UNDERSTANDING SCHOOL LEADERS' ROLE IN TEACHERS' ADOPTION OF TECHNOLOGY INTEGRATED CLASSROOM PRACTICES

by

GARY SHATTUCK

(Under the Direction of Michael Orey)

ABSTRACT

It is generally agreed upon by most educational technology researchers that the integration of technology promised during the 1990s by the proponents of technology in education has not materialized despite the fact that billions of dollars have been spent on technology in schools. The reasons are many and the answers are complex. To understand why technology integration has not succeeded, one must understand how the contextual factors, including educational laws and policies, educational change theories, diffusion of innovation theories, technology integration theories, and educational leadership practices impact how teachers perceive the use of technology within their classroom practices. This study looks at all five of these factors in an effort to understand how school leaders may impact teachers' acceptance of technology integrated classroom practices.

This study uses a case study methodology in an attempt to understand how school leaders in four middle schools in the same school district impacted either positively or negatively the teachers' adoption of technology integrated classroom practices. Four methods are employed to gather data. First, a pre-survey was sent to every teacher in each of the four schools. Second, an in-depth interview was conducted with each principal of these four schools. Third, a focus group

of technology teacher leaders was interviewed in each of these four schools. Fourth, a document review was conducted on selected documents to verify data collected from the other three methods. The data from each method at each school was cross-checked to develop an understanding about how each school uses technology within the building and about how the teachers are integrating technology within their classroom practices.

When analyzing each school's data it becomes obvious that the leader at one school is promoting the use of technology within her school in exemplary ways that causes the teachers to adopt technology integration into their classroom practices. When comparing this exemplary school's data with the other schools' data eight themes emerged as essential strategies that school leaders must adopt if they want their teachers to adopt technology integrated classroom practices. The eight strategies are: vision, modeling, expectations, encouragement, resources, hiring, professional learning, and capacity building.

Key words: technology integration, educational leadership, educational change, diffusion of innovation, technology leadership, educational law and policies

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DEDICATION

The dissertation is dedicated to Tommie Elaine Shattuck, my wife and lifelong companion, who has supported, encouraged, loved, and, at times, cajoled me in this endeavor. When I wanted to give in to the temptation of quitting because I was tired or was frustrated she was there to lift me up and to help me get started again. When I ignored her in those long hours of studying and of writing she was there to give me support and to give me encouragement. When I needed someone to edit my papers for classes or for this dissertation, she was there offering her expertise. When I needed quietness she was there to ensure the house was quiet. When I needed sustenance she was there with food and with drink. In retrospect, this dissertation is as much hers as it is mine for she has been there through it all delaying her own educational aspirations from the beginning to the end to help me traverse this journey; to help me navigate the shoals of life along the way. For all these reasons I am eternally grateful.

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CHAPTER ONE

INTRODUCTION

This research investigates the role that school leadership plays in influencing teachers' adoption of technology integration strategies within the classroom environment. The reason this research is important is because the instructional technology research community generally agrees that technology has not been integrated into the classroom practices of K-12 teachers even though it has been 29 years since personal computing has become etched into the national consciousness (Ferneding, 2003; Prensky, 2006). According to the proponents of instructional technology (Cuban, 2001; Ferneding, 2003), this integration of technology was supposed to transform K-12 education; but this has not happened due to a plethora of reasons (Becker, 2001; Cuban, 2001; Hernandez-Ramos, 2005). These reasons can be understood by examining the extant barriers that prevent technology from being integrated into the classroom practices of teachers. These barriers include teachers' philosophical beliefs about the teaching and learning paradigm (Becker, 2001; Cuban, 2001, Hernandez-Ramos, 2005; Windchitl & Sahl, 2002), lack of adequate computer density in classrooms (Becker, 2001), organizational structure of schools (Cuban, 1993; Cuban, 2001), lack of technical support and instructional support (Becker, 2001; Cuban, 2001), and lack of quality professional development opportunities (Brinkerhoff, 2006; Dwyer, 1995; Mouza, 2003) among others. Since teachers have difficulty overcoming these barriers, can the school leader by leveraging the leader's positionality create a school environment that makes it possible for teachers to integrate technology into their classroom practices.

In 2001, Larry Cuban wrote a stinging rebuke of the Instructional Technology movement in *Oversold and Underused: Computers in the Classroom*. The basic premise of this book was that billions of dollars had been spent on instructional technology in the K-12 educational realm and that this influx of money had failed to provide the promised benefits that the proponents of instructional technology had claimed (Cuban, 2001; Ferending, 2003). Most instructional technology researchers would agree with Cuban's basic premise that instructional technology was not being used in transformational ways, one of the primary promises made by the proponents of instructional technology such as Seymour Papert (1980). Even though there are several themes that most researchers would agree were root causes for this situation, there is also much disagreement as to other root causes (Becker, 2001; Cuban, 2001; Ertmer, 1999; Ferneding, 2003; Hernandez-Ramos, 2005); and there is no consensus among this research community about what actions can be taken to alleviate this situation so that the schools, the state governments, and the federal government can see a return on this considerable investment. Herein lies the conundrum that the instructional technology community faces; the world has dramatically changed economically, socially, and politically due to some degree by a technological revolution (Friedman, 2005; Postman, 1992; Toffler, 1970); whereas education has not changed to meet this changing global landscape (Cuban, Kirkpatrick, & Peck, 2001).

