an executive summary of The No Child Left Behind (NCLB) legislation with recommendations that, when implemented, provided states with more flexibility in the use of federal monies in education. The summary specifically articulated that states were given the authority to apply up to 50% of federal funding received from four major programs: (a) Teacher Quality, (b) Educational Technology, (c) Innovative Programs, or (d) Safe and Drug-Free schools, toward any one of those programs or to support Title I programs. This revision allowed states greater flexibility in applying federal funds toward technology initiatives. Key concepts of the technology integration component of the NCLB, Title II, Part D, included building a technology infrastructure that would enable the integration of technology into the curriculum and increase access to technology and information for both students and parents. As stated in Title II, Part D, "the primary goal of this part is to improve student academic achievement through the use of technology in elementary and secondary schools" (USDOE, 2001, p. 34).

Additional goals stated in NCLB legislation of 2001, included ensuring that all students be technologically literate by completion of eighth grade, and that resources be allocated to support professional development for teachers in order to support research-based instructional models that state and local educational agencies would implement as best practices. In support of the mandate, Title II, Part D, Sec. 2416 Local of the NCLB Act of 2001 further delineated that no less than 25% of allocated funds be directed toward "ongoing, sustained, and intensive, high-quality professional development in the integration of advanced technologies, including emerging technologies into curricula and instruction and in using those technologies to create new learning environments" (USDOE, 2001, p. 34). Though the NCLB provided a directive to incorporate technology into the public school curriculum, there was no framework upon which to build and no existing nationwide requirements or common definitions for technological literacy.

Driven by requirements of the NCLB and continuing changes in technology and in education, the U.S. Department of Education (2004) issued a report, *Toward a New Golden Age in American Education,* which stated that the United States would continue to face the ever-increasing demands and competition of a global economy. Further, the report stated that to an overwhelming extent, mastery, and application of new technologies would be essential to secure the country's economic future.

The U.S. Department of Education (2004) worked in concert with the International Society for Technology in Education (ISTE) to develop the National Educational Technology Standards for Students (NETS-S). NETS-S provided a guideline for states to incorporate principles into each content area that increased in complexity with each grade level and outlined the expectation that students be technologically literate for matriculation to high school. The original standards released in 1998 spanned six categories and included (a) basic operations and concepts; (b) social, ethical, and human issues regarding technology; (c) technology productivity tools; (d) technology communication tools; (e) technology research tools and technology problem-solving; and (f) decision-making tools (ISTE, 1998) (Appendix A). Reflecting the changing dynamic in technology education, ISTE launched the NETS refresh effort in 2006 and revised the NET-S in 2007 to promote authentic, integrated ways for students to amplify skills that enabled them to contribute productively in a global society. Replacing the original standards were the six core understandings that included:

(a) creativity and innovation; (b) communication and collaboration; (c) research and information fluency; (d) critical thinking, problem solving, and decision making; (e) digital citizenship, and (f) technology operations and concepts (ISTE, 2007) (Appendix B).

The release of the National Education Technology Plan (NETP) by the U.S. Department of Education (2004), again mandated an update and Texas took the lead to align the state long-range technology goals with the goals and legislative requirements of the NCLB, specific to Title II, Part D. The Texas Educational Technology Advisory Committee completed a two-year research study that led to the Texas Long Range Plan for Technology, 2006-2020 (TEA, 2006b). The plan was divided into three phases: Phase I 2006-2010, Phase II 2011-2015, and Phase III 2016-2020. Essential elements of the plan and notable revisions of the original TLRPT included articulated technology proficiencies, required professional development, focused technology planning and dedicated resources, and specified expectations of the plan. Receiving much attention was the Technology Proficiency component of the plan, Vision 2020, that stated,

> All professional educators (including teachers, administrators, and librarians) must master the State Board for Educator Certification (SBEC) Technology Applications standards, which are currently mandated for all beginning teachers….Students beginning in kindergarten are required to master the state Technology Applications Texas Essential Knowledge and Skills (TA TEKS) and demonstrate that they are technology literate with the needed proficiencies to acquire information, solve problems, and communicate using technology. (TEA, 2006a, p. 2)

In a sweeping statement of the intent to integrate technology into the curriculum, the SBOE mandated that the Texas Essential Knowledge and Skills (TEKS), a required curriculum framework for all core content areas, reflect 21st century skills and decreed that information and communication literacy skills be fully integrated into core content instruction. The Technology Applications TEKS were embedded into the core content area TEKS with a statement that the Texas Assessment of Knowledge and Skills (TAKS) test reflect the varied skill sets requisite for citizens to maintain economic stability and function in a global, information age.

TEA released a summary progress report to the 81st Texas Legislature that outlined key findings documented from the implementation of Phase I of the TLRPT. Among results from the Texas Technology Immersion Project (TxTIP), data supported that the technology immersion had a statistically significant effect on TAKS mathematics achievement and further that as teachers and students became more accomplished technology users, the effects of the technology immersion on reading and mathematics achievement measured by TAKS scores generally increased (TEA, 2008). Texas is entering Phase II of the Long-Range Plan for Technology that will span 2011-2015.

The recently released revision of the National Educational Technology Plan, *Transforming American Education: Learning Powered by Technology*, clearly outlines an expectation that technology be an integral element of all aspects of the educational system (USDOE, 2010). The plan addresses five critical areas: (a) learning, (b) assessment, (c) teaching, (d) infrastructure, and (e) productivity and calls on the nation to transform education in America, to challenge basic educational assumptions and to redesign the educational system in a way that incorporates 21st century skill development into every aspect of teaching and learning (USDOE, 2010).

National, State, and Local Standards of Accountability

In the face of patterns of teaching that may span decades, education remains a dynamic system, simultaneously exhilarating and exhausting, in which teachers' pedagogical practices and philosophies are constantly challenged (Becker & Ravitz, 2000; King, 2002; Learning for the 21st Century, 2002). With each successive generation come greater challenges and conquests. Many technologies have been created over time, from typewriters to calculators, computers and personal mobile devices, and with them the call to incorporate their use into the educational landscape (CCSSO, 2006; Klopfer, Osterweil, Groff, & Haas, 2009). However, Brunner and Tally (1999) observed that educational technologies command such focus and attention that the human side of education is often forgotten (Tell, 2000). Larger percentages of the population have access to public schools than at any time in the history of our nation and yet we have not resolved the dilemma of inequity in the system (Pfeiffer, 2008; Phillips & Chin, 2003). Former Secretary of Education, Rod Paige, observed that nearly 50 years after the Civil Rights movement, inequality still has a stronghold in America's classrooms (Paige & Witty, 2010). A new didactic digital divide developed based on varied levels of acquisition of basic technological, cultural, scientific, mathematical, visual, and information literacy's and the potential segregation of citizens who had access to, and the know how to access and use, the information from those who did not (Bull et al., 2002; NCREL, 2002; Rideout, Roberts, & Foehr, 2005; Roberts & Foehr, 2008; Warschauer, Knobel, & Stone, 2004). In light of this development, many looked to the integration of technology in public school classrooms as a means to provide more equitable educational opportunities for all (Hall, 2006; Oblinger & Oblinger, 2005; Pearlman, 2009). Conversations vis-à-vis the appropriate integration of technologies indicated both pain and possibility concerning the lifespan and potential impact of the digital divide phenomena (Dickard & Schneider, 2002; Hall, 2006; Ito et al., 2008).

Calls for improved practice, reform, and accountability in education are signposts of every era as the public engages in debate about how best to meet the educational needs of our society. Witness the focus on education during the Presidential Campaign of 2000 as incumbent Bill Clinton vacated his position and then vice-president Al Gore and then Governor of Texas, George W. Bush, Jr., though they differed on specifics, each elevated education to the top of their respective policy agenda. National and state standards presented a vision of technology-rich classrooms that were a significant departure from the arena in which most of today's teachers were students (McHale, 2005; Otero et al., 2005). Politicians and educators have become keenly aware of the educational implications of technological advances evidenced by their support and the vast amounts of resources that continued to flow to build an infrastructure upon which to place additional computers and Internet connectivity in classrooms across the nation (Barron, Kemker, Harmes, & Kalaydjian, 2003; Kalmbacher, 2004). Yet the importance of teachers and students, and of teaching and learning, is easily lost amid continuing conversations regarding technology integration in schools that tend to focus on infrastructure, hardware, and software issues. As political and educational institutions sprinted to provide hardware and software to teachers and students in schools, evidence indicated that few American teachers felt adequately prepared to use technologies for any purpose and much less ready to effectively integrate technologies in the classroom (Breuleux, Baker, & Pagliaroli, 1998; Conte, 2000; McKenzie, 2001; TEA, 2008). Evaluating technology integration and designing appropriate accountability measures is situational and takes time and commitment (Brogden & Couros, 2007). Clearly an emphasis on teacher professional development and student learning is paramount to appropriate and effective use of technologies in the classroom and attempts to diminish the digital divide phenomena (Fadel & Lemke, 2006).

"The medium is not the literacy" (McKenzie, 2002, p. 1) and though the integration of technology appeared to be a panacea for some, a greater than ever focus on standards and accountability left states and districts with the formidable task of determining how best to substantiate specific programs and practices. Pressure at all levels was being leveraged to produce accountability, yet little research was available that provided a direct correlation between technology integration and improved student learning. As the public continued to question schools and schooling in the United States, national and state standards centering student performance on standardized tests as the measure by which to gauge the success of individual teachers and districts, placed more of the burden of accountability on teachers. Yet, commensurate support for teacher professional development and training to effectively integrate technology meaningfully into instruction was insufficient and the public and educators began to acknowledge that merely having the technology in place would not directly result in further educational attainment for students (King, 2002; Vail, 2003). The issue of teaching and learning moved to the forefront of conversations that endorsed restructuring and focused efforts on research that attempted to measure the effect of appropriate technology integration (Ferdig, 2006).

Professionalism of teachers was at a crossroads as political forces rallied to improve the educational system (Fullan & Stiegelbauer, 1991; Pearlman, 2009; Salpeter, 2003). Teachers wanted to know how technology would improve their practice, parents wanted to know whether their children were receiving a good education, administrators wanted to know whether technology professional development facilitated appropriate integration, the public wanted assurance that their tax dollars were well spent, and legislators wanted to know how well schools were doing (Guskey, 2000; Johnston & Barker, 2002; McNabb et al., 1999). Consequently, the goal of integrating information and communication technologies spawned a critical look at technology integration efforts in schools and the nature of professional development for teachers (Breuleux et al., 1998; Pitcher, 1998; Rodriguez & Knuth, 2000). Overall, research literature affirms that teacher quality is a critical factor in student learning and further indicates that effective professional development plays a key role in improving teacher quality (Center for Public Education [CPE], 2005; Colbert, Brown, Choi, & Thomas, 2008; Darling-Hammond, 2000; Wong, 2007). In their critical issue written for NCREL, Rodriguez and Knuth (2000) cited Darling-Hammond and Berry by noting that teacher quality is the most important factor in student learning. If we are to improve student learning, we must focus on the synergy between students and teachers engaged in the learning process.

Technologies have the potential to affect every person in public education yet challenges to the integration of technologies are many. Reticent teachers contributed to the challenge of transparent infusion of technology into the curriculum. The 1995 Office of Technology Assessment report noted that numerous obstacles to technology integration included the lack of time, limited resources, faculty attitudes and comfort levels, and little institutional support for technology use in the classroom (Beck & Wynn, 1998). However, the advent of the No Child Left Behind Act (NCLB) of 2001 (USDOE, 2002) altered the landscape of technology use in schools imposing new requirements on schools, school districts, and states to meet federal guidelines for accountability. Interestingly, the directive for states to provide the public with disaggregated data that allowed comparison of achievement across varied demographics of student populations led to the increased use of technologies at an administrative level that would ultimately strengthen the infrastructure for technology use in the classroom (Anderson, 2005; Halverson & Smith, 2009).

The trend emphasis is directed toward integrating technology into the curriculum to achieve the goal of graduating students prepared to enter the 21st century with commensurate skills to maintain the competitive edge the United States holds in the global economy (Brogden & Couros, 2007; Olson, 2004; Pearlman, 2009; USDOE, 2010). With that in mind, there are tools in place at the national, state, and local level designed to increase the degree of technology integration into teaching and learning and research efforts underway to gauge effectiveness (Pitcher, 1998).

In addition to the (NETS-S) designed for students in 1998 and refreshed in 2007, ISTE, mentioned previously, developed a series of standards to include teachers, administrators, coaches, and computer science teachers. The standards for teachers

(NETS-T) were released in 2000 as a guideline of six performance indicators teachers should meet (Appendix C). Soon to follow, standards for administrators (NETS-A) were released in 2002 to assist in evaluating areas considered critical for school administrators to effectively support digital age learning and technology implementation (Appendix D). The NETS-T and NETS-A were reviewed and, through an extensive process including a town hall model for soliciting nationwide input, refreshed for release in 2008 and 2009 respectively. The refreshed NETS-T focused on creativity, developing and modeling digital age learning experiences, and professional leadership in contrast to the original productivity-oriented standards (Appendix E).

Similarly, the initial NETS-A emphasized the mechanical aspects of administration; the refreshed NETS-A addressed sustaining a digital age learning culture, inspiring shared vision in support of comprehensive technology integration, and professional learning to foster the infusion of contemporary technologies (Appendix F). Further, ISTE developed criteria and an insignia that, when emblazoned on local or state technology plans, indicated alignment with ISTE standards. At the state level, “48 of the 50 states have adopted, adapted, or aligned or otherwise referenced at least one set of standards in their state technology plans, certification, licensure, curriculum plans, assessment plans, or other official state documents” (Roblyer, 2003, p. 10). According to the 2003 NETS report by state, Texas has adopted, adapted, or aligned the NETS-T and has referenced both the NETS-S and NETS-A in some form of state documentation (NETS by State, 2003). Additionally, Texas earned an overall grade of “B” from the Technology Counts 2007: A Digital Decade (2007) state-focused reporting system based on standards rating access to, use of, and capacity to use technology within the state. The report further noted that the capacity to use technology score in Texas stems from state efforts to include expectations for technology use in the areas of teacher standards, administrator standards, initial teacher-license requirements, and initial administrator-license requirements.

The State of Texas created numerous initiatives to support technology integration with a complete restructuring of standards focused on what educators should know and be able to do, in lieu of a list of courses to complete, an area in which no previous standards had been articulated (Freebody, Reimann, & Tiu, 2008). Texas State Board for Educator Certification (SBEC) approved certification standards in Technology Applications for all beginning teachers, based on the Technology Applications TEKS (TA TEKS) for Grades 6-8. In fact, the Technology Application standards for all beginning teachers contain essentially the same elements as the Technology Application standards noted in the TEKS for 8th grade students. The TA TEKS is part of a required enrichment curriculum focusing on teaching and learning technology skills. However, they were not intended to be taught in isolation, rather they are to be embedded within the core area TEKS and the state-devised accountability measures such as the STaR Chart system and district accountability requirements to ensure that the standards are met.

In 2002, the standards became part of the Texas Examination of Educator Standards (TExES) test frameworks for pedagogy and professional development required of all new teachers seeking certification in Texas. SBEC further recommended that districts require all current teachers to demonstrate that they meet or exceed proficiencies stated in the Technology Application Standards I-V. The state anticipated that one element of the NCLB Highly Qualified teacher accountability included documentation of technology proficiency. To ensure that there were teachers with special training to assist fellow teachers and students with integrating technology into the curriculum, the 77th Texas Legislature passed House Bill 1475 that mandated a Master Technology Teacher Certification implemented in 2003. The State Board for Educator Certification (SBEC) in Texas stated that the certification was developed to endorse teachers whose primary purpose would be to serve as a mentor to other teachers in the field of technology instruction. Additionally, Proclamation 2001 was issued in May of 2001 and called for the inclusion of instructional materials in the textbook adoption process that would be available on a subscription basis and address the Technology Application TEKS and standards.

Further affirming the imperative to integrate technology into the curriculum, the Texas Education Agency (2006a) created the School Technology and Readiness (STaR) chart as a self-assessment tool to measure the degree to which districts, campuses, and individual teachers in the state progressed toward meeting the goal of “target tech” delineated in the TLRPT. The STaR chart was implemented in three stages: (a) the first required districts to complete a summary district report, (b) the second required individual campus reports as the basis for the district summary; and (c) the third stage, implemented in 2004-2005 on a voluntary basis by district, requested that each teacher complete an individual teacher STaR chart rubric (Appendix G). By 2006-2007, completion of the online teacher STaR chart rubric was required for all public school teachers. Teachers in Alamo Heights Independent School District, the focus group for this record of study, participated in completing the online teacher STaR chart assessment since its inception as a voluntary tool in 2004-2005.

The Texas Teacher STaR chart results are designed to provide supporting data for the completion of the Texas Campus STaR chart, which in turn is designed to provide supporting data for the Texas District STaR chart (Table 2.1). The teacher STaR chart rubric and the various questions comprised within measured four key areas that aligned with the TLRPT 2006-2020: (a) teaching and learning; (b) educator preparation and development; (c) leadership, administration, and instructional support; and (d) infrastructure for technology. There are six focus elements or categories within each of the four key areas of the teacher STaR chart and for each of the six focus elements, teachers responded by choosing one of four levels of that categorized their progress as (a) early tech, (b) developing tech, (c) advanced tech, or (d) target tech.

The leveled performance descriptors assisted teachers as they self-assessed their progress toward meeting “target tech” goals. Indicators in the teaching and learning and the educator preparation and development areas reflected a teacher’s self-assessed level of proficiency in the respective area. A teacher may have indicators in more than one area of progress in which case, the teacher should select the one level that is the best descriptor of technology proficiency. Indicators in the leadership, administration, and instructional support and infrastructure for technology reflected a teacher’s perception of the instructional environment in the respective area. The results of the teacher STaR chart self-assessment remain confidential, revealed only to the teacher. An aggregate of the teacher scores is made available to the principal who then affirmed or revised the score for each focus element, and the final document comprised the campus STaR chart. The campus STaR progress was reported to the district and state using a composite calculation of the teacher responses.

Table 2.1. Four Key Areas and Focus Areas of the Texas Teacher STaR Chart

Key Area I Teaching and Learning	Key Area II Educator Preparation & Development	Key Area III Leadership, Administration, & Instructional Support	Key Area IV Infrastructure for Technology
TL 1 Patterns of Classroom Use	EP 1 Professional Development Experience	L 1 Leadership and vision	INF 1 Students per classroom computers
TL 2 Frequency/ Design of Instructional Setting Using Digital Content	EP 2 Models of Professional Development	L 2 Planning	INF 2 Internet Access Connectivity Speed
TL 3 Content Area Connection	EP 3 Capabilities of Educators	L 3 Instructional Support	INF 3 Classroom Technology
TL 4 Technology Applications (TA) TEKS Implementation (TAC Ch 126)	EP 4 Technology Professional Development Participation	L 4 Communication and Collaboration	INF 4 Technical Support
TL 5 Student Mastery of Technology Applications (TA) TEKS	EP 5 Levels of Understanding and Patterns of Use	L 5 Budget	INF 5 Local Area Network Wide Area Network
TL 6 Online Learning	EP 6 Capabilities of Educators with Online Learning	L 6 Leadership and Support for Online Learning	INF 6 Distance Learning Capacity

Key Area I, teaching and learning, is directly related to instructional practices that impact student achievement. Key Area II, educator preparation and development, assists with identifying the frequency and depth of teacher professional growth and focused training. Key Area III, leadership, administration, and instructional support and Key Area IV, instructional support and infrastructure, are measures that indicate the degree of progress toward target tech at a campus-level, as perceived by teachers. Results of the teacher, campus, and district STaR chart surveys are reported to the state and provide a snapshot of overall progress toward “target tech” standards for the state of Texas. Results from the STaR chart survey also provide data for the national NCLB reporting system required of eligible districts receiving funds from the No Child Left Behind, Title II, Part D legislation. The performance indicators on the STaR Chart reflect the progression from status as early tech, whereby classrooms are characterized by teacher-centered instruction and student participation is primarily restricted to rote, skill-based activities. The sequence of indicators subsequently advances through developing tech, advanced tech, and ultimately, target tech (Table 2.2). As indicated below, the target tech level is characterized by student-centered learning activities that include opportunities to “evaluate information, analyze data, and solve problems” (TEA, 2006b, p. 6).