The literature on the integration of technology is replete with reasons why this concept has, so far, not succeeded (Becker, 2001; Cuban, 2001; Dwyer, 1995; Ertmer, 1999; Hernandez-Ramos, 2005; Windchitl & Sahl, 2002). Larry Cuban found that most teachers do not believe in a student-centered classroom environment; rather teachers rely on direct instruction pedagogy. The significance of this finding is paramount because to implement technology integrated classroom practices it requires a less didactic approach to teaching and learning (Becker, 2001). This

finding is one of several in which there is no disagreement in the instructional technology research community (Becker, 2001; Cuban, 2001; Ertmer, 1999; Hernandez-Ramos, 2005). Another root cause for the lack of progress in the integration of technology, for which there appears to be no disagreement, is the lack of support teachers get, either technologically or instructionally, in their efforts to integrate technology into their classroom practices (Becker, 2001; Cuban, 2001). A third root cause of this lack of progress for which there again appears to be no disagreement within the instructional technology research community is the lack of effective and sufficient professional development (Becker, 2001; Brinkerhoff, 2006; Cuban, 2001; Dwyer, 1995; Mouza, 2003). Generally speaking, this is where the agreements end. Each researcher has additional reasons for this lack of progress from Larry Cuban's claim that the structural design of schools' organization is a cause, from Howard Becker's thesis that the lack of computer density within classrooms is a cause, to Peggy Ertmer's premise that barriers to the change process is a cause. Whatever the reasons, it is apparent to this research community that the integration of technology is a complex issue that involves multiple variables from multiple disciplines including the diffusion of innovation, educational change, educational leadership, educational laws and policies, and technology integration (see Figure 1). This figure illustrates these interconnected disciplines that are factors in teachers' ability to implement technology integrated classroom practices. Without understanding the roles these factors have on teachers' willingness to adopt a new pedagogy, then technology will not be fully integrated into teachers' classroom practices. The complexity, and as a result the difficulty, of integrating technology into teachers' classroom practices can only be understood by acknowledging the interconnectedness of the five major disciplines that interact with teachers' pedagogical practices. It is only at the

center where all these factors intersect that teachers will be able to adopt a new pedagogy that includes technology integrated classroom practices.

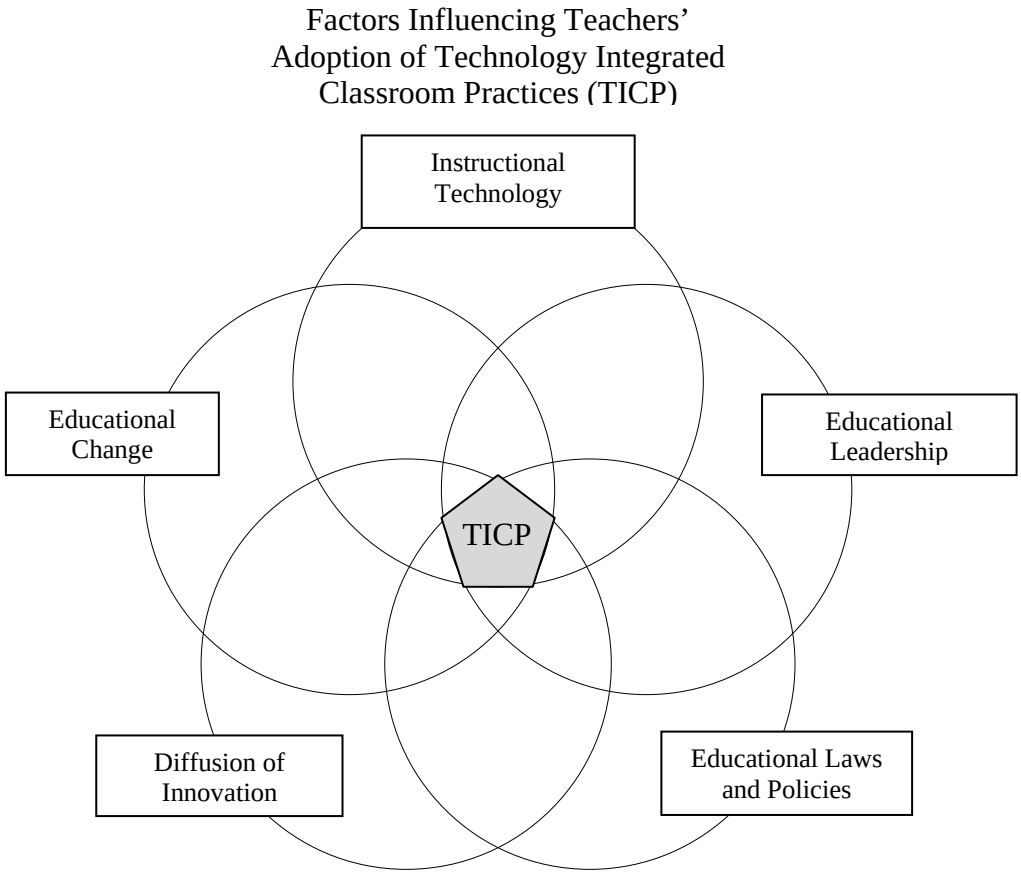

Figure 1

Educational change theories and diffusion of innovation theories are inextricably interwoven together because they deal with essentially the same phenomena – the change process (Fullan, 1993; Rogers, 2003). According to Michael Fullan, one of the driving forces in the educational environment is the need for continuous change. Fullan (1993) goes so far as to say that "It is no exaggeration to say that dealing with change is endemic to post-modern

society" (p. 3). This theme of continuous and constant change in education is an adaptation to a theory first proposed by Alvin Toffler in *Future Shock* (1970) which postulated that ever-accelerating change would be inherent in the post-industrial societies of the late 20th Century and the early 21st Century. Toffler further stated that those individuals who were the most adaptable were the same individuals who were the most likely to succeed in this future world. In order to understand this changing landscape within which teachers are supposed to adopt a new pedagogy and a new method of delivery, it will become necessary to understand the change process and to understand how that process can be used within the basically conservative environment of education in order to transform that educational environment to meet the needs of a changing society, a changing culture, and a changing of the type of students enrolled in our schools (Healy, 1992; Prensky, 2006). Everett Rogers (2003), whose landmark studies on the adoption of innovations were and still are the gold standard for diffusion research for the last four decades, will add valuable insight into understanding the difficulties in integrating technology into the classroom practices of teachers. Although many of the difficulties that teachers face are endemic to education, many are not; and many show up continually in diffusion research in other fields of study; therefore, it is essential to understand the processes of change.