Table 2.2. Example of Texas Teacher STaR Chart Levels of Progress: Teaching and Learning

Focus Area / Levels of Progress	TL 1 Patterns of Classroom Use	TL 2 Frequency/ Design of Instructional Setting Using Digital Content	TL 3 Content Area Connection	TL 4 Technology Applications (TA) TEKS Implementation (TAC Ch 126)	TL 5 Student Mastery of Technology Applications (TA) TEKS	TL 6 Online Learning
Early Tech						
Developing Tech						
Advanced Tech						
Target Tech						

> *Early Tech:* I occasionally use technology to supplement instruction, streamline management functions, and present teacher-centered lectures; my students use software for skill reinforcement.
>
> *Developing Tech:* I use technology to direct instruction, improve productivity, model technology skills, and direct students in the use of applications for technology integration; my students use technology to communicate and present information.
>
> *Advanced Tech:* I use technology in teacher-led as well as some student-centered learning experiences to develop higher order thinking skills and provide opportunities for collaboration with content experts, peers, parents, and community; my students evaluate information, analyze data, and content to solve problems.
>
> *Target Tech:* My classroom is a student-centered learning environment where technology is seamlessly integrated to solve real world problems in collaboration with business, industry, and higher education; learning is transformed as my students propose, assess, and implement solutions to problems. (TEA, 2006b, p. 9)

The aggregate results of Focus Area I, teaching and learning, of the teacher STaR chart may assist districts in determining a snapshot of teacher self-assessed levels of progress toward reaching the target tech goal. Ideally, that data are then used to develop appropriate professional development avenues to target areas for growth.

In addition to the STaR chart, a standard survey required of all teachers and districts in the state of Texas, each district is obligated to adopt a state-approved assessment tool that will assist individual teachers with identifying areas for targeted professional development in the realm of the appropriate integration of technology into the teaching and learning structure. Individual districts are required to document the tools used and report implementation strategies to the state in their respective district technology plan.

The LoTi (Levels of Technology Implementation) Digital Age Survey tool is one such instrument that a district may choose to chart progress being made at a local level toward meeting Texas state standards. Specific to this record of study, the LoTi is the state approved, district-designated means for assessing technology progress at a local level for teachers in Alamo Heights Independent School District. Dr. Chris Moersch originally developed the LoTi Framework in 1994 for use as a research tool that would assess authentic technology use in a classroom setting. The first iteration of the LoTi Framework appeared 16 years ago and it has since evolved into a conceptual model that balances essential characteristics of 21st century teaching and learning to measure teachers implementation of digital age literacy tenets as delineated in the NETS-T (Moersch, 2009).

The LoTi (Levels of Technology Implementation) Framework is the basis for a 37-question survey, Determining Educational Technology and Instructional Learning Skill Sets (DETAILS), designed as a teacher self-rating instrument to gauge Current Instructional Practices (CIP), Personal Computer Use (PCU), and Levels of Technology Implementation (LoTi) (Appendix H). It is important to note that for the purposes of this record of study, the LoTi survey tool was aligned with the Texas STaR chart standards (Stoltzfus, 2006).

Dr. Moersch continued to refine the criteria within the various LoTi designations to include the degree or level of Higher Order Thinking, Engagement, Authenticity, and Technology (H.E.A.T.) teachers incorporate into their pedagogical practice in a student-centered context. A CIP rating reflects, on a scale from 0-7, what instructional practices a teacher incorporates, and progression toward intensity level 7 is based on how involved students are in the decision making processes of the classroom, the degree to which they help determine the problem of study and the final product to be assessed. A PCU rating reflects, on a scale from 0-7, how comfortable teachers are with incorporating existing and emerging technology tools into classroom practice. Progression toward intensity level 7 is based on a high degree of teacher fluency with technology tools and their participation in contributing to the global digital community through their use of technology resources. Publishing a blog is an example of a contribution to a digital community.

A LoTi rating reflects, on a scale of 0-6, the degree to which the respondent supports and implements instructional uses of technology in an instructional setting (Table 2.3). Progression toward intensity level 6 (refinement) along the LoTi scale involves a seamless relationship between instruction and the use of digital tools and resources. A LoTi level 6 (refinement) is indicative of pervasive use of and access to advanced digital tools and high levels of interaction with content and knowledge acquisition. The CIP, PCU, and LoTi elements reflect approximately 10%, 10%, and 80% respectively, of the current LoTi Digital Age assessment framework (Moersch, 2002).

Table 2.3. Levels of Technology Implementation

LoTi Level	Technology Focus	Instructional Focus
0 non-use	▪ Non-existent ▪ Perceived as unrelated to student achievement	▪ Didactic to collaborative ▪ Print materials ▪ Lack of technology
1 awareness	▪ Teacher use ▪ Teacher productivity ▪ Access as reward for students	▪ Information dissemination – lecture ▪ Lower cognitive skills, question/answer
2 exploration	▪ Student extension activities ▪ Pervasive use of multimedia by students to present content ▪ Drill & practice, tutorial programs	▪ Content understanding, mastery ▪ Direct instruction ▪ Research and report
3 infusion	▪ Student use of tools to complete teacher directed tasks ▪ Higher levels of cognitive processing ▪ Related to content under study	▪ Content and process ▪ Decision making, reflective thinking ▪ Use available digital assets
4a integration mechanical	▪ Student use of tools inherent ▪ Motivated by student generated questions ▪ Teacher needing extended support tools; management; professional development	▪ Apply knowledge to the real world ▪ Products are authentic and relevant ▪ Problem-based model ▪ Some teacher concerns with management
4b integration routine	▪ Student use of tools inherent ▪ Motivated by student generated questions ▪ Teacher uses learner-centered strategies; students self-monitor	▪ 4a ▪ Teacher enters own comfort zone ▪ Learner-centered, inquiry based
5 expansion	▪ Student use of tools inherent ▪ Multiple technologies in use to complete higher level tasks ▪ Investigations extend beyond the classroom	▪ 4a & 4b ▪ collaboration extends beyond classroom ▪ authentic problem solving & issues resolution
6 refinement	▪ Seamless integration of multiple technologies for student directed inquiry and investigation of higher order problem solving ▪ Collaboration beyond the classroom ▪ No limit to availability or use of technology	▪ Authenticity is the norm; collaboration, problem solving, & issues resolution ▪ Instructional curriculum is entirely learner based ▪ Content emerges based on interest & needs ▪ Unlimited access to most current digital resources & infrastructure

Terminology in successive LoTi levels increases in complexity with regard to higher-order thinking skills, student-centered instruction, authentic investigations, and access to, and use of, technology resources. The instructional focus transitions from didactic lecture models at lower levels of the original Bloom's taxonomy: (a) knowledge, (b) comprehension, (c) application, (d) analysis, (e) synthesis, and (f) evaluation toward a student-driven model that promotes collaboration in problem solving, evaluation, and creation of content. The progression of LoTi levels aligns with the progression of levels in the new Bloom's Taxonomy: (a) remembering, (b) understanding, (c) applying, (d) analyzing, (e) evaluating, and (f) creating. The metacognitive knowledge dimension invoked at the evaluation level is particularly valid in the use of technology by students. Students need to discern how to approach complex problem resolution and access the most appropriate tools for the task (Cochran, Conklin, & Modin, 2007).

Dr. Moersch (1995), LoTi developer, noted that the original format focused attention more heavily on instruction and assessment practices than on technology, which remains true. The LoTi framework was intentionally consistent with a constructivist approach to teaching and learning. The LoTi scale was based on measuring the use of technology as an interactive learning medium and the element with the most potential to impact classroom pedagogy (*LoTi Profiler Guide Wiki*, 2005).

Numerous studies have been conducted on the LoTi assessment and results confirmed that the new LoTi framework was a statistically valid tool with content, construct, and criterion validity as defined by the Standards for Educational and Psychological Testing as cited in results of a research study by Dr. Jill Stoltzfus (2009). The validation study, conducted by Stoltzfus, focused on three areas: (a) internal consistency or reliability, (b) content validity, and (c) construct validity. A survey with internal consistency or reliability as an assessment tool measures how well various aspects of the survey correlate with one another, the degree to which a test consistently measures what it purports to measure. Surveys with content validity determine how well the survey content or items represent the content the test is designed to measure, the degree to which a test measures an intended content area. Surveys with construct validity determine the extent to which a particular test can be shown to measure a hypothetical construct, how well the traits and indicators are measurable, and the extent to which the instrument accurately reflects those traits. Construct validity is considered the most important form of validity because it determines the fundamental validity issue of what the test really measures (Borg & Gall, 1989; Gay & Airasian, 2000).

In the context of the LoTi framework, the survey intent is to determine common indicators of levels of technology implementation. The LoTi survey content reflected the levels of technology implementation, and the traits and indicators of the levels of technology implementation are measureable, and the instrument accurately reflected those traits (Stoltzfus, 2009). Based on the DETAILS survey's empirical outcomes, the three areas of LoTi Survey categories, LoTi, PCU, and CIP, were determined to be statistically reliable and valid. Therefore, results gleaned from the LoTi data may be used to accurately diagnose instructional uses of technology and further to recommend professional development priorities consistent with 21st century skills and the NETS-A and NETS-T standards (LoTi Connection, 2009). In this context, the LoTi DETAILS survey has both empirical merit and practical utility (Stoltzfus, 2006).

Technology and Pedagogy

Student achievement is at the forefront of intended educational outcomes, yet teaching is a complex practice compounded by the differences in age, academic readiness level, and needs of students (Harris & Rutledge, 2007). A profound emphasis on generating and implementing innovative and sound practices for teaching and learning in a technological age is vital and commensurate attention to the integration of technologies, professional development for both in-service and pre-service teachers, and learning theory are requisite elements of teaching to improve student achievement (Becker & Ravitz, 2000; Brogden & Couros, 2007; King, 2002; Knezek, 2008; Pearlman, 2009; Vannatta & Fordham, 2004). Educational objectives in the learning environment must be aligned with local, state, and national standards, all of which now include technology elements (Kalmbacher, 2004). Therefore, teachers today must make critical decisions about how to prioritize and allocate the limited time allotted to classroom instruction (Forehand, 2005; Sawchuk, 2009). However, due to the flexible nature of the teaching and learning process, measuring gains in student learning or achievement outcomes made with technology remain an elusive goal.

Researchers have noted that the most productive and meaningful uses of technology occurred in constructivist settings where learners used technologies to teach themselves and others in a context that was not possible without the technology (Bull et al., 2002; Jonassen et al., 1999; Ravitz et al., 2000; Stein et al., 2002). A resurgent spotlight on what was sometimes referred to as the “cognitive revolution” or constructivism, amassed a developing consensus regarding how children learn that impacted views of how teaching should be organized at the classroom level (Brooks & Brooks, 1993; Brunner & Tally, 1999; Cannella & Reiff, 1994). Not only must teachers become proficient at using technology applications, they must also transform their practice to view current and future technologies as integral components of the teaching and learning process. Perusal of educational research revealed numerous indicators of the influence of constructivist pedagogy on technology integration efforts (Applefield, Huber, & Moallem, 2001; Beetham, McGill, & Littlejohn, 2009; King, 2002; Ravitz et al., 2000; Vannatta & Fordham, 2004). The research specific to technology integration and improved student achievement is increasing, however, is widely varied in scope, focus, and findings with results often limited to selected subjects or grade levels (Kulik & Thurgood, 2003). Based on the sheer enormity of human knowledge and the unprecedented rate of change resulting from technology innovation, determining whether to use technology is a moot point making the issue at hand how best to ensure and measure effective use of technology to improve student achievement (Lemke et al., 2003; McNabb et al., 1999; Rodriguez & Knuth, 2000).

In a widely known and often cited meta-analysis of quantitative research on instructional practices, Marzano et al. (2001) summarized trend evidence that indicated nine categories of teaching strategies that had a statistically significant positive impact on student achievement: (a) identify similarities and differences, (b) summarize and take notes, (c) reinforce effort and provide recognition, (d) practice and homework, (e) use nonlinguistic recommendations, (f) promote cooperative learning, (g) set objectives and provide feedback, (h) generate and test hypotheses, and (i) use cues, questions, and advance organizers. Common among the strategies are the student-centered focus, the use of higher order thinking skills for problem solving and issue resolution, and the engaging nature of hands on tasks. Marzano (2009a) noted that something as complex as teaching may not be reduced to nine categories and cautions against overemphasizing to the exclusion of a broad array of strategies that relate to effective teaching. However, the nine categories of teaching strategies are consistent with many of the strategies advocated at the higher LoTi levels that may lead one to infer that the use of technology tools to support and extend the strategies may suggest a correlation to improved student achievement. Merging constructivist philosophy and practice with initiatives to integrate educational technology may ultimately lead to improved student achievement (Rochelle et al., 2000).

Frequently, results of research studies on technology use in classrooms noted that teachers viewed the integration of technologies as very time intensive and were, therefore, hesitant to initiate the integration process in their pedagogical practice. The lack of time was cited as a recurrent barrier. Numerous research studies also cited the lack of professional development or preparation for technology use as among the most serious impediments to the effective use of technologies in the classroom (Margerum-Leys & Marx, 2004; Rodriguez & Knuth, 2000; Vannatta & Fordham, 2004). Teachers need ample time to acquire and transfer the knowledge and skills to facilitate the transparent infusion of technologies into the curriculum (Brand, 1997; Speak Up 2009 Report, 2010b).

In a report prepared by the RAND Corporation for the USDOE Office of Educational Technology, Harvey and Purnell (1995) offered that a vision of technology in support of learning was essential and the implication for teachers was an increased call for authentic learning opportunities in open-ended, loosely structured classroom settings. Hooper and Reiber (as cited in Hill et al., 2000) proposed a five-stage model that illustrated how teachers mature in their pedagogical use of computers in instruction: (a) utilization, (b) familiarization, (c) integration, (d) reorientation, and (e) evolution. They note that ongoing support is required for teachers to move beyond the second stage of familiarization and that those who do progress to the integration stage do not cross the "line of transformation" between instructivist and constructivist pedagogical practice (Hooper & Rieber, as cited in Hill et al., 2000).

In that context, the teachers' role had to become more facilitative than directive as they began to guide student learning as opposed to transmitting knowledge (Stein et al., 2002). Daggett (2010) stated that more than ever, teachers have a critical role and must offer facilitated content that allows students to be active participants in their learning and to hone their cognitive and technological skills to be prepared for the future. Additional studies supported that teachers must see technologies as an opportunity rather than a threat if they were to risk the pedagogical shift toward becoming a mentor who was a "guide on the side" rather than a transmitter of knowledge who was the "sage on the stage," and that indeed, integration of technologies may swing the pendulum in that direction (Glennan & Melmed, 1996; Harvey & Purnell, 1995; Hill, Reeves, Heidemier, Grant, & Wang, 1999).

While many contemporary questions in education center on the integration of technology, remaining cognizant of the fact that professional development, technology assessment, and student achievement were all interrelated was critical (Bond-Upson, Latham, & Bartone, 2000; McKenzie, 1998; Shapley et al., 2010b; Sternberg, Kaplan, & Borck, 2007). “Not only do advances in technology influence how teaching and learning occur for students, they may influence how educators learn as well” (National Staff Development Council [NSDC], 2001, p. v). National, state, and local efforts are merging to increase access to technologies for students in public schools and the growing focus on technology as a fundamental component of teaching and learning is compelling individual states and districts to reevaluate the instructional climate in public schools to determine appropriate means of integrating technology into the curriculum and how best to prepare educators to do so.

Further, there exists an inherent contradiction between the statements often heard in the public arena declaring that teachers should teach what students should know and understand and the underlying direction of research on teaching and learning emphasizing brain-based theories that support learner-centered settings (Beetham et al., 2009; Harvey & Purnell, 1995). The historical pedagogical paradigm of the teacher as transmitter of knowledge is shifting toward that of the teacher as a facilitator who will offer learning environments that envelop students in collaborative opportunities that will require communications skills and access to information that only technology can provide (Brooks-Young, 2007; Ertmer, 1999; Molebash, 1999). Teachers must integrate various aspects of their teacher knowledge into the act of teaching (Tsui, 2009). They must possess content knowledge and pedagogical knowledge; the framework intersects as pedagogical-content knowledge and includes specific knowledge about learners, the curriculum, and best practices related to representing the particular topic (McKenzie, 2003; Shulman, 1986). Content must go hand-in-hand with pedagogy, and care must be taken to ensure that attempts to integrate educational technologies complement the current research on teaching and learning rather than simply further entrench traditional practice (Means, 2010).

Conventional wisdom inferred that technology integration would not be accomplished by either novice teachers who possess technical skill yet lack experience to create curricular connections, nor by master teachers who may not grasp the necessity of transcending supplemental benefits of using technology. A ‘morphing’ of the two, resulting in teachers who are technologically savvy, pedagogically astute, and able to draw from a vast repertoire of content, strategies, and experience, will be evidence of promising practice amid the complexities of a global information and technological age. An elementary school principal cited in the Speak Up 2009 Report (2010b) report offered insight on learning in 2019, “The availability and effective use of digital resources will be an integral part of each classroom and the curriculum. It is still new and the learning curve is steep. By 2019, I expect that it will be a routine part of the instructional process” (Speak Up 2009 Report, 2010b, p. 12).

Research on integrating technology in the educational arena provoked criticism based on a lack of theoretical grounding (Glennan & Melmed, 1996; King, 2002). Mishra and Koehler (2006) extended Shulman’s outline of pedagogical content knowledge and proposed a conceptual scaffold linked to a phenomenon of teachers infusing technology and pedagogy. The resulting framework introduced the age of technological pedagogical content knowledge that is becoming an ever-increasing theoretical construct in the field of teacher education (Groth, Spickler, Bergner, & Bardzell, 2009; Mishra & Koehler, 2006; Schmidt et al., 2009).

Based on a review of the literature related to learning theory, professional development, and the integration of technology in the curriculum, it is clear that a transformation of the underlying educational culture is necessary. Teachers must include technology in their mindscape to learn how to effectively access and utilize the many tools at their disposal to amplify teaching and learning in public education (Beaudin & Grigg, 2001; Brooks-Young, 2007; CEO Forum on Education and Technology, 2001; Lemke et al., 2003; Marzano et al., 2001; Muir, 2007; Rodriguez & Knuth, 2000; Scheffler & Logan, 1999; Speak Up 2009 Report, 2010b) and develop their practice of technological pedagogical content knowledge.

Improving Student Achievement

While student achievement was the focus of national and state accountability systems and the billions of dollars spent on educational technology affirmed the enterprise as big business and a cornerstone for efforts to improve student performance, research results on available data linking technology to school effectiveness and student outcomes, or the effects of teaching and learning with technology on student achievement, specifically test scores, continued to be ambiguous or inconclusive (Fishman et al., 2004; Noble, 1996; Ringstaff & Kelley, 2002; Schacter, 1999; Waxman, Lin, & Michko, 2003; Wenglinsky, 2006). Further, as some researchers continued to attempt to collect data that helped determine the actual impact of technology on learning, the inherent challenges of isolating variables that determined outcomes that could be generalized convinced others to consider the endeavor nothing more than an expensive diversion (Conte, 2000; Cuban, 2000; Noble, 1996; Robertson, 2003). Hence, a need for additional research specific to the way technology use correlated to student achievement outcomes continued (Cradler, McNabb, Freeman, & Burchett, 2002; Ringstaff & Kelley, 2002; Schacter, 1999).