Equally as important as change theory is to understand the difficulties faced by classroom teachers in implementing technology integration practices, it is also important to understand the role of educational leadership in overcoming these difficulties – where the head goes, the body must follow. Michael Fullan (2001) describes the role of the school leader as vital, not only to the health of any school, but also, to the success of any education change. Even though successful educational change requires involvement of educational leaders, successful educational change also depends upon the inclusion of teachers in the planning and in the

implementation of the change (Fullan). It is this duality of involvement which will provide the framework for understanding how the integration of technology can be successful. Fullan points out that school leadership provides a function without which change will not succeed; however, for any change to succeed it must be adopted by the classroom teacher. Thomas Sergiovanni (2006) in his book on school principals points out that the culture of a school is actually a negotiated product between the school leadership and the teachers within that school. As a result, school leadership's participation in and support for an educational change such as the integration of technology within teachers' classroom practices are keys for this innovation to be adopted in the K-12 educational environment.

Even though the roles of leadership and teachers are essential in the adoption of an educational change such as the integration of technology, it cannot be overestimated how these roles are impacted by the context within which these educational changes are being attempted. In other words, in addition to contextual factors that are localized to each particular school and district, federal and state educational laws and policies are contextual factors which greatly influence the implementation of any educational change. Sometimes these laws and policies drive educational changes in ways and in directions that are sometimes counterproductive to the intent of the originators of these changes. For example, for years the instructional technology community has been trying to find a way to implement the integration of technology into teachers' classroom practices without any sustained or widespread success; but the *No Child Left Behind Act of 2001*, with its emphasis on scientifically-based research and accountability, caused schools to migrate towards Integrated Learning Systems, a type of technology which is the antithesis of what many in the instructional technology community were trying to achieve in the 1990s. As a result, these contextual factors are essential to our understanding of how and of why

educational changes succeed or fail; for without this knowledge of these contextual factors researchers will be unable to clarify and quantify the underlying reasons for the observed phenomena.

This research uses a case study methodology by examining four middle schools within the same suburban school district in the Southeastern United States. The methods used were semi-structured interviews with each principal and a Focus Group interview with technology teacher leaders in each school, as well as, a survey of teachers at each school. Finally, a review of district documentation provided a cross-check of certain statements made by the principals and by the Focus Group teachers. Focusing just on the middle schools in a single school district is an attempt to minimize the contextual variables that are extant in other settings. Even though each school was its own case study per se, the comparisons between schools provides for richness and an understanding that would be impossible otherwise. By looking at four schools, each school will act as a constant comparison for the other three schools thus allowing for a deeper understanding of the data.

For the last 29 years proponents of instructional technology have been trying to find the keys to effectively integrate technology into the classroom practices of teachers. What these apostles discovered is that this concept is easy to do on paper and difficult to accomplish in practice. Achieving the integration of technology within a school relies on changing the pedagogy of teachers (Becker, 2001; Cuban, 2001) and relies on changing the culture and the norms within a school (Fullan, 2001; Sergiovanni, 2006). Some of the literature on the subject of changing the pedagogy (Cuban, 1986; Cuban, 1993; Cuban, 2001) and of changing the culture of a school (Fullan, 1993; Fullan, 2001; Sergiovanni, 2006) indicate that the integration of technology will fail; however, the diffusion research literature indicates that this change is

possible, only it takes much longer than we can imagine (Rogers, 2003). Other instructional technology researchers (Becker, 2001; Dwyer, 1995; Yi, 2007) indicate that certain prerequisites for teachers may be necessary before teachers can successfully adopt technology integrated pedagogy. Where this study will lead us is to an understanding of how difficult it is to implement any educational change let alone one that deals with changing the belief structure of teachers primarily because of the complexity of the subject. To overcome these difficulties it will require the interaction of school leaders with the school's teachers in a combined effort to effect a change that is perceived to benefit the students in fundamental ways (Sergiovanni, 2006). Although reculturing teachers is necessary for the kind of fundamental change that must occur in order to integrate technology into classroom practices (Fullan, 2001), this kind of reculturing is impossible without the support of and without the encouragement of the school's leadership (Fullan, 2001; Mouza, 2003). This study will be answering the following two main questions in its search to understand if and how school leaders can influence teachers' adoption of technology integrated classroom practices:

1. Can school leaders influence teachers' adoption of technology integration classroom practices?
2. How do school leaders influence teachers' adoption of technology integration classroom practices?

2.1 Who are the technology leaders within each school?

2.2 How can a leader assist teachers in overcoming barriers that prevent the integration of technology?

2.3 In what ways do teachers feel encouraged and/or supported when they take risks concerning integrating technology into their classroom practices?

2.4 How do the teachers' vision for why technology should be integrated within a classroom differ from the principal's vision for why technology should be integrated within a classroom?

2.5 Does the principal's expectations for technology integration influence teachers' integration of technology into their classroom practices?