There have been numerous studies designed to determine to what degree, if any, technology use leads to improved student learning. Research in this area though extensive, varied considerably in scale and findings (Bayraktar, 2002; Bauer, 2005; Cowell, Hopkins, Jorden, Dobbs & Allen, 2005; McCabe & Skinner, 2002; Nguyen, Rice, & Griffith, 2006). Among the mediating factors that influenced research results are course content, curriculum, pedagogy, professional development, technology access, and support for technology (Baker, 2010; Brockmeier, Sermon, & Hope, 2005; Higntte, Margavio, & Margavio, 2009; Means, 2010; Penuel, Means, & Simkins, 2000; Powell, Aeby, & Carpenter-Aeby, 2003). Concurrently, evidence mounted that researchers attempted to alleviate some of the mediating factors by narrowing studies to measure the impact of technology on specific outcome areas. Broad categories for study included: (a) learner outcomes in the cognitive domain and affective domain, (b) teacher outcomes in changed pedagogy and improved technology skills, and (c) technology integration outcomes (Johnston & Barker, 2002). Adding obscurity to an already complex matter, technology in and of itself cannot be the answer to improved student achievement. Rather, technology use must be considered in the context of curriculum and teaching implementation strategies. There is wide variation in the ways technology is used among teachers who are often profoundly influenced by personal philosophy or that of the district or school in which they teach. Teacher knowledge is socially constructed and dynamic in nature; teaching is an ill-structured domain, making it difficult to represent within one overarching framework or theory much less to quantify the relationship of technology integration and student learning within that context (Knight, 2008; Mishra & Koehler, 2006). Nonetheless, the proper use of instructional and information technologies can transform current practice and significantly increase an individual's capacity to communicate, to learn, and to work (Ellmore, Olson, & Smith, 1995).

Despite the wide and varied findings and lack of consensus related to technology integration and increasing student achievement, results of a 2000 poll by Phi Delta Kappa and Gallup revealed that 69% of the public believes that technology improves learning, while 82% recommended spending more money on school technology (NCREL, 2002). Further, it is evident that integrating technology into the curriculum is becoming an integral aspect of best practices in teaching (Mishra & Koehler, 2006; Pierson, 2001); however, it is essential that educators consider key aspects of the research to make appropriate choices about how to best utilize technology to impact student achievement.

It has been generally accepted that the mere use, versus the appropriate use, of technology may have a negligible and potentially negative impact on student achievement (Gulek & Demirtas, 2005; Hashemzadeh & Wilson, 2007; Marzano, 2009b; Warschauer et al., 2004). Conversely, other researchers explored technology integration in schools and maintained that one of the critical factors impacting student success was more access to the technology (Apple Classrooms of Tomorrow [ACOT], 1995; Benner, Shapley, Heikes, & Pieper, 2002; Ditzhazy, 2002; Hill et al., 2000; Whidden, 2008). Purposeful, clearly defined use that aligns content from multiple, complementary sources and offers a competitive advantage with respect to the speed at which learners access that which is new, reinforced the teachers' critical role in technology integration that may translate to increasing student achievement (Bauer, 2005; Cowell et al., 2005; Keller, Ehman, & Bonk, 2005; Marshall, 2002; Marzano et al., 2001; November, 2010; Rochelle, Penuel, & Abrahamson, 2004; Willets, 2008).

In 2005, the widely known ACOT studies noted that teachers' instructional practices involved a five-stage evolution process as they introduced technology implementation: (a) entry, (b) adoption, (c) adaptation, (d) appropriation, and (e) invention. The studies further indicated that technology use does have a positive impact on student learning at the appropriation and invention stages of the continuum (Baker, Gearhart, & Herman, 1990; Jukes, 2000). However, in order for educators to appropriately integrate existing and emerging technologies within the curriculum, there must be a simultaneous focus on providing the requisite professional development that will allow them to do so (Brand, 1997; McKenzie, 2001; Molebash, 1999; Rodriguez &

Knuth, 2000; Rogers, 2001). Technology in and of itself has very limited capability when considered in the context of human potential. Computers do not currently possess the capacity to quantify an entire range of human thought and emotion and for a computer to identify beauty or generate an original idea is beyond the scope of technology.

Suitable professional development models, designed with the characteristics of adult learners in mind and focusing on appropriate integration of technology, are essential elements of transforming current practice (Fardouly, 1998; Finley, Copeland, Ferguson, Marble, & Boethel, 1999; Gordon, 2000; ISTE, 2008; McKenzie, 1991, 1998; Wise, 1997). Noted for his research on education policy development, Thomas R. Guskey observed that professional development must be an intentional, ongoing, and systemic process based on a proficiency rather than deficiency model. Commenting on the need to redesign the nature and structure of the professional development of teachers, Holt (as cited in Guskey, 2000) noted:

> Since we can't know what knowledge will be most needed in the future, it is senseless to try to teach it in advance. Instead, we should try to turn out people who love learning so much and learn so well that they will be able to learn whatever needs to be learned. (p. 226)

An executive summary of a policy brief issued by ISTE (2008) highlighted results of research monitored over the last two decades on the effectiveness of technology use on student outcomes. Trend evidence from the studies showed that appropriate use of education technology has a positive effect on student achievement and that several states have emerged as leaders in that arena. Programs highlighted include Missouri's eMINTS, Michigan's Freedom to Learn (FLT), and the Texas Technology

Immersion Pilot (Tx TIP). The ISTE (2008) policy brief further concluded that positive impact on student achievement resulting from the appropriate integration of educational technology requires focus on seven key conditions:

1. Effective professional development for teachers in the integration of technology into instruction is necessary to support student learning.
2. Teachers' direct application of technology must be aligned to local and/or state curriculum standards.
3. Technology must be incorporated into the daily learning schedule.
4. Programs and applications must provide individualized feedback to students, and teachers and must have the ability to tailor lessons to individual student needs.
5. Technology use must be incorporated in a collaborative environment to be most effective.
6. Project-based learning and real-world simulations must be the main focus of instructional technology utilization.
7. Effective technology integration requires leadership, support, and modeling from teachers, administrators, and the community/parents.

Teachers, classrooms, curriculum, student dynamics, and politics vary on a case-by-case basis. Inherent challenges with research methodology, specifically the mediating factors that inhibit attempts to directly link technology integration to student learning, may prevent researchers from drawing unequivocal conclusions particularly with respect to cause and effect relationships (Freebody et al., 2008; Mishra & Koehler, 2006;

Protheroe, 2005). Multiple confounding factors impede the ability to draw conclusions; hence, the ability to make definitive statements with respect to the direct relationship of technology integration and student achievement remains elusive (Freebody et al., 2008; Marshall, 2002; Sternberg et al., 2007; Trucano, 2005; Warschauer et al., 2004; Whidden, 2008). Despite the challenges, there is a growing body of research to indicate that appropriate uses of technology by highly qualified teachers motivates students to learn in new ways (NSDC, 2001; Quindlen, 2007).

Nonetheless, technology has become a non-negotiable tool to facilitate student learning in a context with a solid instructional foundation and the integration of technology in an instructional setting is paramount to staging the most productive instructional environment for 21st century learning (Cowell et al., 2005; Learning for the 21st Century, 2002; Warschauer et al., 2004). The task of education may well be to embrace the future and empower students to learn with all of the tools that are available to them, thereby compelling educators to accept responsibility for appropriate integration of technologies into the curriculum. Robertson (2003) noted, "using only a little technology is as backward as not using it at all" (p. 292). The goal of this study was to ascertain whether there was a relationship between teachers who appropriately integrate technology in classrooms and the achievement of their 6th, 7th, and 8th grade students as measured by TAKS scores in math and reading at Alamo Heights Junior School, San Antonio, Texas.

Conclusion

The five elements of this review of the literature were intended to create a contextual basis for this record of study to become a useful framework for practitioners developing 21st century learning environments. Section one described characteristics of digital age learners and increasing expectations that their educational environment more closely resemble what they experience in their day-to-day lives, specifically, the desire that learning be socially based, un-tethered, and digitally rich. Section two referenced the historical evolution of technology integration in public schools with an emphasis on national, state, and local policies that drive the direction. Section three was an examination of the standards by which public schools are held accountable for the integration of technology tools in teaching and learning. Section four documented fundamental pedagogical structures that support the appropriate integration of technology for optimal learning experiences and the critical role of professional development in that endeavor. The final section addressed the challenges inherent in linking the use of technology to improvements in student learning or achievement. This record of study examined whether a relationship existed between the levels of technology implementation as measured by the teacher LoTi survey and student scores on the standardized ELA and math TAKS test at Alamo Heights Junior School, San Antonio, Texas.

CHAPTER III

METHODOLOGY

The intention of Chapter III was to explicate the sampling, testing, and statistical measures used in this record of study. For continuity, the researcher's original two questions that frame the study are stated below:

1. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6th, 7th, and 8th graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?
2. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores among 6th, 7th, and 8th graders whose status is identified as economically disadvantaged in student records at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

Beginning with the 2006-2007 academic year, Alamo Heights ISD implemented use of the Levels of Technology Implementation (LoTi) framework, a 37-question survey designed for teachers by Dr. Christopher Moersh, as a self-rating instrument to gauge Current Instructional Practice (CIP), Personal Computer Use (PCU), and Levels of Technology Implementation (LoTi). The LoTi instrument was administered annually to all teaching staff and the archived results met the state-required reporting criteria to document the district's progress toward meeting the stated goal of the Texas Long Range Plan for Technology TLRPT, target technology. Further, results specific to CIP, PCU, and LoTi were available to individual teachers as a means of informing their practice.

Resulting from the emergence of new standards from various entities such as the National Educational Technology Standards for Students (NETS-S) and the National Educational Technology Standards for Teachers (NETS-T) from the International Society for Technology in Education (ISTE), Dr. Moersch revised the LoTi framework to focus on Levels of Teaching Innovation, which includes the same stages as the original structure, however, places heavier emphasis on using digital tools and resources to promote world class teaching and learning. The self-report instrument became the LoTi Digital-Age framework for the Determining Educational Technology and Instructional Literacy Skillsets (DETAILS) survey (Appendix H). The revised LoTi framework was designed to closely align with national initiatives to include Marzano's Research-Based Best Practices and Daggett's Rigor and Relevance.

The amended survey provided equivalent score comparison options between the LoTi instrument and the Rigor and Relevance Framework tool developed by Bill Daggett. A LoTi Level 4 (integration) aligned with Quadrant D (adaptation) of the Rigor/Relevance framework (Moersch, 2008). The LoTi Level 4 (integration) suggests a student-centered learning environment in which students apply their knowledge to real world situations in authentic and relevant contexts. Quadrant D references adaptation and the ability of students to think in complex ways to apply their knowledge and skills (Daggett, 2011). Additionally, the revised LoTi framework was consistent with a constructivist approach to teaching and learning to align with research in the field indicating a connection between appropriate technology implementation in a constructivist context and student achievement (Stoltzfus, 2009).

Each stage of the LoTi scale focused on distinctive elements of the pedagogical continuum as teachers' transitioned from teacher-centered to learner-centered instruction. The DETAILS Quick Scoring Device is a matrix that identifies which questions correspond to the various LoTi Level designations (Appendix I). Progression along the scale also reflects development from lower levels of Bloom's Taxonomy, such as knowledge and comprehension toward higher order levels, such as evaluation and synthesis, and from ritual use of digital tools and resources to more self-directed, interactive use of Web 2.0 tools. Teachers answer a sequence of 44 questions using a Likert-type response scale. Each teacher is assigned a LoTi level based on a series of multi-step calculations based on the frequency with which they report that certain activities occurred in the classroom (Stolzfus, 2009) (Appendix J). Similar in scope to the original framework, the results provided teachers with a valid and reliable snapshot of their LoTi, CIP, and PCU levels along with a personalized profile designed to prioritize focus areas for professional development.

A CIP score uses a scale from 0-7, to indicate the teachers' perception of the degree to which their current instructional practices support a student-centered learning environment as indicated by the methods the teacher uses to deliver instruction. Responses reveal how involved the students are in the classroom decision-making process and in determining the focus of their study or designing the final product they will submit to their teacher for assessment. The CIP framework measures teachers' current instructional practices relative to a subject matter versus a learner-centered classroom design. The attributes of a CIP score range from intensity level 0 (not true of me now) to intensity level 7 (very true of me now). Level 0 indicates that one or more of the questionnaire statements were not applicable to the respondent's current instructional practice. Intensity levels 0-4 tend to be focused on teacher-directed instruction of subject-based material. Intensity levels 5-7 are indicative of a more learner-centered instructional approach and student-driven questions and problems may guide diversified research.

A PCU score reports, on a scale of 0-7, how comfortable teachers are in using the technology tools for personal use and integrating technology into higher levels of teaching innovation. The PCU framework measures the depth and breadth of teachers' fluency levels with using digital tools and resources to guide student learning. PCU intensity levels 0-2 (not true of me now) indicate a low to moderate level of comfort with using computers for personal use with little to no use of computers in the classroom. PCU intensity levels 6-7 (very true of me now) indicate a moderate to high level of comfort with personal computer use that translates into greater levels of computer use in the classroom. Teachers at PCU level 7 are expert users and are typically involved in training their colleagues on technology-related tasks.

A LoTi score reports, on a scale of 0-6, the degree to which the respondent supports and implements instructional uses of technology in a classroom setting. The attributes for the LoTi levels are: Level 0 = Non-use and perceived lack of access or time; Level 1 = Awareness with the actual tools one-step removed from the classroom teacher in labs or pull out programs; Level 2 = Exploration involves technology as a supplement to the instructional program; Level 3 = Infusion indicates technology tools used to complement instructional events; Level 4a = Integration (mechanical) entails heavy reliance on prepackaged programs and/or outside resources; Level 4b = Integration (routine) emphasizes teacher designed learning experiences in which students utilize technology tools to solve problems; Level 5 = Expansion encompasses an experiential basis for learning and technology tools that extend learning beyond the classroom; and Level 6 = Refinement implies that technology is a seamless medium in an entirely learner-based curriculum (Moersch, 2009). The LoTi framework was conceptualized as a research tool to assess authentic classroom technology use and designed to be consistent with a constructivist philosophy of teaching and learning (Appendix H).

The goal of using the LoTi framework is to inform teachers, administrators, and campus technology support staff of the current status of technology implementation to assist in the design and planning for professional development that will result in improved student academic achievement. At the time of this study, there was no research available to assess the correlation between the teacher perceptions of technology implementation and tangible increases in student achievement at Alamo Heights Junior School. This study was undertaken to examine the possibility of a correlation between technology implementation and achievement in math and reading among 6th, 7th, and 8th grade students at Alamo Heights Junior School in San Antonio, Texas.

To assist with measuring the correlation between technology implementation and student achievement in Alamo Heights ISD, this study sought to answer the following questions:

1. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6^{th}, 7^{th}, and 8^{th} graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?
2. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores among 6^{th}, 7^{th}, and 8^{th} graders whose status is identified as economically disadvantaged in student records at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

In the fall of 2009, Alamo Heights ISD teachers responded to the LoTi DETAILS Digital Age Survey self-assessment tool that determined, on a scale of Level 0 to Level 6, an individual LoTi designation for each respondent. To answer the questions above, the teacher data from the Digital Age survey and the existing student TAKS data for the corresponding year were imported into a database. Statistical tests were conducted on the data to infer generalizations about potential relationships between and among the groups contained within the data sets. Existing TAKS data with appropriate demographic and scheduling identifiers to include gender, socioeconomic status, the coded names of a student's core content area teacher and TAKS scale scores were gleaned from the district's AEIS IT software, a password protected database program installed on select campus computers. The specific procedures used are described in the following sections. This was the first year that the new iteration of LoTi, the LoTi Digital Age survey questionnaire was administered, resulting in one year of LoTi teacher data (2008-2009). The TAKS tests for science and social studies are administered at the 8th grade. The reading/English Language Arts and math TAKS tests are administered at the 6th, 7th, and 8th grades. Therefore, the population for this study was limited to 6th, 7th, and 8th grade students who took the reading/English Language Arts and math TAKS tests.

Population

Alamo Heights Independent School District covers 9.4 square miles and geographically is one of the smallest school districts in the state. The district founded as a rural district in 1909, became an independent school district in 1923. There are five schools: one early childhood center, two elementary schools, one junior high school, and one senior high school with an enrollment of approximately 4,600 students from the communities of Alamo Heights, Olmos Park, Terrell Hills, and an area of north San Antonio. The district spends approximately $8,117 per pupil allocating 65% to instruction, 33% to support services, and 3% on other elementary and secondary expenditures (Alamo Heights Independent School District [AHISD], 2008). Approximately 94% of the students, who remain in the district and graduate from Alamo Heights High School, continue their formal education by attending college.

For the purposes of this study, both school and student performance analysis includes only Alamo Heights Junior School in the Alamo Heights Independent School District (AHISD). The student data in the study was collected from 825 6th, 7th, and 8th

graders who took the math TAKS test 2009; and 946 6th, 7th, and 8th graders who took the ELA/reading TAKS test in 2009. A total of 29 teachers (18 English Language Arts and 11 math teachers) from the Junior School campus covered the population in the study. The teacher LoTi scores were derived from the 29 English Language Arts and math teachers at the 6th, 7th, and 8th grades at the Alamo Heights Junior School. The composition of the population for this study is summarized in Table 3.1.

Table 3.1. Summary of Population Comprising the Study From Alamo Heights Junior High School in Alamo Heights Independent School District, San Antonio, Texas

Population	Math 6th, 7th, & 8th	ELA 6th, 7th, & 8th
Students	827	946
Teachers	11	18

The sample student population of Alamo Heights Junior School is distinct from the general state population in that the percentage of all Alamo Heights Junior School students passing TAKS in each subject area test is typically higher than the state averages of all students passing those tests (Table 3.2). The overall percentage of students classified as economically disadvantaged in Alamo Heights Independent School district is less than that of the state-reported percentages of students classified as economically disadvantaged (Table 3.3).

Table 3.2. Summary of Students Meeting the Standard for TAKS in ELA/Reading and Math in Grades 6, 7, and 8 for the State, Region 20, and AHISD for 2009

Subject	Grade	State	Region 20	AHISD
ELA/Reading	6	93%	93%	97%
Mathematics	6	82%	78%	85%
ELA/Reading	7	87%	88%	94%
Mathematics	7	82%	79%	88%
ELA/Reading	8	95%	95%	98%
Mathematics	8	82%	81%	93%

Source. AEIS-IT Standard Reports Page (TEA, 2011a).

Table 3.3. Summary of Students Classified as Economically Disadvantaged Totals for the State and AHISD for 2010-2011

2010-2011	Eligible Free Meals Count/%	Eligible for Reduced Priced Meals Count/%	Other Economic Disadvantage Count/%	Not Economically Disadvantaged Count/%	Total
State of Texas	2,151,179.00/ 43.60	323,352.00/ 6.55	440,385.00/ 8.93	2,018,701.00/ 40.92	4,933,617
Alamo Heights	891.00/ 18.77	173.00/ 3.64	0.00/ 0.00	3,684.00/ 77.59	4,748

Source. PEIMS Standard Reports Page (TEA, 2011b).

Further, the teacher population of this research study was highly unique because, unlike mandatory participation in the Texas STaR Chart, mentioned in Chapter II, use of the LoTi survey is voluntary since there are a variety of state-recognized methods that may be used to report progress toward the goals of the TLRPT. These distinctions should be considered when reviewing the findings and conclusions of this study.

Instrumentation

The data collected for the purposes of this study originated from teacher LoTi score information gleaned from the Fall 2008 LoTi DETAILS Survey questionnaire. Student data from TAKS scores for reading/English Language Arts (ELA) and math for 6^{th}, 7^{th}, and 8^{th} graders was taken from the Spring 2009 state administration of both tests. Data for scores on the science and social studies TAKS test were not included as those tests for middle school are only administered at the 8^{th} grade level. Scores for TAKS-A students were also eliminated.

Teacher data encompassed three independent scores gained from the revised LoTi (Levels of Teaching Innovation) Digital Age DETAILS survey administered by Alamo Heights Junior School in December of 2008 in conjunction with the annual district requirement that teachers complete the survey to meet the state reporting standard for documenting progress toward the TLRPT. Each reading/English Language Arts and math teacher received three scores from the survey: CIP, PCU, and LoTi scores. The LoTi score was isolated for the purposes of analysis for this study as the specific spotlight of the LoTi score is the perceived level of technology implementation, the focus of the research questions for this study. The researcher obtained approval from the LoTi support site to gain administrative access to individual teacher LoTi data for Alamo Heights Junior School. The data were exported from the LoTi database to a Microsoft Excel spreadsheet for pre-analysis data scrubbing and manipulation. For example, a campus identifying number was assigned to each teacher on the LoTi spreadsheet along with respective course and section numbers for each class taught.

Student data were obtained from the Spring 2009 results of TAKS testing. Alamo Heights ISD contracts with Riverside Publishing Company, a subsidiary of Houghton Mifflin Harcourt, for use of DataDirector, a data management and student information system (SIS) that acts as a repository for the Alamo Heights ISD, housing historical academic and demographic student data, as well as state TAKS scores and relevant records. TAKS scores are reported as a scale score per student. Each student's name and student identification number remained confidential and unpublished. The data were exported from DataDirector into a second Microsoft Excel spreadsheet.

Procedures

The procedures for collecting data were coordinated with the Alamo Heights ISD Central Office and administrative and technical support for the LoTi Lounge. Written permission was originally granted for this research project in the Spring of 2007. The first step was to download existing student TAKS and economic status data from DataDirector and import into an Excel spreadsheet. The Junior School campus data processor provided a spreadsheet of class rosters to include student names, grade level, student socio economic status, teacher names, campus identifying teacher number, course numbers, and sections. Next, campus identifying teacher numbers were added to the spreadsheet of teacher names and LoTi scores that had been downloaded from the LoTi Lounge DETAILS report summary. The data sets were merged using FileMaker Pro database software. The resulting merged data set was then exported to a master Excel file that consisted of student names, grade level, socio economic status and ELA and math TAKS scores, as well as content area teacher names for each of the TAKS tests, and the teacher LoTi scores. Data from the compiled Excel spreadsheet were imported into the Statistical Package for Social Studies (SPSS, version 18) software application for final descriptive and inferential statistical analysis.

The research study examined two variables: (a) student TAKS scores and (b) teacher LoTi ratings. The research question under investigation focused on the extent to which teacher levels of technology implementation has an effect on student ELA and math TAKS scores. Therefore, the independent variable was teacher LoTi scores, while the student TAKS scores comprised the dependent variable. The study used an ex post facto non-experimental design as both the independent variable values of the teacher LoTi ratings and the independent variable values of the student ELA and math TAKS scores predated the research investigation. The design was descriptive in that the study did not involve causality, rather, related one variable to another across cases. As a consequence of the design, findings may reveal inferences and not causality.

The design of the study also depended on the participant scores. There were seven possible LoTi scores that created the potential for the independent variables to be evenly distributed. In the event that the dependent variable of student TAKS scores were evenly spread among the LoTi ratings, the population number (N) would have been reduced for each group.

Teachers were grouped based on the distribution of LoTi ratings clustered around levels 2 and 4, thus comparison of student performance on TAKS was relative to the teachers’ varied levels of technology implementation. Since teacher responses to the LoTi Digital Age Survey may be influenced by potential personal bias or the subjectivity of interpreting the survey questions, grouping teachers based on LoTi ratings does not guarantee criterion validity. Stoltzfus (2006) noted in her study that without validating the LoTi survey using some external model or rule, the design of the instrument leaves it susceptible to bias and subjectivity.

Data Analysis

Although the data set is technically a population and not a random sample, inferential statistics were administered, nonetheless, to hypothesize to a larger population. The data were analyzed using the appropriate quantitative techniques delineated in *Educational Research: Competencies for Analysis and Application* by Gay and Airasian (2000). Using version 18 of the Statistical Package for Social Studies: an IBM company, (SPSS) software, the results of this study were based on an independent samples t-test and a two-way Analysis of Variance (ANOVA) test.

To answer the first research question, an independent-samples t-test was run for each subject – math and English Language Arts – combining the results of grade 6, 7, and 8 TAKS scores and teacher self-reported LoTi ratings. The math teachers were grouped into two categories, LoTi 2 or LoTi 4, based on the preponderance of self-reported LoTi ratings. The ELA teachers were grouped into two categories, LoTi 1 or LoTi 2, based on the preponderance of self-reported LoTi ratings. Using a t-test, the researcher compared the teacher self-reported LoTi ratings by subject area, math or ELA. Based on the total sample size of teachers and students, there was no disaggregation by grade level.

To address the second research question, combining the results of 6th, 7th, and 8th grade student TAKS scores, a two-way ANOVA test was run to compare the differences in the mean scale scores of students in each subject, math and ELA, by economically disadvantaged status and teacher LoTi scores. Student Public Education Information Management System (PEIMS) data were reviewed and based on the state guideline, students who qualified for free and reduced lunch were categorized as economically disadvantaged.

CHAPTER IV

PRESENTATION OF FINDINGS

The purpose of this record of study was to determine the relationship between teacher Level of Technology Implementation (LoTi) self-ratings and student achievement scores on the Texas Assessment of Knowledge and Skills (TAKS) for 6^{th}, 7^{th}, and 8^{th} grade students in the Alamo Heights Independent School District. The research explored whether there was a relationship between the teacher LoTi self-ratings and student achievement as measured by the English Language Arts (ELA) and math scores on TAKS for students at Alamo Heights Junior School. In addition, the research study further examined whether there was a relationship between teacher LoTi self-ratings and student achievement for students whose socioeconomic classification was economically disadvantaged.

For the purposes of this study, both school and student performance analysis include only Alamo Heights Junior School in the Alamo Heights Independent School District (AHISD). The student data in the study were collected from 825 6^{th}, 7^{th}, and 8^{th} graders who took the math TAKS test in 2009; and 946 6^{th}, 7^{th}, and 8^{th} graders who took the ELA/reading TAKS test in 2009. A total of 29 teachers (18 English Language Arts and 11 math teachers) from the Junior School campus covered the population in the study.

The teacher LoTi levels were derived from the 29 English Language Arts and Math teachers at the 6^{th}, 7^{th}, and 8^{th} grades at the Alamo Heights Junior School. A LoTi rating reflects, on a scale of 0-6, the degree to which the respondent supports and implements instructional uses of technology in an instructional setting. As specified by the LoTi instrument (see Table 2.3), the level of technology implementation in the classroom is indicated on a scale of 0-6 (0 = nonuse, 1 = Awareness, 2 = Exploration, 3 = Infusion, 4a = Integration Mechanical, 4b = Integration Routine, 5 = Expansion, and 6 = Refinement. The instrument further characterizes levels 0-3 as teacher-centered instruction, whereas levels 4-6 are considered to be student-centered learning with an increase in LoTi levels indicating an increased use of higher order thinking skills such as application, analysis, evaluation, and creation in the classroom setting.

Accordingly, based on teacher responses to the LoTi instrument, there were eight possible LoTi levels among which teachers could be distributed. In the event that the dependent variable of student TAKS scores were evenly spread among the LoTi ratings, the population number (N) would have been reduced for each group. However, teachers had LoTi ratings grouped at levels 2 (exploration) and 4 (integration) that indicated there were limited levels of technological competence.

In effect, the research examined whether achievement levels on TAKS differed for students identified as economically disadvantaged, as compared to students who were not economically disadvantaged based on the LoTi self-ratings of their designated teacher. The record of study was guided by the following questions:

1. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6th, 7th, and 8th graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

2. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores among 6th, 7th, and 8th graders whose status is identified as economically disadvantaged in student records at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

Findings for Research Question 1

Was there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6th, 7th, and 8th graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

Teacher LoTi self-rating data and student TAKS and demographic data were gathered for each content area. Teachers were categorized into groups based on their LoTi self-rating in ELA or math. Based on LoTi self-ratings, ELA teachers in the study were grouped as either a LoTi 1 (awareness) or a LoTi 2 (exploration), while math teachers were grouped as either a LoTi 2 (exploration) or a LoTi 4 (integration). Students from each content area were further categorized into groups determined by their assigned teacher LoTi self-rating. To clarify, all students within a specific content area such as ELA, who also had a teacher in that content area with a LoTi self-rating of 1 (awareness), were considered a group. All students within the ELA content area, who also had a teacher in that content area with a LoTi self-rating of 2 (exploration), were identified as a different group. The groups for math were identified in the same manner with students who had an assigned teacher with a LoTi self-rating of 2 (exploration) in one group and students who had an assigned teacher with a LoTi self-rating of 4 (integration) in a different group. The mean TAKS score was calculated for each LoTi group within a content area, and the resulting mean scores were then compared according to the appropriate inferential statistical test used to analyze the data.

Teacher LoTi Self-Ratings and English Language Arts TAKS Scores

All student reading/ELA scale scores were entered into frequency tables based on the teacher LoTi self-rating. Students who were absent, exempt from the test, or took the State Developed Alternative Assessment (SDAA), a test designed to be appropriate for Special Education students, were not included in the study.

Additionally, score codes were filtered to ensure that only "S" codes, representing valid scored TAKS tests, were included in the data set. The total number of student tests scored for the 6^{th}, 7^{th}, and 8^{th} grade reading and English Language Arts (ELA) TAKS test was 946. Next, the groups were established using teacher LoTi self-ratings. This procedure resulted in two distinct groups. Group 1 was comprised of reading/ELA teachers with a LoTi self-rating of 1 (awareness). Group 2 was comprised of reading/ELA teachers with a LoTi self-rating of 2 (exploration). Table 4.1 shows the distribution of reading/ELA teacher LoTi self-ratings and the number of students included in each respective group. As a result of the groupings, a t-test for independent samples was performed using the Statistical Package for Social Sciences (SPSS) software, version 18.

Table 4.1. Distribution in Groups by English Teacher Level of Technology Implementation (LoTi) of Students Who Took Reading and English Language Arts (ELA) Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

ELA Teacher LoTi	Students N
1	533
2	413
Total	946

Table 4.2 shows the group statistics for this t-test. Table 4.3 shows the results of the of the t-test for the independent samples of students in group 1 comprised of students with an ELA teacher whose LoTi self-rating was 1(awareness) and students in group 2 comprised of students with an ELA teacher whose LoTi self-rating was 2 (exploration).

It was determined that two discreet groups existed in the data set of students with ELA TAKS scores: students who had English teachers with a LoTi score of 1 (awareness) and students who had English teachers with a LoTi level of 2 (exploration). A t-test for independent samples tested the differences between the means of two groups and was, therefore, the appropriate inferential test used to judge whether a relationship existed (Gall, Borg, & Gall, 1996).

Table 4.2. Descriptive Statistics for Groups by Teacher Level of Technology Implementation (LoTi) of Students Who Took Reading and English Language Arts (ELA) Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School

ELA Teacher LoTi	Students N	TAKS Scale Score Mean	Standard Deviation	Standard Error Mean
1	533	2482.88	181.937	7.881
2	413	2348.95	202.403	9.960

Table 4.3. Summary of Inferential Statistics Test Independent Samples of t-test of Groups by Teacher Level of Technology Implementation (LoTi) of Students Who Took Reading and English Language Arts (ELA) Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig	t	df	Sig. (2-tailed)*	Mean Difference	Std. Error Difference
ELA Scale Score	Equal Variances Assumed	.290	.590	10.689	944	.000	133.929	12.530

*Significant at the 0.05 level.

Teacher LoTi Levels and English Language Arts TAKS Scores – Results

As indicated in Table 4.3, under the columns for the t-test for equality of means, the 2-tailed significance measured 0.000. This was less than the alpha level of 0.05, which was used to determine a statistically significant difference. As a result of this level of comparison, the null hypothesis that there was no relationship between the LoTi levels of English teachers and the ELA TAKS scores of students was rejected. In this instance, rejecting the null hypothesis suggested that within the population of students from which this sample was drawn, the mean TAKS score of students who had an English teacher whose LoTi level is 1 (awareness) was significantly different from the mean TAKS score of students who had and English teacher whose LoTi level was 2 (exploration). Therefore, it was inferred that there was a relationship between an English teacher's LoTi level and student ELA TAKS scores. In this study, students taught by teachers with a LoTi score of 1 (awareness) scored significantly higher than students taught by teachers with a LoTi score of 2 (exploration).

Teacher LoTi Levels and Math TAKS Scores

All student math scale scores were entered into frequency tables based on the teacher LoTi self-rating. Students who were absent, exempt from the test, or took the State Developed Alternative Assessment (SDAA), a test designed to be appropriate for Special Education students, were not included in the study.

Additionally, score codes were filtered to ensure that only "S" codes, representing valid scored TAKS tests, were included in the data set. The total number of student tests scored for the 6th, 7th, and 8th grade math TAKS test was 827. Next, the data were filtered using teacher LoTi self-ratings, and students were grouped based on the assigned teacher LoTi self-rating. This procedure resulted in two distinct groups. Group 1 was comprised of math teachers with a LoTi self-rating of 2 (exploration). Group 2 was comprised of math teachers with a LoTi self-rating of 4 (integration). Table 4.4 shows the distribution of math teacher LoTi self-ratings and the number of students included in each respective group. As a result of the groupings, a t-test for independent samples was performed using the Statistical Package for Social Sciences (SPSS) software, version 18.

Table 4.4. Distribution in Groups by Math Level of Technology Implementation (LoTi) of Students Who Took Math Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 Administration at Alamo Heights Junior School in AHISD

Math Teacher LoTi	Students N
2	512
4	315
Total	827

Table 4.5 shows the group statistics for this t-test. Table 4.6 shows the results of the of the t-test for the independent samples of students in group 1 comprised of students with a math teacher whose LoTi self-rating was 2 (exploration) and students in group 2 comprised of students with a math teacher whose LoTi self-rating was 4 (integration).

It was determined that two discreet groups existed in the data set of students with math TAKS scores: students who had math teachers with a LoTi level of 2 (exploration) and students who had math teachers with a LoTi level of 4 (integration). A t-test for independent samples tested the differences between the means of two groups and was, therefore, identified as the appropriate test to use to judge whether a relationship existed (Gall et al., 1996).

Table 4.5. Descriptive Statistics for Groups by Teacher Level of Technology Implementation (LoTi) of Students Who Took Math Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

Math Teacher LoTi	Students N	TAKS Scale Score Mean	Standard Deviation	Standard Error Mean
2	512	2248.27	186.155	8.227
4	315	2413.94	246.605	13.895

Table 4.6. Summary of Inferential Statistics Test Independent Samples of t-test of Groups by Teacher Level of Technology Implementation (LoTi) of Students Who Took Math Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig	t	df	Sig. (2-tailed)*	Mean Difference	Std. Error Difference
Math Scale Score	Equal Variances Assumed	27.924	.000	-10.260	532.539	.000	-165.673	16.148

*Significant at the 0.05 level.

Teacher LoTi Levels and Math TAKS Scores – Results

As indicated in Table 4.6, under the columns for the t-test for equality of means, the 2-tailed significance was 0.000, less than the critical level of significance at 0.05. As a result of this level of comparison, the null hypothesis that there was no relationship between the LoTi levels of math teachers and the math TAKS scores of students was rejected. In this instance, rejecting the null hypothesis suggested that within the population of students in this sample, the mean TAKS score of students who had a math teacher whose LoTi level is 2 (exploration) was significantly different from the mean TAKS score of students who had a math teacher whose LoTi level is 4 (integration). Therefore, it may be inferred that there was a difference between math teacher's LoTi level and student math TAKS scores. In this study, math students taught by teachers with a LoTi score of 2 (exploration) scored significantly lower than math students taught by teachers with a LoTi score of 4 (integration).

Findings for Research Question 2

In order to determine whether an interaction existed between teacher LoTi levels and students' status as economically disadvantaged, teacher LoTi data and student demographic data were collected for both English Language Arts (ELA) and math content areas respectively. The methodology for answering Research Question 2 built on that of Research Question 1. For each content area, students were categorized into groups based on their respective teachers' LoTi level. All students who had an ELA teacher with a LoTi level of 1 (awareness) comprised one group, all students who had an ELA teacher with a LoTi level of 2 (exploration) comprised a second group, all students who had a math teacher with a LoTi level of 2 (exploration) comprised a third group, and all students who had a math teacher with a LoTi level of 4 (integration) comprised the fourth and final group. A mean score for each group within a content area was calculated and compared one to another. The appropriate inferential statistical test was run to analyze the data.

An additional step was included to answer Research Question 2 that sought to examine students according to their socioeconomic status. For each content area, students within each respective LoTi level group were divided into two additional categories: those whose socioeconomic status was low, economically disadvantaged, and those whose socioeconomic status was not low, not economically disadvantaged. District demographic data identified a student as being on the free lunch program (low SES), the reduced priced lunch program (low SES), or the full priced lunch program (not low SES).

Teacher LoTi levels, English Language Arts (ELA) TAKS Scores, and Student Socioeconomic Status

The total number of 6th, 7th, and 8th grade students who had a valid scored ELA TAKS test, was 946. Table 4.1 referenced above, outlines the distribution of English Language Arts teachers' LoTi levels and the number of students who had teachers with an identified LoTi level. As shown in Table 4.1, there were two distinct groups: English Language Arts teachers with a LoTi level of 1 (awareness) and English Language Arts teachers with a LoTi level of 2 (exploration).

Table 4.7 illustrates more disaggregated groupings of students who took the ELA TAKS test by their socioeconomic status. The total number of students who had an English Language Arts teacher with a LoTi level of 1 (awareness) was 533. Of those students who had an English Language Arts teacher with a LoTi level of 1 (awareness), there were 478 identified as not low socioeconomic status and 55 were identified as low socioeconomic status. The total number of students who had an English Language Arts teacher with a LoTi level of 2 (exploration) was 413. Of those students who had an English Language Arts teacher with a LoTi level of 2 (exploration), there were 302 identified as not low socioeconomic status and 111 were identified as low socioeconomic status. Of the 946 total students, there were 780 identified as not low socioeconomic status and 166 were identified as low socioeconomic status. A two-way Analysis of Variance (ANOVA) procedure was determined to be the appropriate statistical tool to judge whether there was a difference between ELA teacher LoTi score and student level of economic disadvantage and if there was an interaction between ELA teacher LoTi score and student level of economic disadvantage when comparing TAKS scores.

Table 4.7. Between-Subjects Factors for Groups by English Teacher Level of Technology Implementation (LoTi) and Economic Status of Students Who Took Reading and English Language Arts (ELA) Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

Between-Subjects Factors LoTi by Economically Disadvantaged (low SES or not low SES)			
		Value Label	N
ELA LoTi (Level 1)	1	Total	533
Economically Disadvantaged		No	478
		Yes	55
ELA LoTi (Level 2)	2	Total	413
Economically Disadvantaged		No	302
		Yes	111
ELA LoTi (2 levels total)		Total	946
Economically Disadvantaged	No	No	780
	Yes	Yes	166

Teacher LoTi levels, English Language Arts (ELA) TAKS Scores and Student Socioeconomic Status – Results

This section of the study reviewed whether the ELA TAKS scores of students whose status was economically disadvantaged differed based on an ELA teacher's LoTi level. Table 4.8 highlights the descriptive statistics of groups by ELA teacher LoTi level and economic status of students who took the ELA TAKS assessment.

The t-test for independent samples, outlined above in the section for Research Question 1, compared the level of significance indicated by the inferential procedure with the critical level of significance of 0.05. As noted in Table 4.3, the significance figures for the t-test Equality of Means measured 0.000, which was less than the critical level of significance standard of 0.05. Therefore, the null hypothesis of no relationship between an English Language Arts teacher's LoTi level and student ELA TAKS score means was rejected. Rejection of the null hypothesis inferred that within the student population sampled for this research study, the ELA TAKS score mean of students who had an ELA teacher whose LoTi level is 1 (awareness) was significantly different from the ELA TAKS score mean of students who had an ELA teacher whose LoTi level is 2 (exploration). In this study, students taught by ELA teachers with a LoTi score of 1 (awareness) scored significantly higher than students taught by ELA teachers with a LoTi score of 2 (exploration) (Table 4.8). Accordingly, a relationship between an English Language Arts teacher's LoTi level and student ELA TAKS score may be inferred.