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

The purpose of this study is to examine the influence that a school leader can have on the adoption of technology integration strategies by K-12 teachers within a school. The review of literature conducted for this study covers four areas of research: the impact that national and state educational laws and policy have upon school leaders' perception of how and of why educational technology should be used by K-12 teachers, the difficulties that are associated with the adoption of technological educational innovation including methods or strategies for the remediation of these difficulties, the strategies that are necessary for the successful implementation of technology integration practices by K-12 teachers, and the role that a school leader plays in affecting educational change when it pertains to technology. This literature review examines these four areas of research by answering the following questions:

1. Can school leaders influence teachers' adoption of technology integration classroom practices?
2. How do school leaders influence teachers' adoption of technology integration classroom practices?

2.1 Who are the technology leaders within each school?

2.2 How can a leader assist teachers in overcoming barriers that prevent the integration of technology?

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2.4 How do the teachers' vision for why technology should be integrated within a classroom differ from the principal's vision for why technology should be integrated within a classroom?

2.5 Does the principal's expectations for technology integration influence teachers' integration of technology into their classroom practices?

While investigating the body of literature concerning the integration of instructional technology into the classroom practices of K-12 teachers I have come to the conclusion that to adequately cover this area of research I must delve into a variety of academic disciplines and areas of research such as educational administration, educational policy, educational law, educational technology, technology integration, and change theory. Implementing instructional technology represents a major change, a paradigm shift, in the way educators think about teaching and learning because the traditional pedagogy used by a vast majority of teachers consists of a teacher-centered classroom in which information is passed directly from the teacher to the student. Learning research now indicates that students learn best by constructing their own knowledge by scaffolding information upon previous learned information (Reeves, 1998). Changing this teaching-learning paradigm is a difficult task (Ertmer, 2005); but it has been made even more difficult recently with the passage of the *No Child Left Behind Act of 2001*. In order to successfully implement the integration of technology a school's leadership will play a major role in changing the school's norms and the school's culture which will allow for the elimination of the barriers to technology integration and for the reculturing of teachers. It is this reculturing of

teachers that represents the paradigm shift from a teacher-centered learning environment to a student-centered learning environment that will foster the integration of technology by teachers.

To find the research literature needed to address these questions in a scholarly manner, a variety of resources have been used. First and foremost, I have accessed refereed educational research journal publications using the GALILEO search tools provided by The University of Georgia Library. GALILEO provides access to numerous full text publications related to the issues relevant to my study. When relevant publications were unavailable for download, the services of the Interlibrary Loan System were used. Finally, I supplemented GALILEO searches with public online search tools such as Google Scholar.

A Brief History of Computers in Education

In 1980, Seymour Papert wrote *Mindstorms: Children, Computers, and Powerful Ideas* as a counter-argument to the prevailing conventional wisdom at the time that permeated educational technology. This conventional wisdom maintained that technology was best used in a instructivist manner through programmed instruction, skills-based drills, or what at the time was known as computer-assisted instruction (CAI) or computer-based instruction (CBI) (Reeves, 1998). These instructivist oriented computer programs were eventually integrated into larger scale commercial programs called integrated learning systems. Still in use today, instructivist approaches to technology integration are based upon direct instruction pedagogy (Reeves, 1998).

Papert's book challenged the landscape of instructional technology and the assumptions that were prevalent at the time about how best to use technology in education. The debates that ensued about the most effective role for technology in the educational environment in general as well as about the specific role for technology in the curriculum of K-12 schools in particular continue to this day. Papert's ideas about instructional technology borrowed heavily from

Piaget's theories on constructivism and learning (Papert, 1980). Arguments about the efficacy of the instructionist model of technology in K-12 education versus the constructivist model of technology in K-12 education have raged on ever since with public opinions and with professional opinions ebbing and flowing between these two competing views (Ferneding, 2003; Reeves, 1998). A report from the Office of Technology Assessment prepared for the U.S. Congress in 1995 included a timeline of changes between 1982 and 1994 in how technology should be used; this timeline indicated that there were seven shifts constantly changing back and forth in the "prevailing wisdom of 'experts'" (p. 104) in these 12 years between the constructivist model and the instructivist model about how technology should be used in K-12 education.

In the 2000 report *Teachers' Tools for the 21st Century: A Report on Teachers' Use of Technology* the National Center for Educational Statistics outlined the progression of this technology usage from the previous two decades. In the late 1970s and the early 1980s drill and skill activities were prominent until Seymour Papert's book Mindstorms: *Children, Computers, and Powerful Ideas* challenged those ideas. After the availability of microcomputers in the late 1970s and after Papert's book was published in1980, schools began teaching computer programming skills even to older elementary school children (U.S. Department of Education, National Center for Educational Statistics, 2000). What computers were not used for during the early 1980s was the teaching of or was the support for the teaching of the content of core academic courses. Even the relatively few people who wanted to teach core subjects thought that teachers themselves would have to create their own computer-assisted instruction, hence the "need" for teachers to learn programming (U.S. Department of Education, National Center for Educational Statistics, 2000).

By the 1990s, however, instruction in computer programming declined considerably; and the use of computers as a tool in teaching core academic courses emerged (U.S. Department of Education, National Center for Educational Statistics, 2000). Contrary to the trend of adopting constructivist usage of technology that was occurring in high schools, the use of drill and skill still continued at all schools but most especially in elementary schools; but, “finally, as the decade of the 1990s progressed, school computer use [at all levels] had shifted to some degree to reflect a greater emphasis on problem solving and in-depth learning and less emphasis on drill and skill and basic skills” (U.S. Department of Education, National Center for Educational Statistics, 2000, p. 2).