Table 4.8. Descriptive Statistics of Groups by English Teacher Level of Technology Implementation (LoTi) and Economic Status of Students Who Took Reading and English Language Arts (ELA) Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

ELA LoTi (2 levels total)	Economically Disadvantaged	Mean	Standard Deviation	N
1	No	2500.88	174.081	478
	Yes	2326.36	174.923	55
	Total	2482.88	181.937	533
2	No	2384.48	198.701	302
	Yes	2252.27	180.289	111
	Total	2348.95	202.403	413
Total	No	2455.82	192.434	780
	Yes	2276.82	181.403	166
	Total	2424.41	202.267	946

The two-way ANOVA procedure was the statistical tool used to answer Research Question 2 specific to whether the ELA TAKS scores of students whose status was economically disadvantaged differed based on an ELA teacher's LoTi level. An

ANOVA test compared the level of significance produced by the inferential procedure with an alpha level of 0.05. As shown in Table 4.9, a value of less than 0.05 in the significance column indicated that there was a statistically significant difference between students' ELA TAKS score means for those whose ELA teacher had a LoTi level of 1 (awareness) as compared to those students whose ELA teacher had a LoTi level of 2 (exploration), with level 1 (awareness) students scoring higher. Data were similar for students whose status was economically disadvantaged. A value of less than 0.05 in the significance column indicated that there was a statistically significant difference between ELA TAKS score means of students whose status was economically disadvantaged (low SES) and those students whose status was not economically disadvantaged (not low SES).

Table 4.9. Summary of Two-Way Analysis of Variance (ANOVA) by English Teacher Level of Technology Implementation (LoTi) and Economic Status of Students Who Took Reading and English Language Arts (ELA) Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.095E6	3	2364977.152	70.574	.000
Intercept	2.748E9	1	2.748E9	82002.698	.000
ELA_LOTI_2	**1113376.758**	**1**	**1113376.758**	**33.225**	**.000**
ECON_DIS	**2886531.716**	**1**	**2886531.716**	**86.138**	**.000**
ELA_LOTI_2* ECON_DIS	**54925.765**	**1**	**54925.765**	**1.639**	**.201**
Error	3.157E7	942	33510.565		
Total	5.599E9	946			
Corrected Total	3.866E7	945			

Note. Dependent Variable: ELA Scale Score.
[a]R Squared = .219 (Adjusted R Squared = .216).
*Stands for 'by' – loti 2 by econ dis – looks at both variables.

Further, the data that answered Research Question 2 were found in the "ELA Teacher LoTi by Economically Disadvantaged" row of Table 4.9 above that reports any potential interaction between the variables of student ELA TAKS score mean, teacher LoTi level, and student status as low SES or not low SES. The finding was a significance level of 0.201, which was greater than the critical level of 0.05. The data showed that there was not a statistically significant difference between the student mean scores on the ELA TAKS test for students in the low SES category whose ELA teacher had a LoTi level of 1 (awareness) or 2 (exploration) and the student mean scores on the ELA TAKS test for students in the not low SES category whose ELA teacher had a LoTi level of 1 (awareness) or 2 (exploration). The null hypothesis for Research Question 2 was that the difference between mean student scores on ELA TAKS and the ELA teacher LoTi levels were significant based on the student's socioeconomic status.

Since the ANOVA does not indicate an interaction between the three variables at the 0.05 level, the study failed to reject the null hypothesis. A relationship may not be inferred between mean student scores on the ELA TAKS test, ELA teacher LoTi levels, and student socioeconomic status. Also, by themselves, non-economically disadvantaged ELA students statistically outperformed economically disadvantaged ELA students. However, when taken together, an interaction effect was observed. Non-economically disadvantaged ELA students being taught by Level 1 (awareness) LoTi ELA teachers achieved at statistically higher levels than economically disadvantaged ELA students being taught by Level 2 (exploration) LoTi ELA teachers. The results are illustrated in Figure 4.1 below.

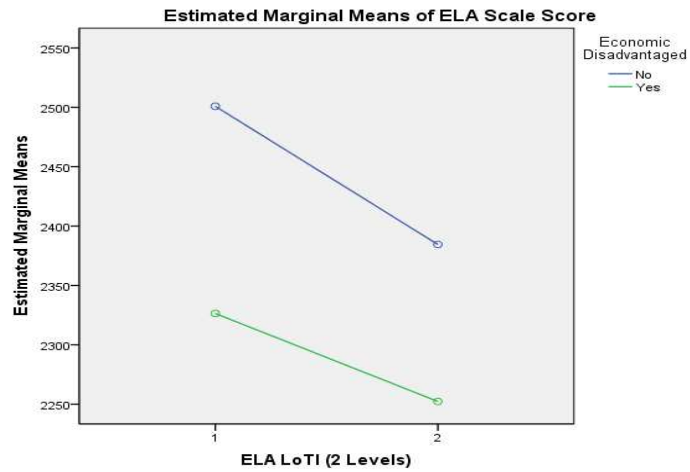

Figure 4.1. Results of Analysis of Variance (ANOVA) Test for Interaction Between English Language Arts (ELA) Level of Technology Implementation (LoTi), Combined Student ELA TAKS Score Means, and Student Socioeconomic Status of Students Who Took Reading and English Language Arts (ELA) Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD.

Teacher LoTi Levels, Math TAKS Scores and Student Socioeconomic Status

The total number of 6th, 7th, and 8th grade students who had a score code of "S," meaning they had taken a valid, scored, math TAKS test, was 827. Table 4.4 outlines the distribution of math teachers' LoTi levels and the number of students who had teachers with an identified LoTi level. As shown in Table 4.4, there were two distinct groups: math teachers with a LoTi level of 2 (exploration) and math teachers with a LoTi level of 4 (integration). Respectively, a t-test for independent samples was conducted using the Statistical Package for Social Sciences (SPSS) software, version 18. Table 4.6 indicated the results of the t-test for independent samples of students in group 1 and group 2.

Table 4.10 illustrates more disaggregated groupings of students who took the math TAKS test by their socioeconomic status. The total number of students who had a math teacher with a LoTi level of 2 (exploration) was 512. Of those students who had a math teacher with a LoTi level of 2 (exploration), there were 374 identified as not low socioeconomic status and 138 were identified as low socioeconomic status. The total number of students who had a math teacher with a LoTi level of 4 (integration) was 315. Of those students who had a math teacher with a LoTi level of 4 (integration), there were 271 identified as not low socioeconomic status and 44 were identified as low socioeconomic status. Of the 827 total students, there were 645 identified as not low socioeconomic status and 182 were identified as low socioeconomic status. An Analysis of Variance (ANOVA) procedure was determined to be the appropriate statistical tool to judge whether there was a difference between math teacher LoTi score and student level of economic disadvantage and if there was an interaction between math teacher LoTi score and student level of economic disadvantage when comparing TAKS scores.

Table 4.10. Between-Subjects Factors for Groups by Math Level of Technology Implementation (LoTi) and Economic Status of Students Who Took Math Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

Between-Subjects Factors LoTi by Economically Disadvantaged (low SES or not low SES)			
		Value Label	N
Math LoTi (Level 2)	1	Total	512
Economically Disadvantaged		No	374
		Yes	138
Math LoTi (Level 4)	2	Total	315
Economically Disadvantaged		No	271
		Yes	44
Math LoTi (2 levels total)		Total	827
Economically Disadvantaged	No	No	645
	Yes	Yes	182

Teacher LoTi Levels, Math TAKS Scores, and Student Socioeconomic Status – Results

This section of the study reviewed whether the math TAKS scores of students whose status was economically disadvantaged differed based on a math teacher's LoTi level. Table 4.11 highlights the descriptive statistics of groups by math teacher LoTi level and economic status of students who took the math TAKS assessment.

The t-test for independent samples, outlined above in the section for Research Question 1, compared the level of significance indicated by the inferential procedure with the critical level of significance of 0.05. As noted in Table 4.6, the significance figures for the t-test Equality of Means measured 0.000, which was less than the critical level of significance standard of 0.05. Therefore, the null hypothesis that there is no relationship between math teacher's LoTi level and student math TAKS score means was rejected. Rejection of the null hypothesis inferred that within the student population sampled for this research study, the math TAKS score mean of students who had a math teacher whose LoTi level is 2 (exploration) was significantly different from the math TAKS score mean of students who had a math teacher whose LoTi level is 4 (integration). In this study, students taught by math teachers with a LoTi score of 2 (exploration) scored significantly lower than students taught by math teachers with a LoTi score of 4 (integration) (Table 4.11). Accordingly, a relationship between math teacher's LoTi level and student math TAKS score may be inferred.

Table 4.11. Descriptive Statistics of Groups by Math Teacher Level of Technology Implementation (LoTi) and Economic Status of Students Who Took Math Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

Math LoTi (2 levels total)	Economically Disadvantaged	Mean	Standard Deviation	N
2	No	2284.38	181.023	374
	Yes	2150.40	163.795	138
	Total	2248.27	186.155	512
4	No	2446.61	230.485	271
	Yes	2212.73	249.712	44
	Total	2413.94	246.605	315
TOTAL	No	2352.54	218.343	645
	Yes	2165.47	189.309	182
	Total	2311.37	225.913	827

An ANOVA test was the statistical tool used to answer Research Question 2 specific to whether the math TAKS scores of students whose status was economically disadvantaged differed based on the math teacher's LoTi level. An ANOVA test compared the level of significance produced by the inferential procedure with a critical level of significance of 0.05. As shown in Table 4.12, a value of less than 0.001 in the significance column, indicated that there was a statistically significant difference between students' math TAKS score means for those whose math teacher had a LoTi level of 2 (exploration) as compared to those students whose math teacher had a LoTi level of 4 (integration), with level 4 (integration) students scoring higher. Data were similar for students based on economically disadvantaged status. A value of less than 0.001 in the significance column indicated there was a statistically significant difference between math TAKS score means of students whose status was economically disadvantaged (low SES) and those students whose status was not economically disadvantaged (not low SES).

Table 4.12. Summary of Two-Way Analysis of Variance (ANOVA) by Math Teacher Level of Technology Implementation (LoTi) and Economic Status of Students Who Took Math Texas Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9.233E6	3	3077700.366	76.935	.000
Intercept	2.276E9	1	2.276E9	56893.484	.000
MATH_LOTI_2	**1387732.498**	**1**	**1387732.498**	**34.690**	**.000**
ECON_DIS	**3724189.040**	**1**	**3724189.040**	**93.095**	**.000**
MATH_LOTI_2* ECON_DIS	**274655.894**	**1**	**274655.894**	**6.866**	**.009**
Error	3.292E7	823	40004.059		
Total	4.460E9	827			
Corrected Total	4.216E7	826			

Note. Dependent Variable: ELA Scale Score.
[a]R Squared = .219 (Adjusted R Squared = .216).
*Stands for 'by' – loti 2 by econ dis – looks at both variables.

Further, the data that answered Research Question 2 are found in the "Math teacher LoTi by Economically Disadvantaged" row of Table 4.12 above that reports any potential interaction between the variables of student math TAKS score mean, teacher LoTi level, and student status as low SES or not low SES. The finding was a significance level of 0.009, which was less than the critical level of 0.05. The data showed that there were a statistically significant interaction between the student mean scores on the math TAKS test for students in the low SES category whose math teacher had a LoTi level of 2 (exploration) or 4 (integration) and the student mean scores on the math TAKS test for students in the not low SES category whose math teacher had a LoTi level of 2 (exploration) or 4 (integration). The null hypothesis of interaction for Research Question 2 was rejected. That is, there was some interaction between LoTi level and economic disadvantage status. As previously indicated, by themselves, students being taught by level 4 (integration) LoTi teachers statistically outperformed students being taught by level 2 (exploration) math LoTi teachers. Also, by themselves, non-economically disadvantaged students statistically outperformed economically disadvantaged math students. However, when taken together, an interaction effect was observed. Non-economically disadvantaged math students being taught by Level 4 (integration) LoTi teachers achieved at statistically higher levels than economically disadvantaged math students being taught by Level 2 (exploration) LoTi math teachers. The results are illustrated in Figure 4.2 below.

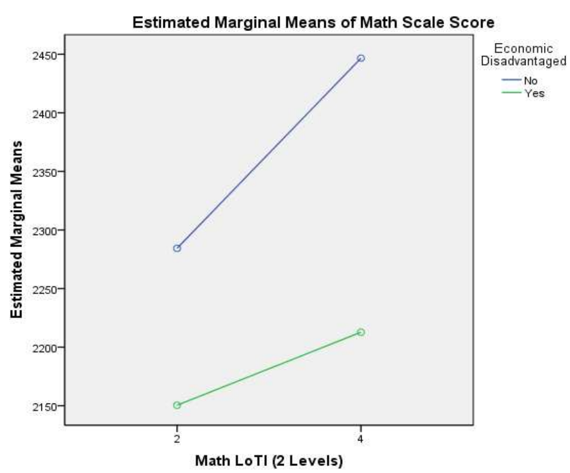

Figure 4.2. Results of Analysis of Variance (ANOVA) Test for Interaction Between Math Level of Technology Implementation (LoTi), Combined Student Math TAKS Score Means, and Student Socioeconomic Status of Students Who Took Math Texas

Assessment of Knowledge and Skills (TAKS) Test in the Spring of 2009 at Alamo Heights Junior School in AHISD.

Summary of Findings

The focus of the research study was to answer two questions specific to teacher self-reported LoTi levels and student TAKS test scores. The following research questions were posed:

1. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6th, 7th, and 8th graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?
2. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores among 6th, 7th, and 8th graders whose status is identified as economically disadvantaged in student records at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

The findings for Research Question 1 led the researcher to reject the null hypothesis for English Language Arts (ELA) and math content areas. As a result, in English Language Arts (ELA) and math, the difference in achievement may be inferred between teacher LoTi levels and student TAKS test scores. The level of technology implementation indicated by a teacher did have an impact on student achievement on the respective TAKS test.

The findings for Research Question 2 led the researcher to reject the null hypothesis for English Language Arts (ELA) and math content areas respective to economic disadvantage status. That is, there was some interaction between LoTi level and economic disadvantage status. By themselves, non-economically disadvantaged students statistically outperformed economically disadvantaged students on both the ELA and math TAKS tests. However, when taken together, an interaction effect was observed. Non-economically disadvantaged ELA students being taught by level 1 (awareness) LoTi ELA teachers statistically outperformed non-economically disadvantaged ELA students being taught by level 2 (exploration) LoTi ELA teachers. Further, non-economically disadvantaged math students being taught by Level 4 (integration) LoTi math teachers achieved at statistically higher levels than non-economically disadvantaged math students being taught by Level 2 (exploration) LoTi math teachers.

Conclusions drawn from the research findings, recommendations for educators, and recommendations for further research and study will be addressed in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter is divided into three main sections containing the summary, conclusions, and recommendations of the researcher. The first section outlines a summary of the study and the procedures taken by the researcher to investigate the research questions. The second section delineates the author's findings that resulted from the research questions posed and conclusions derived from the data analysis. The third section includes implications for educational leaders and practitioners as well as recommendations for further study as indicated by the conclusions.

Overview of the Study

The central focus of this record of study was to examine whether there was a relationship between teacher Levels of Technology Implementation (LoTi) and student achievement scores on the Texas Assessment of Knowledge and Skills (TAKS) tests at the junior high level, 6^{th}, 7^{th}, and 8^{th} grades. The following two research questions were analyzed as the basis for determining whether a relationship existed between levels of teacher technology implementation and student achievement as measured by TAKS scores:

1. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6^{th}, 7^{th}, and 8^{th} graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

2. Is there a relationship between teacher self-reported LoTi ratings and TAKS scores among 6^{th}, 7^{th}, and 8^{th} graders whose status is identified as economically disadvantaged in student records at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

The population of teachers and students who comprised the study were from Alamo Heights Junior School, in Alamo Heights Independent School District (AHISD) in San Antonio, Texas. Both school and student performance analysis include only Alamo Heights Junior School in the Alamo Heights Independent School District.

In order to determine whether a relationship existed between teacher LoTi scores and student TAKS scores, teacher LoTi data along with student TAKS and demographic data were collected. Specific to this record-of study, the LoTi is the state approved, district-designated means for assessing technology progress at a local level for teachers in Alamo Heights Independent School District. A LoTi rating reflects, on a scale of 0-6, the degree to which the respondent supports and implements instructional uses of technology in an instructional setting (Table 2.3). Progression from level 0 (non use) toward intensity level 6 (refinement) along the LoTi scale involves a seamless relationship between instruction and the use of digital tools and resources. A LoTi level 6 (refinement) is indicative of pervasive use of and access to advanced digital tools and high levels of interaction with content and knowledge acquisition (Appendix K).

In each of the content areas studied, ELA and math, students were categorized into groups as determined by their teacher's LoTi scores. For instance, all students within a specific content area, such as ELA, who also had a teacher within that content area with a LoTi score of 1 (awareness), were defined as a group. All students within the ELA content area, who also had a teacher within that content area with a LoTi score of 2 (exploration), were defined as another group. The process was repeated for math and the additional content area studied. All students within the math content area who also had a teacher within that content with a LoTi score of 2 (exploration) were defined as a group and all math students who had a teacher within that content area with a LoTi score of 4 (integration) comprised the final group. A mean score for the respective TAKS results, for each group within an identified content area, was calculated to compare one group mean to another using the appropriate inferential statistical procedure.

The second part of the study re-grouped student test score data to determine whether a difference existed between those test scores based on the teacher LoTi scores and the students' level of economically disadvantage. That is, the study examined whether teacher LoTi scores affected student achievement data for economically disadvantaged (low SES) students differently than the achievement data for non-economically disadvantaged (not low SES) students.

Data were collected from Alamo Heights ISD and the LoTi Connection. Student achievement data, scores on the ELA and math TAKS tests, were collected from existing records in the district. Individuals completing the LoTi questionnaire receive their personal LoTi level, however, the score remains confidential and the district receives a report noting the aggregate score of the respondents. The researcher obtained permission from the chief communications officer at the LoTi Connection to obtain individual teacher LoTi results to be sorted by subject area for data analysis. Additionally, the

Public Education Information Management System (PEIMS) database was used to collect demographic data relevant to student economically disadvantaged status. The data were compiled into an Excel spreadsheet and imported into SPSS software for final statistical analysis.

Data were collected from 946 6th, 7th, and 8th grade students who took the reading and English Language Arts (ELA) TAKS test and 827 6th, 7th, and 8th grade students who took the math TAKS test. There were a total of 29 ELA and math teachers from the Alamo Heights Junior School who further comprised the population under study. Although the data set is technically a population and not a random sample, inferential statistics were administered, nonetheless, to hypothesize to a larger population. Version 18 of the Statistical Package for Social Studies (SPSS) computer program was used to conduct an independent samples t-test for the ELA and math content areas to answer Research Question 1. An analysis of variance (ANOVA) procedure was then used to analyze whether there was a difference between teacher LoTi level and student TAKS score, when the level of student economic disadvantage was included, to answer Research Question 2.

Findings

Research Question 1

Is there a relationship between teacher self-reported LoTi ratings and TAKS scores as reported in student records for 6th, 7th, and 8th graders at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

The results from this study determined that there was a significant relationship at the junior high level between teacher LoTi levels and student TAKS scores in each content area. By analyzing the overall mean of the TAKS achievement scores for each teacher LoTi level, the researcher discovered that the highest mean TAKS scores do not correlate with the highest teacher LoTi level across subject areas. A LoTi rating reflects, on a scale of 0-6, the degree to which the respondent supports and implements instructional uses of technology in an instructional setting. Progression toward intensity level 6 along the LoTi scale involves a seamless relationship between instruction and the use of digital tools and resources. A LoTi level 6 is indicative of pervasive use of and access to advanced digital tools and high levels of interaction with content and knowledge acquisition. As specified by the LoTi instrument, the level of technology implementation in the classroom is indicated on a scale of 0-6 (0 = nonuse, 1 = Awareness, 2 = Exploration, 3 = Infusion, 4a = Integration Mechanical, 4b = Integration Routine, 5 = Expansion, and 6 = Refinement). The instrument further characterized levels 0-3 as teacher-centered instruction, whereas levels 4-6 were considered to be student-centered learning with an increase in LoTi levels indicating an increased use of higher order thinking skills such as application, analysis, evaluation, and creation in the classroom setting.

Within the population of students from which the sample was drawn, the mean TAKS score of students who had an English teacher with a LoTi level of 1 was significantly different from the mean TAKS score of students who had an English teacher with a LoTi level of 2. It may be inferred that there was a relationship between an English teacher's LoTi level and student ELA TAKS scores. In this study, students taught by an ELA teacher with a LoTi score of 1 scored significantly higher than students taught by an ELA teacher with a LoTi score of 2. It may be inferred that there was a relationship between ELA teacher's LoTi level and student ELA TAKS scores. In this case, the findings indicated an inverse relationship in that ELA mean TAKS scores were higher for those students who had teachers with LoTi scores of 1 and ELA mean TAKS scores were lower for those students who had teachers with LoTi scores of 2. The fact that teacher LoTi ratings were limited to level 1 (awareness) and level 2 (exploration) indicated that in either case, teacher use of technology tools was characterized by information dissemination to students and direct instruction. Use of technology tools by students in this context would be minimal to nonexistent. This finding confirms the research that all too often the use of new technologies is limited to supporting traditional existing teaching practices (Apple, 2002; Learning for the 21st Century, 2002; McKenzie, 1998; Means, 2010; Rogers, 2001; Vannatta & Fordham, 2004; Wise, 1997).

The results from this study further determined that within the population of students from which the sample was drawn, the mean TAKS score of students who had a math teacher whose LoTi level is 2 was significantly different from the mean TAKS score of students who had a math teacher whose LoTi level is 4. It may be inferred that there was a relationship between math teacher's LoTi level and student math TAKS scores. In this study, students taught by a math teacher with a LoTi score of 2 scored significantly lower than students taught by a math teacher with a LoTi score of 4.

Literature suggests that the most productive and meaningful uses of technology occur in constructivist settings where the teacher becomes a facilitator and learners use technologies to teach themselves and others in a student-centered context that would not be possible without the technology (Boethel & Dimock, 1999; Bull et al., 2002; Jonassen, Peck, & Wilson, 1999; Ravitz, Becker, & Wong, 2000). Math teachers rated at a LoTi level 4 (integration) indicated a more student-centered learning environment in which the teacher may have facilitated student engagement in real world problem solving using digital tools and resources. The finding that students of math teachers at LoTi level 4 (integration) scored significantly higher than students of math teachers at LoTi level 2 (exploration) is consistent with this literature. Based on the data presented for ELA and math, the highest mean TAKS scores were not associated with the highest teacher LoTi level across content areas.

For many teachers, the constructivist direction of the research findings is a radical departure from the didactic transmission model characterized by the teacher-centered whole class instruction (Pea, as cited in Becker & Ravitz, 2000). Further, there is consensus among researchers that the advent of computers in the classroom has not led to a transformation of instructional practices among the vast majority of teachers (Brinkerhoff, 2006; Ferdig, 2006; Halverson & Smith, 2009; Ravitz et al., 2000; Russell et al., 2003; Sandholtz & Reilly, 2004). Some research suggests that merging constructivist philosophy and practice with initiatives to integrate educational technology may ultimately lead to improved student achievement (Rochelle et al., 2000).

Based on the LoTi framework, teachers must reach a minimum of LoTi 4 (integration) to approach a constructivist model of teaching.

Research Question 2

Is there a relationship between teacher self-reported LoTi ratings and TAKS scores among 6th, 7th, and 8th graders whose status is identified as economically disadvantaged in student records at Alamo Heights Junior School, Alamo Heights Independent School District, in San Antonio, Texas?

The researcher further disaggregated that data from Research Question 1 to analyze the overall effect of a teacher's LoTi level, a student's economically disadvantaged status (low SES or not low SES), and the student's achievement as measured by TAKS score, to determine whether higher LoTi levels yielded higher TAKS scores for students. A two-way analysis of variance indicated there was a significant difference in the student's ELA achievement level, as measured by TAKS scores, based on teacher LoTi levels. The findings further indicated that the overall mean ELA TAKS scores were significantly lower for students with economically disadvantaged status than the overall mean ELA TAKS scores for students with non-economically disadvantaged status. However, in the case of English Language Arts, there was no interaction effect. Mean TAKS scores for students designated as economically disadvantaged (low SES) were consistent with the mean TAKS scores of their peers who were not designated as economically disadvantaged (not low SES). For both ELA students who were economically disadvantaged and ELA students who were not economically disadvantaged, the mean ELA TAKS scores were higher for ELA students who had an ELA teacher with a LoTi level of 1 and the mean ELA TAKS scores were lower for ELA students who had an ELA teacher with a LoTi level of 2.

A two-way analysis of variance indicated there was a significant difference in the student's math achievement level, as measured by TAKS scores, based on teacher LoTi levels. The findings further indicated that the overall mean math TAKS scores were significantly lower for students with economically disadvantaged status than the overall mean math TAKS scores for students with non-economically disadvantaged status. Additionally, in the case of mathematics, there was no interaction effect. Mean TAKS scores for students designated as economically disadvantaged (low SES) were consistent with the mean TAKS scores of their peers who were not designated as economically disadvantaged (not low SES). For both students who were economically disadvantaged and students who were not economically disadvantaged, the mean math TAKS scores were lower for students who had a math teacher with a LoTi level of 2 and the mean math TAKS scores were higher for students who had a math teacher with a LoTi level of 4. The findings further indicated that the overall mean math TAKS scores were significantly lower for math students with economically disadvantaged status than the overall mean math TAKS scores for math students with non-economically disadvantaged status.

Findings that in both ELA and math, the overall mean TAKS scores for students with economically disadvantaged status were significantly lower than the overall mean TAKS scores for students with non-economically disadvantaged status are consistent with literature suggesting a didactic digital divide based on varied levels of acquisition of knowledge and the potential segregation of citizens who had access to, and the know how to use the information from those who did not (Bull et al., 2002; NCREL, 2002; Rideout et al., 2005; Roberts & Foehr, 2008; Warschauer et al., 2004).

Implications and Recommendations for Further Study

This study was intended as a research tool for Alamo Heights Independent School District to investigate teacher implementation of technology and its impact on student achievement as measured by TAKS scores. The primary focus was to determine whether there was a relationship between teacher LoTi levels and student performance on ELA and math TAKS tests. A secondary goal was to determine whether there was a relationship between teacher LoTi levels and student performance on ELA and math TAKS tests that differed based on students economically disadvantaged status. Based on the findings from Research Question 1, the relationship between teacher LoTi levels and student performance on TAKS tests was not consistent across content areas. That is, in both subject areas there was a difference in student achievement based on the instructor's LoTi Level. However, the higher LoTi level was not linked to higher achievement in both subjects. The LoTi framework was conceptualized as a research tool to assess authentic classroom technology use and designed to be consistent with a constructivist philosophy of teaching and learning. In this study, findings that overall mean math TAKS scores were among students of math teachers with LoTi 4 (integration) rating would support a suggestion that LoTi 4 teachers implemented a more student-centered learning environment, in turn, leading to higher student achievement on TAKS.

Findings from Research Question 2 indicated the relationship between teacher LoTi levels and student performance on ELA and math TAKS tests based on students economically disadvantaged status was consistent within content areas, however, was not consistent across content areas. Both students who were designated as economically disadvantaged (low SES) and students who were not designated as economically disadvantaged (not low SES) had ELA TAKS scores that were significantly higher where the ELA teacher had a LoTi level of 1 and significantly lower where the ELA teacher had a LoTi level of 2. Both students who were designated as economically disadvantaged (low SES) and students who were not designated as economically disadvantaged (not low SES) had math TAKS scores that were significantly higher where the math teacher had a LoTi level of 4 and significantly lower where the math teacher had a LoTi level of 2. Both ELA and math students, who were designated as economically disadvantaged (low SES), scored significantly lower than students who were designated as not economically disadvantaged (not low SES) in ELA and math respectively. This would indicate the value of additional research to determine what specific technology was used in order to judge the effectiveness in the context for which it is meant (Ferdig, 2006) and to ascertain whether the teacher’s use of technology was pedagogically sound (Margerum-Leys & Marx, 2004; Otero et al., 2005).

The overall findings of this study appear to be consistent with the literature that research results on available data linking technology to school effectiveness and student outcomes, or the effects of teaching and learning with technology on student achievement, specifically test scores, continues to be ambiguous or inconclusive

(Fishman et al., 2004; Noble, 1996; Ringstaff & Kelley, 2002; Schacter, 1999; Waxman et al., 2003; Wenglinsky, 2006).

The following are recommendations offered for consideration based upon the findings and conclusions of this study.

1. According to a review of literature, the LoTi instrument is based on the principles of constructivist learning that fosters high levels of student achievement resulting from student-centered learning opportunities in addition to promoting higher order thinking strategies resulting from the appropriate integration of technology tools into the learning environment. Although this study did not provide significant results with respect to integrating technology and higher student achievement, the LoTi framework provided a tool through which to learn about utilizing technology as a tool for teaching and learning. It is recommended that campus leaders continue to utilize the LoTi framework as a tool to align best practices for teaching and learning.
2. Although there was a statistically significant relationship between teacher Levels of Technology Implementation (LoTi) and student performance on TAKS tests, the relationship did not constitute a positive correlation across content areas. In ELA, students with ELA teachers who had the lower LoTi level of 1 = Awareness outperformed their peers on ELA TAKS tests who had ELA teachers with a higher LoTi level of 2 = Exploration. In math, students with math teachers who had a higher LoTi level of 4 = Integration

(mechanical or routine), outperformed their peers on math TAKS tests who had math teachers with a LoTi level of 2 = Exploration. Varied explanations may account for the inconsistency. One example may be that teacher levels of technology implementation as self-reported on the LoTi questionnaire may not be consistent with their actual levels of technology implementation in their classroom practices. Additional professional development specific to the LoTi framework focused on increased understanding of technology use in conjunction with instructional practices may lead to different levels of awareness and hence potentially lead to different results. Classroom observations to ascertain the degree of alignment between teacher self-reports of technology use and actual use as outlined by the LoTi instrument are worthy of consideration.

3. The review of literature suggests that the LoTi questionnaire is consistent with a constructivist model of teaching and learning. Studies have shown a connection between a constructivist approach and increased student achievement. Based findings supported by research, that the LoTi framework incorporates elements of best instructional practices in implementing technology into the teaching and learning environment, the researcher recommends that the LoTi framework be incorporated into the overall ongoing campus professional development as one of the tools to identify constructivist teaching practice.

4. The study should be replicated and longitudinal data analyzed to determine whether teaching practices include increased technology implementation. At the time of this study, AHISD teachers were in the introductory phase of implementing technology into instructional practices.
5. Data from the study indicated that in math, economically disadvantaged students being taught by teachers with higher levels of technology implementation significantly outperformed their peers who were being taught by teachers with lower levels of technology implementation. It is recommended that the campus assess technology implementation strategies being utilized in the math department to investigate interdepartmental training possibilities.

Recommendations for Further Study

The following are recommendations for further research related to this topic:

1. Research is needed to observe and refine appropriate technology implementation practiced in the instructional setting.
2. Research is needed to investigate how technology is specifically implemented and how it may be varied in the instructional setting by content area.
3. Research is needed to examine the effect of teacher professional development utilizing the LoTi Framework on teacher responses to the LoTi questionnaire.
4. Research is needed to study the effect of teacher professional development utilizing the LoTi Framework on student achievement in general and specifically on student achievement for economically disadvantaged students.

Conclusions

The central focus of this record of study was to examine whether there was a relationship between teacher Levels of Technology Implementation (LoTi) and student achievement scores on the Texas Assessment of Knowledge and Skills (TAKS) tests at the junior high level, 6th, 7th, and 8th grades. The findings for both English Language Arts and math reveal that there was a relationship between the teacher's level of technology implementation in the instructional setting and student performance on the TAKS test. Due to the nature of the results, it is important to continue efforts to research the role of technology implementation in student learning to further delineate and define the relationship. Further, this study is in agreement with Culp et al. (2003) and among those to concur that additional research is needed on the impact of technology on schools and teaching and learning activities.

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APPENDIX A

NATIONAL EDUCATION TECHNOLOGY STANDARDS

FOR STUDENTS NETS-S 1998

Technology Foundation Standards for Students

The technology foundation standards for students are divided into six broad categories. Standards within each category are to be introduced, reinforced, and mastered by students. These categories provide a framework for linking performance indicators within the Profiles for Technology Literate Students to the standards. Teachers can use these standards and profiles as guidelines for planning technology-based activities in which students achieve success in learning, communication, and life skills.

Technology Foundation Standards for Students

1. Basic operations and concepts
   - *Students demonstrate a sound understanding of the nature and operation of technology systems.*
   - *Students are proficient in the use of technology.*
2. Social, ethical, and human issues
   - *Students understand the ethical, cultural, and societal issues related to technology.*
   - *Students practice responsible use of technology systems, information, and software.*
   - *Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.*
3. Technology productivity tools
   - *Students use technology tools to enhance learning, increase productivity, and promote creativity.*
   - *Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.*

4. Technology communications tools
   - *Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.*
   - *Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.*

5. Technology research tools
   - *Students use technology to locate, evaluate, and collect information from a variety of sources.*
   - *Students use technology tools to process data and report results.*
   - *Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.*

6. Technology problem-solving and decision-making tools
   - *Students use technology resources for solving problems and making informed decisions.*
   - *Students employ technology in the development of strategies for solving problems in the real world.*

APPENDIX B

NATIONAL EDUCATION TECHNOLOGY STANDARDS

FOR STUDENTS NETS-S 2007

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ADVANCING DIGITAL AGE LEARNING

1. Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.

a. Apply existing knowledge to generate new ideas, products, or processes
b. Create original works as a means of personal or group expression
c. Use models and simulations to explore complex systems and issues
d. Identify trends and forecast possibilities

2. Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
c. Develop cultural understanding and global awareness by engaging with learners of other cultures
d. Contribute to project teams to produce original works or solve problems

3. Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information.

a. Plan strategies to guide inquiry
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
d. Process data and report results

4. Critical Thinking, Problem Solving, and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

a. Identify and define authentic problems and significant questions for investigation
b. Plan and manage activities to develop a solution or complete a project
c. Collect and analyze data to identify solutions and/or make informed decisions
d. Use multiple processes and diverse perspectives to explore alternative solutions

5. Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

a. Advocate and practice safe, legal, and responsible use of information and technology
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
c. Demonstrate personal responsibility for lifelong learning
d. Exhibit leadership for digital citizenship

6. Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations.

a. Understand and use technology systems
b. Select and use applications effectively and productively
c. Troubleshoot systems and applications
d. Transfer current knowledge to learning of new technologies

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APPENDIX C

NATIONAL EDUCATION TECHNOLOGY STANDARDS

FOR TEACHERS NETS-T 2000

ISTE NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS (NETS) AND PERFORMANCE INDICATORS FOR TEACHERS

All classroom teachers should be prepared to meet the following standards and performance indicators.

I. TECHNOLOGY OPERATIONS AND CONCEPTS

Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:

A. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE *National Educational Technology Standards for Students*).

B. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

II. PLANNING AND DESIGNING LEARNING ENVIRONMENTS AND EXPERIENCES

Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

A. design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.

B. apply current research on teaching and learning with technology when planning learning environments and experiences.

C. identify and locate technology resources and evaluate them for accuracy and suitability.

D. plan for the management of technology resources within the context of learning activities.

E. plan strategies to manage student learning in a technology-enhanced environment.

III. TEACHING, LEARNING, AND THE CURRICULUM

Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:

A. facilitate technology-enhanced experiences that address content standards and student technology standards.

B. use technology to support learner-centered strategies that address the diverse needs of students.

C. apply technology to develop students' higher order skills and creativity.

D. manage student learning activities in a technology-enhanced environment.

IV. ASSESSMENT AND EVALUATION

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:

A. apply technology in assessing student learning of subject matter using a variety of assessment techniques.

B. use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.

C. apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.

V. PRODUCTIVITY AND PROFESSIONAL PRACTICE

Teachers use technology to enhance their productivity and professional practice. Teachers:

A. use technology resources to engage in ongoing professional development and lifelong learning.

B. continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.

C. apply technology to increase productivity.

D. use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning.

VI. SOCIAL, ETHICAL, LEGAL, AND HUMAN ISSUES

Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK–12 schools and apply that understanding in practice. Teachers:

A. model and teach legal and ethical practice related to technology use.

B. apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.

C. identify and use technology resources that affirm diversity.

D. promote safe and healthy use of technology resources.

E. facilitate equitable access to technology resources for all students.

APPENDIX D

NATIONAL EDUCATION TECHNOLOGY STANDARDS FOR ADMINISTRATORS NETS-A 2002

ISTE NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS (NETS) AND PERFORMANCE INDICATORS FOR ADMINISTRATORS

(Developed by the TSSA Collaborative and adopted by ISTE NETS)

I. LEADERSHIP AND VISION—Educational leaders inspire a shared vision for comprehensive integration of technology and foster an environment and culture conducive to the realization of that vision.

Educational leaders:

A. facilitate the shared development by all stakeholders of a vision for technology use and widely communicate that vision.

B. maintain an inclusive and cohesive process to develop, implement, and monitor a dynamic, long-range, and systemic technology plan to achieve the vision.

C. foster and nurture a culture of responsible risk-taking and advocate policies promoting continuous innovation with technology.

D. use data in making leadership decisions.

E. advocate for research-based effective practices in use of technology.

F. advocate, on the state and national levels, for policies, programs, and funding opportunities that support implementation of the district technology plan.

II. LEARNING AND TEACHING—Educational leaders ensure that curricular design, instructional strategies, and learning environments integrate appropriate technologies to maximize learning and teaching.

Educational leaders:

A. identify, use, evaluate, and promote appropriate technologies to enhance and support instruction and standards-based curriculum leading to high levels of student achievement.

B. facilitate and support collaborative technology-enriched learning environments conducive to innovation for improved learning.

C. provide for learner-centered environments that use technology to meet the individual and diverse needs of learners.

D. facilitate the use of technologies to support and enhance instructional methods that develop higher-level thinking, decision-making, and problem-solving skills.

E. provide for and ensure that faculty and staff take advantage of quality professional learning opportunities for improved learning and teaching with technology.

III. PRODUCTIVITY AND PROFESSIONAL PRACTICE—Educational leaders apply technology to enhance their professional practice and to increase their own productivity and that of others.

Educational leaders:

A. model the routine, intentional, and effective use of technology.

B. employ technology for communication and collaboration among colleagues, staff, parents, students, and the larger community.

C. create and participate in learning communities that stimulate, nurture, and support faculty and staff in using technology for improved productivity.

D. engage in sustained, job-related professional learning using technology resources.

E. maintain awareness of emerging technologies and their potential uses in education.

F. use technology to advance organizational improvement.

IV. SUPPORT, MANAGEMENT, AND OPERATIONS—Educational leaders ensure the integration of technology to support productive systems for learning and administration.

Educational leaders:

A. develop, implement, and monitor policies and guidelines to ensure compatibility of technologies.

B. implement and use integrated technology-based management and operations systems.

C. allocate financial and human resources to ensure complete and sustained implementation of the technology plan.

D. integrate strategic plans, technology plans, and other improvement plans and policies to align efforts and leverage resources.

E. implement procedures to drive continuous improvements of technology systems and to support technology replacement cycles.

V. ASSESSMENT AND EVALUATION—Educational leaders use technology to plan and implement comprehensive systems of effective assessment and evaluation.

Educational leaders:

A. use multiple methods to assess and evaluate appropriate uses of technology resources for learning, communication, and productivity.

B. use technology to collect and analyze data, interpret results, and communicate findings to improve instructional practice and student learning.

C. assess staff knowledge, skills, and performance in using technology and use results to facilitate quality professional development and to inform personnel decisions.

D. use technology to assess, evaluate, and manage administrative and operational systems.

VI. SOCIAL, LEGAL, AND ETHICAL ISSUES—Educational leaders understand the social, legal, and ethical issues related to technology and model responsible decision-making related to these issues.

Educational leaders:

A. ensure equity of access to technology resources that enable and empower all learners and educators.

B. identify, communicate, model, and enforce social, legal, and ethical practices to promote responsible use of technology.

C. promote and enforce privacy, security, and online safety related to the use of technology.

D. promote and enforce environmentally safe and healthy practices in the use of technology.

E. participate in the development of policies that clearly enforce copyright law and assign ownership of intellectual property developed with district resources.

The materials contained on this panel and on the reverse side of this poster were originally produced as a project of the Technology Standards for School Administrators Collaborative.