The Critics of Technology in Education

The opponents to educational technology took a beating during the mid- to-late 1990s as the coalition of neo-conservatives and of neo-liberals steamrolled their program through Congress and through the various state legislatures. “Those who [did] take a stand against technology-driven reform policy [were] marginalized and ultimately silenced” (Ferneding, 2003, p. 243). The opponents were characterized by the proponents as being Luddites. There were a few critics, however, who braved this withering tide in the early 1990s and who spoke out against this monolithic attack on traditional educational values (Ferneding, 2003). Andre Gory wrote in 1989, “Technical culture is lack of culture in all things non-technical” (as quoted in Ferneding, 2003, p. 201). Neil Postman equated this struggle between the technophiles and the humanists as a war when in 1992 he wrote that there is a cultural war between the technophiles and everyone else (Ferneding, 2003). According to Postman most people thought that technology was a friend; but technology had other consequences that were darker as well. Postman postulates "Uncontrolled growth of technology destroys the vital sources of our humanity. It

creates a culture without a moral foundation. It undermines certain mental processes and social relationships that make human life worth living" (as quoted in Ferneding, 2003, p. 47). In other words, the opponents believed that technology was stripping humans of their humanity, a point emphasized over a decade later in 2004 by the Alliance for Childhood. This contrary position was a hard sell for the opponent of technology in education because as Ferneding wrote, "The American public [in the 1990s was] also convinced [of the inevitability of technology]. Eight of every ten Americans believe[d] that understanding computers and technology [was] critical for students' success in the future" (p. 29). It was not until the turn of the century that this historic inevitability argument, or technological determinism as it is also called, began showing cracks in its armor due primarily to the reality of what was happening in schools.

Even though there are excellent teachers who follow an instructivist orientation, there are some very compelling reasons why all teachers should strive to adapt to the changing educational landscape and should adopt more constructivist practices. Alvin Toffler in his 1970 book *Future Shock* explained that the world has changed and will continue to change at an ever-increasing rate. He articulated that the people who will thrive in this new economic age, the Knowledge Age, will be those individuals who are adaptable. Whereas some of Toffler's predictions did not turn out to be true, many more of them did turn out to be true; and the general thesis of his book is eerily prophetic. Instructivist approaches to teaching and to learning do not emphasize practices that stress creative problem-solving and critical thinking, both practices that will be essential in the Knowledge Age (Toffler, 1970).

In addition to these competing views of the proper way to use technology in education, another voice has weighed heavily in this educational technology debate. This voice covers a broad spectrum of positions; however, its basic premise is that it argues against any technology

in education (Ferneding, 2003). This view ranges from the extreme position as taken by Neil Postman (1992) in his book *Technopoly: The Surrender of Culture to Technology* to a more moderate position as illustrated in Alliance for Childhood's 2004 report called *Tech Tonic: Towards a New Literacy of Technology*. The late Neil Postman argued that technology often robs humankind of its humanity; and he expressed opposition to many forms of computerized technology, arguing that technology debases the qualities that humans should cherish the most. On the other hand, even though the Alliance for Childhood's argument borrowed heavily from Postman's theories, the Alliance's 2003 argument stressed more than the inhumanity aspect of technology by emphasizing the inappropriateness of technology, especially in elementary schools, on the basis that technology deprives students of human interactions necessary for healthy physical, emotional, and psychological development. Technology, according to the Alliance for Childhood (2003), steals from children the socialization activities that are a part of what it is to be human; and technology substitutes instead the isolation and the separateness that have been identified by the opponents of technology in education as inherent in computerized technology. Ferneding (2003) called these opponents of technology the humanists because they maintain that education should be organized around the traditional humanistic framework that emphasized social justice.

Given that the transition from the Industrial Age to the Knowledge Age continues unabated throughout the world (Friedman, 2005), this anti-technology argument, as postulated by Postman and by others, may turn out to be just an esoteric exercise in futility because since the 1990s the proponents of technology in education have held sway, whether they followed the instructivist model or whether they followed the constructivist model, largely due to widespread support in the business community and to the influence of power brokers in Washington (Cuban,

2004; Ferneding, 2003). This victory for technophiles over technophobes was also aided by the rapid development of and y the rapid dissemination of access to the World Wide Web, especially after easy to use browsers became available in 1993.

The Rise of Accountability in Education

To further understand this strong swing toward the proponents of technology in education in the 1990s, one must first go back to 1983 and to the publication of *A Nation at Risk: The Imperative for Educational Reform* a report from the National Commission on Excellence in Education. This report was critical of the education system in the U.S.; in fact, the language used in the report sounded alarmist, confrontational, and inflammatory; and, to some extent, most of the issues that education still faces today were highlighted in *A Nation at Risk* (Cuban, 2004; Ferneding, 2003). This report stated that "a rising tide of mediocrity" (¶ 1) was being produced by our nation's schools; and if a foreign power imposed an educational system upon the U.S. like the system the U.S. had in 1983, this imposition might have been considered to be an "act of war" (¶ 2). *A Nation at Risk* quoted Paul Hurd, an educational researcher, who said that the U.S. was "raising a new generation of Americans that [was] scientifically and technologically illiterate" ("Indicators of the Risk"). Furthermore, *A Nation at Risk* made an explicit link between the economic health of the U.S. and of the nation's education system; therefore, when the country was suffering through a severe recession during the early years of the 1980s the root cause must, by definition, be a poor education system (Cuban, 2004).

As a counter argument to this report, David Berliner and Bruce Biddle (1995) analyzed the various positions staked out by the authors of *A Nation at Risk*. In every single case, Berliner and Biddle refuted the report's conclusions. For example, *A Nation at Risk* reports that American students were being outperformed by their foreign counterparts on every measure of learning.

Berliner and Biddle (1995) discovered that when eighth grade students were tested on math, most of what was tested was algebraic knowledge which is taught to eighth grade students in Japan and in other foreign countries. In the U.S., however, most students do not study algebra until the ninth grade. As a result, eighth grade U.S. students do not do as well on this test as do students from other industrialized countries because at that point in time American students' educational curriculum does not yet call for algebra; thus, American students have not yet had the requisite background knowledge. In their analysis Berliner and Biddle disaggregated the data and found that American students who had algebra in the eighth grade actually outperformed their foreign counter parts on this test. Despite Berliner and Biddle's valiant effort to point out the fallacies contained in *A Nation at Risk*, their book appeared too late to have an impact on the nation's perceptions about education. The myth persisted that America's education system was failing the nation.

Ferneding (2003) stated that *A Nation at Risk* pushed electronic technologies as the foundation for future economic prosperity; and, thus technology should also be the foundation of education as well. The consequences of this report were immediate, vast, and numerous. Soon, accountability, student achievement, and standards became the watch-words of educational reform; technology became a critical curricular component (Cuban, 2004; Ferneding, 2003). This report declared that schools must be held accountable for their products – student achievement – and to their customers – the students, their parents, and the nation. Students needed more rigorous coursework in English, Math, and Science (National Commission, 1983). This report also emphasized the need of integrating technology into the schools' curriculum. In fact, the curriculum espoused by *The Nation at Risk* included computer science as being one of five core subjects, the others being English, Math, Science, and Social Studies.

Furthermore, in order to hold schools accountable on a level playing field, the report argued that all schools' accountability should be based upon standardized testing (Cuban, 2004; Ferneding, 2003). This report equated technological acquisition to future economic prosperity both for individuals and for the nation, laying the groundwork for the technological euphoria that began evolving in the mid-to-late 1980s into President George H. W. Bush's Education Summit in 1989 which stressed the need for technological skills, finally reaching fruition in the mid 1990s with the passage of *Goals 2000: Educate America Act* (1994) and with the passage of *Technology for Education Act* (1994). This movement towards embracing technology in education even extended to the U.S. Labor Department whose 1991 report from the Secretary's Commission of Achieving Necessary Skills (SCANS) stated that "Those unable to use … [technology], face a lifetime of menial labor" (as quoted in U.S. Congress, Office of Technology Assessment, 1995, p. 4). From 1983 forward, technology emerged as one of several focal points for reforming the curriculum of K-12 education; but the issue that remained to be answered was, "How is technology to be used?" and "What purpose did technology serve in the overall educational mission of schools?" In other words, how could technology be incorporated into a meaningful way into a K-12 curriculum that increased student learning and that helped prepare students for the future.

The Role of Technology in Education

This reform movement which began with *A Nation at Risk: The Imperative for Educational Reform* (1983) was, and still is, being promoted by the business community (Cuban, 2004; Ferneding, 2003) because the business community felt, and still feels, that for businesses to remain competitive in the global economy they must acquire highly skilled, knowledgeable workers; but unfortunately this type of worker increasingly is not the product of America's

schools (Friedman, 2005). Outsourcing, off-shoring, and global supply chains are revolutionizing American businesses, and, as a result, are revolutionizing the types of jobs that will be available for American workers in the future (Friedman, 2005). The implications of this trend for America's educational system are huge. No longer is a high school diploma a young person's ticket to a good paying job. Increasingly the jobs of the future will require more than what is now being taught in high school (Friedman, 2005). In 1980 a college graduate earned 50% more than someone with just a high school diploma; in 2000, the pay differential had risen to 100% and has continued to expand (The Knowledge Age, n.d.). When the term, "the digital divide" was coined in the 1990's, it primarily referred to unequal access to the Internet and to computer technology; in the 21st Century, apparently the term "the digital divide" increasingly will refer to the type of jobs available: highly skilled, highly paid technology jobs, and low skilled, low paid service jobs. In fact, a study conducted by Suarez-Orozco at Harvard University in 2003 found a growing discrepancy between the wages earned by the technical workers and the wages earned by the non-technical workers:

> The income gaps that we have witnessed in the post industrial democracies over the last ten to twenty years are precisely predicated on children having had access to the kind of skills that will be required in economies dominated by knowledge-intensive information technologies (p. 30).

As the new millennium began in 2000, the need for highly skilled workers was so great that the U.S. Congress passed an amendment to the immigration law which temporarily tripled the quota for persons who possessed special scientific, technical knowledge or skills who wanted to immigrate into the U.S. (The Knowledge Age, n.d.). One of the effects on the K-12 educational establishment of these societal changes and of these economical changes in America

is that schools increasingly were pressured to find a way to incorporate technology into the K-12 curriculum (Ferneding, 2003). Even though critics of technology as exemplified by Neil Postman (1992) continued to push their agenda during the 1990s, the proponents of technology held the upper hand.

The battle between the technophobes and the technophiles continued throughout the 1990s even though the main event was the battle between the proponents of the instructivist model of technology integration and the proponents of the constructivist model of technology integration (Jonassen & Reeves, 1996). In 1998, Reeves summarized the available literature on the subject in *The Impact of Media and Technology in Schools* in a report commissioned by the Bertelsmann Foundation. Reeves described the conceptual framework that encapsulates the differences between the instructivist model of technology integration and the constructivist model of technology integration. Since the instructivist model relies on a teacher-centered learning environment, Reeves called this framework "learning *from*" (p. 4). Since the constructivist model relies on the construction of knowledge based upon previous experience theories of Jean Piaget for its philosophical foundations, Reeves called this framework "learning *with*" (p. 4). These "from" and "with" technology integration delineations were defined earlier by Jonassen and Reeves (1996) among others. In a practical sense "learning from" represents a tutorial approach to learning, such as to computer assisted instruction (CAI), to computer based instruction (CBI), or to integrated learning systems (ILS); and thus in Papert's (1980) lexicon represented in *Mindstorms: Children, Computers, and Powerful Ideas*, the computer is programming the student. On the other hand, "learning with" represents the utilization of cognitive tools for the construction of knowledge; and thus, as Papert asserted in 1980, the

student is programming the computer. These are diametrically opposed philosophical stances about how students learn and about how students understand reality.