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APPENDIX E

NATIONAL EDUCATION TECHNOLOGY STANDARDS

FOR TEACHERS NETS-T 2007

iste.nets·t

ADVANCING DIGITAL AGE TEACHING

Effective teachers model and apply the NETS·S as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community. All teachers should meet the following standards and performance indicators.

1. Facilitate and Inspire Student Learning and Creativity

Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

a. Promote, support, and model creative and innovative thinking and inventiveness
b. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources
c. Promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes
d. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments

2. Design and Develop Digital Age Learning Experiences and Assessments

Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS·S.

a. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity
b. Develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress
c. Customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources
d. Provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching

3. Model Digital Age Work and Learning

Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.

a. Demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations
b. Collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation
c. Communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital age media and formats
d. Model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning

4. Promote and Model Digital Citizenship and Responsibility

Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices.

a. Advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate documentation of sources
b. Address the diverse needs of all learners by using learner-centered strategies providing equitable access to appropriate digital tools and resources
c. Promote and model digital etiquette and responsible social interactions related to the use of technology and information
d. Develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital age communication and collaboration tools

5. Engage in Professional Growth and Leadership

Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources.

a. Participate in local and global learning communities to explore creative applications of technology to improve student learning
b. Exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others
c. Evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning
d. Contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community

iste.org/nets

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APPENDIX F

NATIONAL EDUCATION TECHNOLOGY STANDARDS FOR ADMINISTRATORS NETS-A 2009

iste.nets·a

ADVANCING DIGITAL AGE LEADERSHIP

1. Visionary Leadership

Educational Administrators inspire and lead development and implementation of a shared vision for comprehensive integration of technology to promote excellence and support transformation throughout the organization.

a. Inspire and facilitate among all stakeholders a shared vision of purposeful change that maximizes use of digital-age resources to meet and exceed learning goals, support effective instructional practice, and maximize performance of district and school leaders

b. Engage in an ongoing process to develop, implement, and communicate technology-infused strategic plans aligned with a shared vision

c. Advocate on local, state and national levels for policies, programs, and funding to support implementation of a technology-infused vision and strategic plan

2. Digital Age Learning Culture

Educational Administrators create, promote, and sustain a dynamic, digital-age learning culture that provides a rigorous, relevant, and engaging education for all students.

a. Ensure instructional innovation focused on continuous improvement of digital-age learning

b. Model and promote the frequent and effective use of technology for learning

c. Provide learner-centered environments equipped with technology and learning resources to meet the individual, diverse needs of all learners

d. Ensure effective practice in the study of technology and its infusion across the curriculum

e. Promote and participate in local, national, and global learning communities that stimulate innovation, creativity, and digital age collaboration

3. Excellence in Professional Practice

Educational Administrators promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources.

a. Allocate time, resources, and access to ensure ongoing professional growth in technology fluency and integration

b. Facilitate and participate in learning communities that stimulate, nurture and support administrators, faculty, and staff in the study and use of technology

c. Promote and model effective communication and collaboration among stakeholders using digital age tools

d. Stay abreast of educational research and emerging trends regarding effective use of technology and encourage evaluation of new technologies for their potential to improve student learning

4. Systemic Improvement

Educational Administrators provide digital age leadership and management to continuously improve the organization through the effective use of information and technology resources.

a. Lead purposeful change to maximize the achievement of learning goals through the appropriate use of technology and media-rich resources
b. Collaborate to establish metrics, collect and analyze data, interpret results, and share findings to improve staff performance and student learning
c. Recruit and retain highly competent personne who use technology creatively and proficiently to advance academic and operational goals
d. Establish and leverage strategic partnerships to support systemic improvement
e. Establish and maintain a robust infrastructure for technology including integrated, interoperable technology systems to support management, operations, teaching, and learning

5. Digital Citizenship

Educational Administrators model and facilitate understanding of social, ethical and legal issues and responsibilities related to an evolving digital culture.

a. Ensure equitable access to appropriate digital tools and resources to meet the needs of all learners
b. Promote, model and establish policies for safe, legal, and ethical use of digital information and technology
c. Promote and model responsible social interactions related to the use of technology and information
d. Model and facilitate the development of a shared cultural understanding and involvement in global issues through the use of contemporary communication and collaboration tools

APPENDIX G

TEXAS SCHOOL TECHNOLOGY AND READINESS (STaR) CHART

TEXAS STAR CHART

TEACHER CHART

School Technology and Readiness
A Teacher Tool for Planning and Self-Assessing
aligned with the
Long-Range Plan for Technology, 2006-2020

Instructional Materials and Educational Technology Division
Texas Education Agency

The Texas Teacher School Technology and Readiness (STaR) Chart

KEY AREA:	TEACHING & LEARNING					
Focus Area: / Levels of Progress:	TL 1 Patterns of Classroom Use	TL 2 Frequency/ Design of Instructional Setting Using Digital Content	TL 3 Content Area Connections	TL 4 Technology Applications (TA) TEKS Implementation (TAC Chapter 126)	TL 5 Student Mastery of Technology Applications (TA) TEKS	TL 6 Online Learning
Early Tech	I occasionally use technology to supplement instruction, streamline management functions, and present teacher-centered lectures My students use software for skill reinforcement	I occasionally use technology to supplement or reinforce instruction in my classroom, library, or lab	I use technology for basic skills with little or no connections with content objectives	I am aware that there are Technology Applications (TA) TEKS for Grades K-12 and adopted Technology Applications instructional materials	Up to 25% of my students have mastered Technology Applications TEKS	I have used a few web-based learning activities with my students
Developing Tech	I use technology to direct instruction, improve productivity, model technology skills, and direct students in the use of applications for technology integration My students use technology to communicate and present information	I have regular weekly access and use of technology and digital resources for curriculum activities in my classroom, library, or lab	I use technology to support content objectives	I am aware of the TA TEKS that are appropriate for content area TEKS and occasionally include technology skills in planning and implementing instruction I use adopted TA instructional materials to assist in instruction (where applicable)	26-50% of my students have mastered Technology Applications TEKS	I have customized several web-based lessons which include online TEKS-based content, resources, and learning activities that support learning objectives
Advanced Tech	I use technology in teacher-led as well as some student-centered learning experiences to develop higher order thinking skills and provide opportunities for collaboration with content experts, peers, parents, and community My students evaluate information, analyze data and content to solve problems	I have regular weekly access and use of technology and digital resources in various instructional settings such as in my classroom, library, lab, or through mobile technology	I use technology as a collaborative tool and integrate technology in subject area TEKS, to support development of higher-order thinking skills	I am knowledgeable of and consistently use Technology Applications (TA) TEKS as appropriate for content area and grade level	51 to 85% of my students have mastered Technology Applications TEKS	I have created many web-based lessons which include online TEKS-based content, resources, learning activities, and interactive communications that support learning objectives
Target Tech	My classroom is a student-centered learning environment where technology is seamlessly integrated to solve real world problems in collaboration with business, industry, and higher education Learning is transformed as my students propose, assess, and implement solutions to problems	My students and I have on-demand access to all appropriate technology and digital resources anytime/anywhere for technology integrated curriculum activities on the campus, in the district, at home, or key locations in the community	My students and I seamlessly apply technology across all subject areas to provide learning opportunities beyond the classroom that are not possible without the technology	I seamlessly integrate Technology Applications (TA) TEKS in collaborative, cross-curricular units of instruction	86 to 100% of my students have mastered Technology Applications TEKS	I have created and integrated web-based lessons which include online TEKS-based content, resources, learning activities, and interactive communications that support learning objectives throughout the curriculum
Campus STaR Chart Correlation	**Patterns of Classroom Use**	**Frequency/ Design of Instructional Setting Using Digital Content**	**Content Area Connections**	**Technology Applications (TA) TEKS Implementation** (TAC Chapter 126)	**Student Mastery of Technology Applications (TA) TEKS**	**Online Learning**

The Texas Teacher School Technology and Readiness (STaR) Chart

EDUCATOR PREPARATION & DEVELOPMENT					
EP 1	**EP 2**	**EP 3**	**EP 4**	**EP 5**	**EP 6**
Professional Development Experiences	**Models of Professional Development**	**Capabilities of Educators**	**Technology Professional Development Participation**	**Levels of Understanding and Patterns of Use**	**Capabilities of Educators with Online Learning**
I have received professional development on basic technology literacy skills and district information systems	I participate in large group professional development sessions to acquire basic technology skills	I am aware of the State Board of Educator Certification (SBEC) Technology Applications Standards (I-V) and meet at least one of these standards	I participate in less than 9 hours of technology professional development per year	I understand technology basics and how to use teacher productivity tools	I have participated in professional development on the use of web-based/online learning
I have received professional development on integrating technology into content area activities for students as well as to streamline productivity and management tasks	I participate in large group professional development sessions that focus on increasing teacher productivity and building capacity to integrate technology effectively into content areas with follow-up that facilitates implementation	I meet 2 to 3 of the SBEC Technology Applications Standards	I participate in 9 to 18 hours of technology professional development per year	I adapt technology knowledge and skills for content area instruction	I have participated in professional development on the customization of web-based/online learning content for my subject area or student courses
I have received professional development on technology integration into the curriculum through the creation of new lessons and activities that promote higher order thinking skills and collaboration with experts, peers, and parents	I actively engage in on-going professional development, including training, observation/ assessment, study groups, and mentoring	I meet 4 of the SBEC Technology Applications Standards	I participate in 19 to 29 hours of technology professional development per year	I use technology as a tool in and across content areas to enhance higher order thinking skills	I have participated in professional development to create web-based lessons or to teach online
I collaborate with other professionals in the development of new learning environments which empowers students to think critically to solve real-world problems and communicate with experts across business, industry and higher education	I actively participate in multiple professional development opportunities that support anytime, anywhere learning available through delivery systems including individually guided activities, inquiry/action research, and involvement in a developmental/ improvement process	I meet all 5 of the SBEC Technology Applications Standards	I participate in 30 or more hours of technology professional development per year	I create new, interactive, collaborative, and customized learning environments	I have participated in professional development to create and integrate web-based lessons or to teach content units or courses online
Content of Professional Development	**Models of Professional Development**	**Capabilities of Educators**	**Access to Professional Development**	**Levels of Understanding and Patterns of Use**	**Capabilities of Educators with Online Learning**

The Texas Teacher School Technology and Readiness (STaR) Chart

LEADERSHIP, ADMINISTRATION & INSTRUCTIONAL SUPPORT					
L 1	**L 2**	**L 3**	**L 4**	**L 5**	**L 6**
Leadership and Vision	**Planning**	**Instructional Support**	**Communication and Collaboration**	**Budget**	**Leadership and Support for Online Learning**
Responses to the Leadership, Administration & Instructional Support section should reflect the teacher's perception of the instructional environment.					
My campus leadership has basic awareness of the potential of technology in education to lead to student achievement	My campus has few technology goals and objectives incorporated in the campus improvement plan	My campus has limited opportunity for technology integration planning or professional development	My campus has limited use of technology for written communication with teachers and parents	My campus has limited discretionary funds for implementation of technology strategies to meet goals and objectives outlined in the campus improvement plan	My campus leadership has a basic understanding about the use of online learning, but does not encourage my use of it
My campus leadership develops a shared vision and begins to build buy-in for comprehensive integration of technology leading to increased student achievement	My campus has several technology goals and objectives that are incorporated in the campus improvement plan	My campus provides time for professional development on the integration of technology	Technology is used at my campus for communication and collaboration among colleagues, staff, parents, students and the larger community	Campus discretionary funds and other resources are allocated to advance implementation of **some** technology strategies to meet goals and objectives outlined in the campus improvement plan	My campus leadership communicates and collaborates with administrators, teachers, and others regarding integration of online learning into the curriculum
My campus leadership communicates and implements a shared vision and obtains buy-in for comprehensive integration of technology leading to increased student achievement	My campus has a technology-rich campus improvement plan along with a leadership team that sets annual technology benchmarks based on SBEC Technology Applications standards	My campus has teacher cadres to work with me to create and participate in learning communities that stimulate, nurture, and support the use of technology to maximize teaching and learning	Current information tools and systems are used at my campus for communication, management of schedules and resources, performance assessment, and professional development	Campus discretionary funds and other resources are allocated to advance implementation of **most** of the technology strategies to meet the goals and objectives outlined in the campus improvement plan	My campus leadership encourages my use of online learning and supports my use with professional development
My campus leadership promotes a shared vision with policies that encourage continuous innovation with technology leading to increased student achievement	My campus leadership team has a collaborative, technology-rich campus improvement plan that is grounded in research and aligned with the district strategic plan that is focused on student success	Educational leaders and teacher cadres facilitate and support my use of technologies to enhance instructional methods that develop higher-level thinking, decision-making, and problem-solving skills	At my campus, a variety of media and formats, including telecommunications and the school website are used to communicate, interact, and collaborate with all education stakeholders	Campus discretionary funds and other resources are allocated to advance implementation of **all** the technology strategies to meet the goals and objectives outlined in the campus improvement plan	My campus leadership facilitates my use of online learning and supports my use with professional development
Leadership and Vision	**Planning**	**Instructional Support**	**Communication and Collaboration**	**Budget**	**Leadership and Support for Online Learning**

The Texas Teacher School Technology and Readiness (STaR) Chart

INFRASTRUCTURE FOR TECHNOLOGY					
INF 1	**INF 2**	**INF 3**	**INF 4**	**INF 5**	**INF 6**
Students per Classroom Computers	**Internet Access Connectivity Speed**	**Classroom Technology**	**Technical Support**	**Local Area Network Wide Area Network**	**Distance Learning Capacity**
Responses to the Infrastructure for Technology section should reflect the teacher's perception of the instructional environment.					
There are less than two Internet-connected multimedia computers in my classroom for student use	I do not have access to the Internet in my classroom.	I have shared access to resources such as, but not limited to digital cameras, PDAs, MP3 players, probes, interactive white boards, projection systems, scanners, classroom sets of graphing calculators	When I need technology technical support the response time is greater than 24 hours	My students and I have access to technologies such as print/file sharing and some shared resources outside the classroom	My students have access to text based online learning with still images and audio
There are 2-5 Internet-connected multimedia computers available in my classroom for student use	I have Internet access on at least one computer in my classroom	I have access to a designated computer and shared use of resources such as, but not limited to digital cameras, PDAs, MP3 players, probes, interactive white boards, projection systems, scanners, classroom sets of graphing calculators	When I need technology technical support, the response time is less than 24 hours	My students and I have access to technologies such as print/file sharing, multiple applications, and district servers	My students have scheduled access to online learning with rich media such as streaming video, podcasts, applets, animation, etc.
There are 6 or more Internet-connected multimedia computers available in my classroom for student use	I have direct Internet access with reasonable response times in my classroom	I have access to a designated computer and dedicated and assigned use of commonly used technologies such as, but not limited to digital cameras, PDAs, MP3 players, probes, interactive white boards, projection systems, scanners, classroom sets of graphing calculators	When I need technology technical support, the response time is less than 8 hours	My students and I have access to technologies such as print/file sharing, multiple applications, and district-wide resources on my campus network	My students have simultaneous access to online learning with rich media such as streaming video, podcasts, applets, animation, etc.
There is 1-to-1 access to Internet-connected multimedia computers available in my classroom for all my students when needed	I have direct Internet connectivity and can receive district-wide resources in my classroom with adequate bandwidth to access e-learning technologies and resources for all students	I have ready access to a designated computer and a fully equipped classroom to enhance student instruction. Technologies include those listed above, as well as the use of new and emerging technologies	When I need technology technical support, the response time is less than 4 hours	All rooms are connected to a robust LAN/WAN that allows for easy access to multiple district-wide resources for students and teachers, including but not limited to, video streaming and desktop videoconferencing	My students have simultaneous access to online learning with rich media such as streaming video, podcasts, applets, and animation, and sufficient bandwidth and storage to customize online instruction
Students per Classroom Computers	**Internet Access Connectivity Speed**	**Classroom Technology**	**Technical Support**	**Local Area Network/ Wide Area Network**	**Distance Learning Capacity**

Texas Teacher STaR Chart Summary

Using the Texas Teacher STaR Chart, select the cell in each category that best describes your knowledge and skills.
Enter the corresponding number in the chart below using this scale.
1 = Early Tech   2 = Developing Tech   3 = Advanced Tech   4 = Target Tech

Key Area I: Teaching and Learning

TL1 Patterns of Classroom Use	TL2 Frequency/ Design of Instructional Setting Using Digital Content	TL3 Content Area Connections	TL4 Technology Applications (TA) TEKS Implementation (TAC Chapter 26)	TL5 Student Mastery of Technology Applications (TA) TEKS	TL6 Online Learning	*Total

Key Area II: Educator Preparation and Development

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	*Total

Key Area III: Leadership, Administration and Instructional Support

L1 Leadership and Vision	L2 Planning	L3 Instructional Support	L4 Communication and Collaboration	L5 Budget	L6 Leadership and Support for Online Learning	*Total

Key Area IV: Infrastructure for Technology

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

Key Area Summary
Copy your Key Area totals into the first column below and use the Key Area Rating Range to indicate the Key Area rating for each category.

Key Area — *Key Area Total — Key Area STaR Classification

I. Teaching and Learning ________ ________
(6-8 Early Tech   9-14 Developing Tech   15-20 Advanced Tech   21-24 Target Tech)

II. Educator Preparation and Development ________ ________
(6-8 Early Tech   9-14 Developing Tech   15-20 Advanced Tech   21-24 Target Tech)

III. Leadership, Administration & Instructional Support ________ ________
(6-8 Early Tech   9-14 Developing Tech   15-20 Advanced Tech   21-24 Target Tech)

IV. Infrastructure for Technology ________ ________
(6-8 Early Tech   9-14 Developing Tech   15-20 Advanced Tech   21-24 Target Tech)

Teacher Name: ________   County/Campus Number: ________

Campus Name: ________   Completion Date: ________

E-mail: ________   School Year: ________

Check the box which best describes the subject area you teach:

☐ Math ☐ English/Language Arts ☐ Reading ☐ Social Studies ☐ Science ☐ All Subjects
☐ Other ________

Please go to the online Texas Teacher STaR Chart (www.tea.state.tx.us/starchart) to enter your results and print summary reports.

APPENDIX H

LEVELS OF TECHNOLOGY IMPLEMENTATION (LoTi)

DETAILS QUESTIONNAIRE

DETAILS for the 21st Century Questionnaire

Determining
Educational
Technology
And
Instructional
Literacy
Skillsets
for the 21st Century

Version 1.0

Inservice Teachers

DETAILS for the 21st Century Questionnaire

Using the DETAILS for the 21st Century Questionnaire for professional development planning is part of an ongoing nationwide effort to sharpen educator skillsets as defined by the Partnership for 21st Century Skills. Individual information will remain anonymous, while the aggregate information will provide various comparisons for your school, school district, regional service agency, and/or state. Please fill out as much of the information as possible.

The DETAILS for the 21st Century Questionnaire takes about 20-25 minutes to complete. The purpose of this questionnaire is to determine your current professional development priorities related to technology and instruction based on your current position (i.e., pre-service teacher, inservice teacher, building administrator, instructional specialist, media specialist, higher education faculty).

Completing the questionnaire will enable your educational institution to make better choices regarding staff development and future technology purchases. The questionnaire statements were developed from typical responses of educators who ranged from non-users to sophisticated users of technology in the classroom. Questionnaire statements will represent different uses of technology that you currently experience or support, in varying degrees of intensity, and should be recorded appropriately on the scale. Please respond to the statements in terms of your present uses or support of technology in the classroom.

Name of State: ____

Name of School District: ____

Name of School: ____

Subject/Specialty: ____________________________________ **Grade Level:** ____________

User Email Address: ____

Do you have computer access at school?

☐ **Yes**

☐ **No**

Computer access means that students and teachers can use computers within the school building for instructional purposes; including computers in your classroom, computer labs, computers on carts, general access computers in the Library or something similar.

DETAILS for the 21st Century Questionnaire

Read each response and assign a score based on the following scale:

0	1	2	3	4	5	6	7
N/A	Not true of me now			Somewhat true of me now			Very true of me now

1 Score __________
I frequently engage students in learning activities that require them to analyze information, think creatively, make predictions, and/or draw conclusions using the classroom technology resources.