The 1990s' battle over technology's role in education took on national implications because, as Ferneding (2003) in her thorough, critical analysis of educational technology in the 1990s points out, the battle over technology's role in education created some very strange bedfellows. On one side of this debate was what Ferneding called the "policy elites" (p. 201); these were the proponents of technology. They drew members from both political parties: from the Republicans came the so-called neo-conservatives and from the Democrats came the so-called neo-liberals or Democratic centrists. The neo-conservatives were led by Congressman Newt Gingrich, the maverick politician who led the Republican revolt in the House of Representatives in the election of 1994 which put the Republicans in control of the House. United States Representative Newt Gingrich became Speaker of the House after that election. The neo-liberals were led by Bill Clinton, a Democrat, who became president of the U.S. in the election of 1992. Although these contentious political rivals were butting heads over most political issues throughout the 1990s, they joined forces on one issue: the role of technology in education (Ferneding, 2003). These policy elites were supported in this endeavor of pushing for the ascendancy of technology in education in multiple ways by the business community who blamed the old, traditional, non-technological educational system for their own structural weaknesses which led to an increasingly non-competitiveness on a global scale (Cuban, 2004).

Even though integrated learning systems' (ILS) drill and practice remained very popular throughout the 1990s, under these policy elites it became the constructivist model of technology which received all the political attention. Becker (2001), Cuban (1993), Cuban, Kirkpatrick, & Peck (2001), and Ertmer (1999) have reported, however, that very few teachers were using

technology in a constructivist manner even though a 2000 report from the National Center for Educational Statistics (U.S. Department of Education) could be interpreted to mean that constructivist technology was the number one way that technology was being used. In spite of the fact that classroom teachers had not adopted technology integration in large numbers, the proponents of technology had some very powerful friends; and it was these friends who pushed hard to include technology in the mainstream of education because these policy elites' vision for technology in education was based on what Ferneding (2003) called "technological determinism" (p. 208). This argument used the rhetoric of inevitability to advance its agenda: if America's schools do not adopt technology then these schools will risk becoming irrelevant because the technological revolution is here and because the technological revolution is reshaping the entire global community. In 1970, Alvin Toffler in *Future Shock* predicted this rise of the Knowledge Age as the third wave of worldwide historic economic transformations. In other words, if America's educational establishment did not jump onto this technological bandwagon, then America's students, America's workforce, and America's businesses would be left in the economic dustbin of history.

Obviously, this technological determinism argument postulates, as Cuban (2004) and as Ferneding (2003) point out, that one of schoolings' primary purposes, if not the primary purpose, is to prepare its students for the future workplace by teaching technological skills. This argument became so pervasive and so persuasive during the last half of the 1990s that any initiative proposed by President Clinton that dealt with technology and education passed without much opposition (Ferneding, 2003). Basing his policy decisions upon his vision of a technological world, President Clinton began reforming America's educational system with the implementation of his educational agenda: *Goals 2000: Educate America Act* (1994). In this act

three of the eight goals that were to be achieved by the year 2000 were technologically oriented. Two of the concepts that buttressed the propositions in this act were the concept of the emerging Knowledge Age and the concept that America's future depended upon its development of its "human capital" (Ferneding, 2003, p. 28).

President Clinton's Role in Promoting Technology in Education

In September 1995, President Clinton proposed that every American classroom be connected to the Internet by the year 2000 (Sommerfeld, 1995). In addition, President Clinton staked out the importance of educational technology as early as 1995 when he said that, "Preparing our children for a lifetime of computer use is now just as essential as teaching them to read and write and do math" (as quoted in Sommerfeld, 1995, p. 3). Heady comments like this fueled the public's sense of technological inevitability. This comment by Clinton foreshadowed the first National Technology Plan which was published in 1996; this plan and the Office of Educational Technology in the U.S. Department of Education were mandated as part of the far-reaching visionary aspects of *Goals 2000: Educate America Act of 1994* (U.S. Congress, Office of Technology Assessment, 1995). This National Technology Plan set forth four objectives: 1) equip all classrooms with modern computers, 2) connect all classrooms to the Internet, 3) develop engaging software and networked learning content to help all students meet high standards, and 4) prepare all teachers to integrate new technologies into the curriculum (U.S. Department of Education, 1998). Two years later at the MIT commencement on June 5, 1998, President Clinton said,

> "Until every child has a computer in the classroom and the skills to use it . . . until every student can tap the enormous resources of the Internet . . . until every high-tech company can find skilled workers to fill its high-wage jobs . . . Americans will miss the full

promise of the Information Age." (as quoted in U.S. Department of Education, 2000, p. 1)

In order to jumpstart education's entrance into the Knowledge Age, the Clinton Administration took extraordinary steps to fund technology in the K-12 educational sector, for example: E-Rate fund (1995), National Challenge Grant for Technology in Education (1995), Title 2D grants (1996), and Preparing Tomorrow's Teachers to use Technology grant (1999) (U.S. Department of Education, 1998; U.S. Department of Education, 2004b; U.S. Department of Education, 2005). Not only was the federal government putting money into educational technology, but states, local educational agencies, and private entities all were putting money into educational technology. These donations pushed the estimated technology expenditures in the late 1990s to between $5 billion and $7 billion annually (Carroll, 2000; Robelen, 1999; Spending, 1998). This tremendous cash flow, and with it dramatically heightened technological expectations, forced schools to re-examine their curriculum; and, in most cases, schools adapted their curriculum to accommodate this perceived need to include educational technology (Cuban, 2004; Ferneding, 2003). Although the availability of technology increased rapidly and money flowed freely, the human capital part of this equation struggled to keep up. The knowledge base was too small; the experiential factor was too limited; and the expertise needed to use technology properly was not yet developed. Therefore, the emphasis of technology integration was overwhelming for schools.