2 Score __________
Students in my classroom design either web-based or multimedia presentations to showcase their research (e.g., information gathering) on topics that I assign in class.

3 Score __________
I frequently assign web-based projects to my students as a means of emphasizing specific complex thinking skill strategies aligned to the content standards.

4 Score __________
My students collaborate with me in setting both group and individual academic goals that provide opportunities for them to direct their own learning aligned to the content standards.

5 Score __________
Problem-based learning is common in my classroom because it allows students to use the classroom technology resources as a tool for higher-order thinking and personal inquiry.

6 Score __________
My students identify important school/community issues or problems, then use multiple technology resources as well as human resources beyond the school building (e.g., partnerships with business professionals, community groups) to solve them.

7 Score __________
Constant technical problems prevent me and/or my students from using the classroom technology resources during the instructional day.

8 Score __________
I am proficient with basic software applications such as word processing tools, internet browsers, spreadsheet programs, and multimedia presentations.

9 Score __________
My students frequently discover innovative ways to use our school's advanced learning technologies to make a real difference in their lives, in their school, and in their community.

10 Score __________
I can solve most technical problems with our classroom's technology resources during the instructional day without calling for technical assistance.

11 Score __________
Locating quality software programs, websites, or CD's to supplement my curriculum and reinforce specific content standards is a priority of mine at this time.

12 Score __________
Though I may use technology for teacher preparation, I am not comfortable using my classroom technology resources as part of my instructional day.

13 Score __________
I am comfortable training others in using basic software applications, browsing/searching the Internet, and using specialized technologies unique to my grade level or content area.

14 Score __________
Computers and related technology resources in my classroom are not used during the instructional day, nor are there any plans to include them at this time.

15 Score __________
I consistently provide alternative assessment opportunities that encourage students to "showcase" their understanding of the content standards in nontraditional ways.

16 Score __________
My students use the Internet for (1) collaboration with others, (2) publishing, (3) communication, and (4) research to solve issues and problems of personal interest that address specific content standards.

17 Score __________
My students participate in online collaborative projects (not including email exchanges) with other students, government agencies, or business professionals to solve their self-selected problems or issues.

18 Score __________
Given my current curriculum demands and class size, it is much easier and more practical for my students to learn about and use computers and related technology resources outside of my classroom (e.g., computer lab, resource center).

19 Score __________
My current instructional program is effective without the use of technology; therefore, I have no current plans to change it to include any technology resources.

20 Score __________
I use our technology resources daily to access the Internet, send email, and/or plan classroom activities.

DETAILS for the 21st Century Questionnaire

Read each response and assign a score based on the following scale:

0	1	2	3	4	5	6	7
N/A	Not true of me now			Somewhat true of me now			Very true of me now

21 Score __________
Due to time constraints and/or lack of experience, I prefer using instructional units recommended by my colleagues that emphasize complex thinking skills, student technology use, content standards, and student relevancy to the real world.

22 Score __________
I can locate and implement instructional units that emphasize students using the classroom technology resources to solve “real-world” problems or issues, but I don’t usually create them myself.

23 Score __________
I have an immediate need for some outside help with designing student-centered performance assessments using the available technology that involve students applying what they have learned to make a difference in their school/community.

24 Score __________
Students’ use of information and inquiry skills to solve problems of personal relevance guides the types of instructional materials used in and out of my classroom.

25 Score __________
Students taking meaningful action at school or in the community relating to the content standards learned in class is an essential part of my approach to using the classroom technology resources.

26 Score __________
I have an immediate need for professional development opportunities that place greater emphasis on using my classroom technology resources with challenging and differentiated learning experiences rather than using specific software applications to support my current lesson plans.

27 Score __________
My students create their own web pages or multimedia presentations to showcase what they have learned in class rather than preparing traditional reports.

28 Score __________
My students frequently use the classroom technology resources for research purposes that require them to investigate an issue/problem, think creatively, take a position, make decisions, and/ or seek out a solution.

29 Score __________
Having students apply what they have learned in my classroom to the world they live in is a cornerstone to my approach to instruction and assessment.

30 Score __________
Curriculum demands, scheduling, and/or budget constraints at our school have prevented me from using any of the available technology resources during the instructional day.

31 Score __________
I am skilled in merging the classroom technology resources with relevant and challenging, student-directed learning experiences that address the content standards.

32 Score __________
My immediate professional development need is to learn how my students can use our classroom technology resources to achieve specific outcomes aligned to the content standards.

33 Score __________
It is easy for me to identify and implement software applications, peripherals, and web-based resources that support student’s complex thinking skills and promote self-directed problem solving.

34 Score __________
My students have immediate access to all forms of the most advanced and complete technology infrastructure available that they use to pursue problem-solving opportunities surrounding issues of personal and/or social importance.

35 Score __________
I need access to more resources and/or training to begin using the available technology resources as part of my instructional day.

36 Score __________
I regularly use different technology resources for personal or professional communication and planning.

37 Score __________
Students’ questions and previous experiences heavily influence the content that I teach as well as how I design learning activities for my students.

APPENDIX I

LEVELS OF TECHNOLOGY IMPLEMENTATION (LoTi)

DETAILS QUICK SCORING DEVICE

Level 0	Level 1/2	Level 3	Level 4a/4b	Level5/6	PCU	CIP
Q12 ________	Q4 ________	Q1 ________	Q27 ________	Q10 ________	Q13 ________	Q6 ________
Q19 ________	Q16 ________	Q5 ________	Q30 ________	Q14 ________	Q15 ________	Q20 ________
Q25 ________	Q17 ________	Q8 ________	Q31 ________	Q21 ________	Q18 ________	Q32 ________
Q42 ________	Q23 ________	Q37 ________	Q36 ________	Q22 ________	Q26 ________	Q41 ________
Q48 ________	Q38 ________	Q40 ________	Q43 ________	Q47 ________	Q49 ________	Q50 ________
	Q45 ________		Q46 ________			
/5	/6	/5	/6	/5	/5	/5
Level 0	Level 1/2	Level 3	Level 4a/4b	Level5/6	PCU	CIP

APPENDIX J

LEVELS OF TECHNOLOGY IMPLEMENTATION (LoTi)

CALCULATION KEY

DETAILS to LoTi Calculation Key

After determining the variables using the DETAILS Quick Scoring Device, apply the following rules in order to determine a participant's final LoTi Score.

If *Computer Access?* is *FALSE,* **LoTi Score = 0**

If *Highest Raw LoTi Score* is < *6*, **LoTi Score = 0**

If *Highest Raw LoTi Score* is < *10*, **LoTi Score = 1**

If *Highest Raw LoTi Score* is < *15*, **LoTi Score = 2**

If *Highest Level 5/6* has *Raw LoTi Score* ≥ *33* and *PCU* is ≥ *30* and *CIP* is ≥ *30* and *Highest Level 0* is ≤ *15*, **LoTi Score = 6**

If *Highest Level 5/6* has *Raw LoTi Score* ≥ *25* and *PCU* is ≥ *25* and *CIP* is ≥ *25* and *Highest Level 0* is ≤ *15*, **LoTi Score = 5**

If *Highest Level 5/6* has *Raw LoTi Score* ≥ *25* and (*PCU* is ≥ *20* and *PCU* is < *25)* and (*CIP* is ≥ *20* and *CIP* is < *25*) and *Highest Level 0* is ≤ *15*, **LoTi Score = 4b**

If *Highest Level 4a/4b* has *Raw LoTi Score* ≥ *25* and *PCU* is ≥ *20* and *CIP* is ≥ *25* and *Highest Level 0* is ≤ *15*, **LoTi Score = 4b**

If *Highest Level 4a/4b* has *Raw LoTi Score* ≥ *25* and (*PCU* is ≥ *15* and *PCU* is < *20)* and (*CIP* is ≥ *20* and *CIP* is < *25*) and *Highest Level 0* is ≤ *20*, **LoTi Score = 4a**

If *Highest Level 4a/4b* has *Raw LoTi Score* ≥ *20* and *PCU* is ≥ *15* and *CIP* is ≥ *20* and *Highest Level 0* is ≤ *20*, **LoTi Score = 4a**

If *Highest Level 4a/4b* has *Raw LoTi Score* ≥ *20* and *PCU* is ≥ *15* and (*CIP* is ≥ *15* and *CIP* is < *20*), **LoTi Score = 3**

If *Highest Level 3* has *Raw LoTi Score* ≥ *15* and *PCU* is ≥ *15*, **LoTi Score = 3**

If *Highest Level 3* has *Raw LoTi Score* ≥ *15* and *PCU* is < *15* and *Highest Level 3 Raw Score* > *Highest Level 0 Raw Score*, **LoTi Score = 2**

If *Highest Level 1/2* has *Raw LoTi Score* ≥ *15* and *PCU* is ≥ *10* and *Highest Level 1/2 Raw Score* > *Highest Level 0 Raw Score*, **LoTi Score = 2**

If *Highest Level 1/2* has *Raw LoTi Score* ≥ *15* and *Highest Level 1/2 Raw Score* > *Highest Level 0 Raw Score*, **LoTi Score = 1**

If *Highest Level 0* has *Raw LoTi Score* ≥ *15*, **LoTi Score = 0**

APPENDIX K

LEVELS OF TECHNOLOGY IMPLEMENTATION (LoTi) FRAMEWORK

LoTi Resource

LoTi Digital-Age Framework

LoTi Level 0: Non-use

At a Level 0 (Non-Use), the instructional focus can range anywhere from a traditional direct instruction approach to a collaborative student-centered learning environment. The use of research-based best practices may or may not be evident, but those practices do not involve the use of digital tools and resources.

The use of digital tools and resources in the classroom is non-existent due to (1) competing priorities (e.g., high stakes testing, highly-structured and rigid curriculum programs), (2) lack of access, or (3) a perception that their use is inappropriate for the instructional setting or student readiness levels. The use of instructional materials is predominately text-based (e.g., student handouts, worksheets).

LoTi Level 1: Awareness

At a Level 1 (Awareness), the instructional focus emphasizes information dissemination to students (e.g., lectures, teacher-created multimedia presentations) and supports the lecture/discussion approach to teaching. Teacher questioning and/or student learning typically focuses on lower cognitive skill development (e.g., knowledge, comprehension).

Digital tools and resources are either (1) used by the classroom teacher for classroom and/or curriculum management tasks (e.g., taking attendance, using grade book programs, accessing email, retrieving lesson plans from a curriculum management system or the Internet), (2) used by the classroom teacher to embellish or enhance teacher lectures or presentations (e.g., multimedia presentations), and/or (3) used by students (usually unrelated to classroom instructional priorities) as a reward for prior work completed in class.

LoTi Level 2: Exploration

At a Level 2 (Exploration) the instructional focus emphasizes content understanding and supports mastery learning and direct instruction. Teacher questioning and/or student learning focuses on lower levels of student cognitive processing (e.g., knowledge, comprehension).

Digital tools and resources are used by students for extension activities, enrichment exercises, or information gathering assignments that generally reinforce lower cognitive skill development relating to the content under investigation. There is a pervasive use of student multimedia products, allowing students to present their content understanding in a digital format that may or may not reach beyond the classroom.

LoTi

LoTi Resource

LoTi Digital-Age Framework

LoTi Level 3: Infusion

At a Level 3 (Infusion), the instructional focus emphasizes student higher order thinking (i.e., application, analysis, synthesis, evaluation) and engaged learning. Though specific learning activities may or may not be perceived as authentic by the student, instructional emphasis is, nonetheless, placed on higher levels of cognitive processing and in-depth treatment of the content using a variety of thinking skill strategies (e.g., problem-solving, decision-making, reflective thinking, experimentation, scientific inquiry). Teacher-centered strategies including the concept attainment, inductive thinking, and scientific inquiry models of teaching are the norm and guide the types of products generated by students.

Digital tools and resources are used by students to carry out teacher-directed tasks that emphasize higher levels of student cognitive processing relating to the content under investigation.

LoTi Level 4a: Integration (Mechanical)

At a Level 4a (Integration: Mechanical) students are engaged in exploring real-world issues and solving authentic problems using digital tools and resources; however, the teacher may experience classroom management (e.g., disciplinary problems, internet delays) or school climate issues (lack of support from colleagues) that restrict full-scale integration. Heavy reliance is placed on prepackaged materials and/or outside resources (e.g., assistance from other colleagues), and/or interventions (e.g., professional development workshops) that aid the teacher in sustaining engaged student problem-solving. Emphasis is placed on applied learning and the constructivist, problem-based models of teaching that require higher levels of student cognitive processing and in-depth examination of the content.

Students use of digital tools and resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience.

LoTi Level 4b: Integration (Routine)

At a Level 4b (Integration: Routine) students are fully engaged in exploring real-world issues and solving authentic problems using digital tools and resources. The teacher is within his/her comfort level with promoting an inquiry-based model of teaching that involves students applying their learning to the real world. Emphasis is placed on learner-centered strategies that promote personal goal setting and self-monitoring, student action, and issues resolution that require higher levels of student cognitive processing and in-depth examination of the content.

Students use of digital tools and resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience.

LoTi Resource

LoTi Digital-Age Framework

LoTi Level 5: Expansion

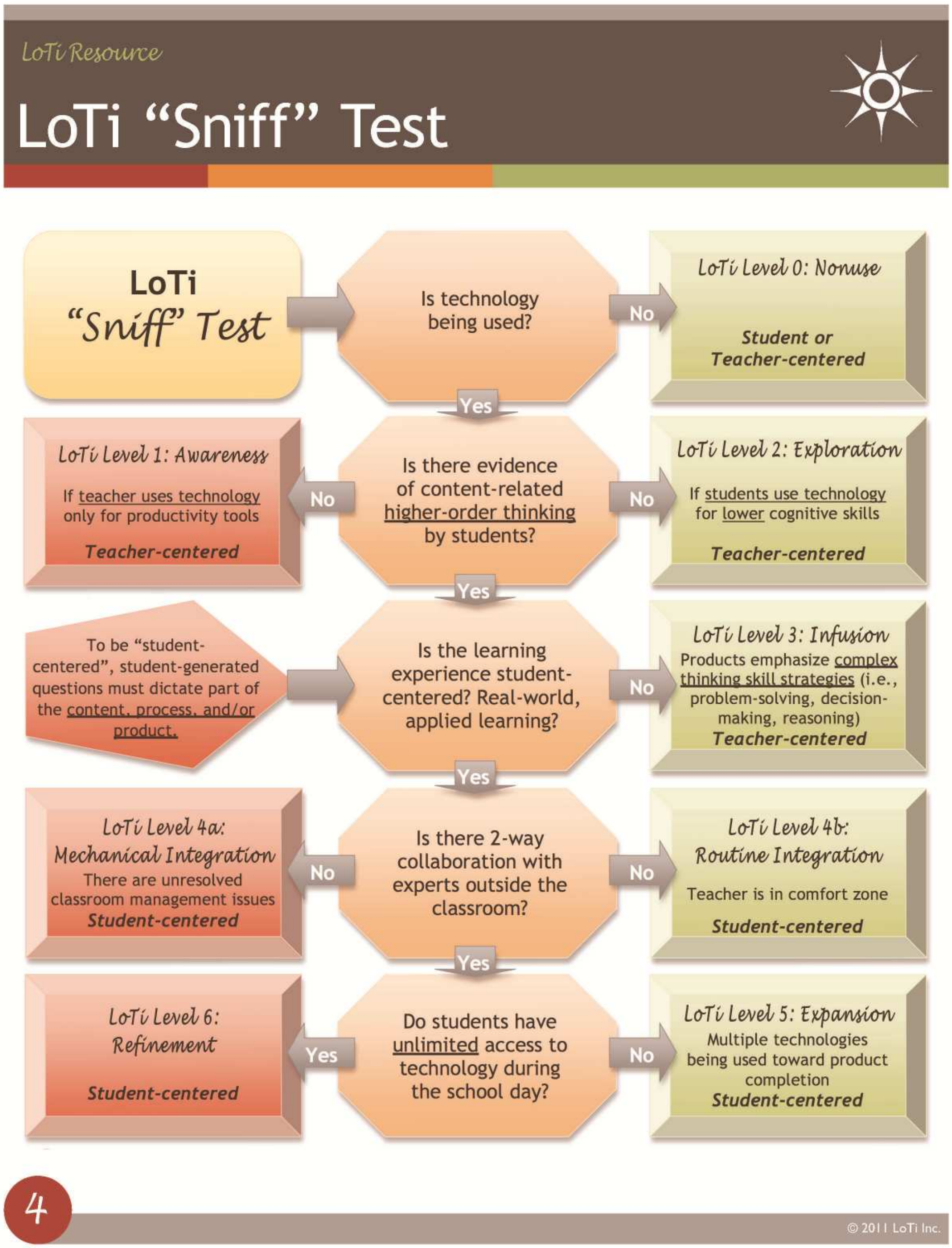
At a Level 5 (Expansion), collaborations extending beyond the classroom are employed for authentic student problem-solving and issues resolution. Emphasis is placed on learner-centered strategies that promote personal goal setting and self-monitoring, student action, and collaborations with other diverse groups (e.g., another school, different cultures, business establishments, governmental agencies).

Students use of digital tools and resources is inherent and motivated by the drive to answer student-generated questions that dictate the content, process, and products embedded in the learning experience. The complexity and sophistication of the digital resources and collaboration tools used in the learning environment are now commensurate with (1) the diversity, inventiveness, and spontaneity of the teacher's experiential-based approach to teaching and learning and (2) the students' level of complex thinking (e.g., analysis, synthesis, evaluation) and in-depth understanding of the content experienced in the classroom.

LoTi Level 6: Refinement

At a Level 6 (Refinement), collaborations extending beyond the classroom that promote authentic student problem-solving and issues resolution are the norm. The instructional curriculum is entirely learner-based. The content emerges based on the needs of the learner according to his/her interests, needs, and/or aspirations and is supported by unlimited access to the most current digital applications and infrastructure available.

At this level, there is no longer a division between instruction and digital tools/resources in the learning environment. The pervasive use of and access to advanced digital tools and resources provides a seamless medium for information queries, creative problem-solving, student reflection, and/or product development. Students have ready access to and a complete understanding of a vast array of collaboration tools and related resources to accomplish any particular task.


LoTi Resource
LoTi "Sniff" Test
LoTi "Sniff" Test
Is technology being used?
No
LoTi Level 0: Nonuse
Student or Teacher-centered
Yes
Is there evidence of content-related higher-order thinking by students?
No
LoTi Level 1: Awareness
If teacher uses technology only for productivity tools
Teacher-centered
No
LoTi Level 2: Exploration
If students use technology for lower cognitive skills
Teacher-centered
Yes
To be "student-centered", student-generated questions must dictate part of the content, process, and/or product.
Is the learning experience student-centered? Real-world, applied learning?
No
LoTi Level 3: Infusion
Products emphasize complex thinking skill strategies (i.e., problem-solving, decision-making, reasoning)
Teacher-centered
Yes
Is there 2-way collaboration with experts outside the classroom?
No
LoTi Level 4a: Mechanical Integration
There are unresolved classroom management issues
Student-centered
No
LoTi Level 4b: Routine Integration
Teacher is in comfort zone
Student-centered
Yes
Do students have unlimited access to technology during the school day?
Yes
LoTi Level 6: Refinement
Student-centered
No
LoTi Level 5: Expansion
Multiple technologies being used toward product completion
Student-centered
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VITA

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EDUCATION

2012	Doctor of Education, Educational Administration Texas A&M University, College Station, Texas
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1995	Master of Education, School Administration Trinity University, San Antonio, Texas
1979	Bachelor of Arts, Sociology and History Trinity University, San Antonio, Texas

CERTIFICATIONS

Professional Life – Texas State Administrator Certificate
Mid-Management Administrator (PK-12)

Provisional Life – Texas State Teaching Certificate
Secondary (6-12) History & Social Studies, Social Studies Composite

EXPERIENCE

2001 – Present	Secondary Instructional Technology Specialist Alamo Heights Independent School District San Antonio, Texas
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This record of study was typed and edited by Marilyn M. Oliva at Action Ink, Inc.