Assaults on the Use of Instructional Technology in Schools

By 2001, it was becoming obvious to a few educational technology critics that the educational technology bandwagon needed to be stopped or at least needed to be slowed. It was at this junction that Larry Cuban (2001) wrote his rebuttal to the entire educational technology

movement in *Oversold and Underused: Computers in the Classroom*. What set aside this critique from other critiques of the educational technology movement is that this book attacked the educational technology movement not from a philosophical point of view like Postman had in *Technopoly: The Surrender of Culture to Technology* (1992) which the technology determinism argument had easily overcome but from the financial point of view. Cuban's research indicated that, even with billions of dollars spent on educational technology, the introduction of computers into K-12 schools as well as into higher education neither has changed teaching methods nor had a significant positive impact on educational outcomes. In an Op-Ed article in *Education Week*, Cuban (2000) wrote, "It is time to ask again whether the dollars spent are worth it. And, if not, we should spend the money on policies that do matter in the lives of children" (¶ 17). These biting criticisms had an effect on the educational technology movement.

Cuban's (2001) attack on educational technology was just one of a two prong assault against technology in education. The other one was Congress' passage of President George W. Bush's educational reform bill known as the *No Child Left Behind Act of 2001*. Although this bill does not specifically target instructional technology as being bad, the bill stresses accountability, standards, and scientifically-based research which have caused a major shift in how technology is viewed by educational leaders, by the policy elites, and by the power brokers in Washington and elsewhere. This emphasis on accountability harkens back to *A Nation at Risk.* As it will be shown in the discussion of *No Child Left Behind*, the funding for instructional technology from the federal government is quickly drying up.

National and State Educational Law and Policy

National Education Summit 1989

Within several months after securing the presidential election of 1988, President George H. W. Bush developed an idea of convening all the nation's governors for an educational conference. This attempt at implementing a solution to the problems first discussed in the report *A Nation at Risk: The Imperative for Educational Reform* (National Commission, 1983) was limited from the start due to some rather amateurish political ineptness (Vinovskis, 1999). In 1989 both houses of Congress were controlled by the Democrats; yet, rather inexplicably, President George H. W. Bush chose not to invite any of the Senate or any of the House Democratic or Republican leaders to this conference even though the fate of the legislative agenda that could possibly emanate from this conference needed the support from these same legislative leaders. Not surprising, they "were particularly upset that the Bush administration had ignored them altogether in this process" (Vinovskis, 1999, p. 37). This conference, which eventually came to be called the National Education Summit, developed the first national educational goals. Ironically, the Democratic co-chairman of the National Education Summit was none other than then Governor Bill Clinton of Arkansas (Vinovskis, 1999). Even though never enacted during President George H. W. Bush's administration due to political reasons, these very same goals five years later would eventually become the framework from which President Bill Clinton crafted his educational legislative agenda known as *Goals 2000: Educate America Act of 1994.*

Five months after the nation's governors met at the National Education Summit at Charlottesville, Virginia, in 1989, President George H. W. Bush announced and the governors adopted six national education goals. These goals were supposed to be guiding principles that

would lead to the reform of education efforts in all 50 states (National Educational Goals Report, 1993). These goals were:

> Goal 1: By the year 2000, all children in America will start school ready to learn.
>
> Goal 2: By the year 2000, the high school graduation rate will increase to at least 90 percent.
>
> Goal 3: By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter, including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.
>
> Goal 4: By the year 2000, U.S. students will be first in the world in science and mathematics education.
>
> Goal 5: By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.
>
> Goal 6: By the year 2000, every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning. (National Educational Goals Report, 1993)

In addition to creating these goals, the 1989 Education Summit created an ongoing monitoring system to annually assess the status of the various states in meeting these six goals. This monitoring system consisted of creating a panel of individuals, who were mostly politicians

including some national legislators, and a staff of experts who prepared the documents for the panel members to consider (National Educational Goals Report, 1993).

The significance of this summit is hard to overestimate because it placed the federal government into the center of the educational reform movement, a heretofore unknown position for federal leaders. Less than a decade earlier candidate Ronald Reagan when campaigning for the presidency in 1980 declared that he would abolish the Department of Education at the federal level (Vinovskis, 1999), a campaign promise he did not keep. In 1988, not only did Vice President George H. W. Bush not pledge to abolish the Department of Education, while campaigning for president in New Hampshire, he declared that he would be the "Education President" (Vinovskis, 1999, p. 23) and that he would be committed to the federal government as having a leadership role in reforming education, a role that from 1989 forward continued to grow. Although no new programs or funding emanated from this summit, what emanated was a new awareness among the political chief executives that a national effort was needed to focus attention on the plight of education in the U.S. and a new set of reforms to improve this plight in education. The actual legislative action that enacted the goals created at the National Education Summit of 1989 had to wait five years and had to wait for a different political climate; it had to wait for the election of a new president – Bill Clinton.

Goals 2000: Educate America Act of 1994 (U.S.)

By the time Bill Clinton was elected president in 1992, the nation was ready for a national educational agenda; his legislative proposal which passed Congress in 1994 mirrored the goals published five years earlier. In fact, six of the eight goals that comprise *Goals 2000: Educate America Act of 1994* came directly from the goals published by the National Education Summit in 1989. This *Goals 2000: Educate America Act of 1994* basically legislated solutions to

concerns that were first brought up in *The Nation at Risk* in 1983 (National Commission). This act established eight goals that were to be achieved by the year 2000. These goals were:

Goal 1: By the year 2000, all children in America will start to school ready to learn.

Goal 2: By the year 2000, the high school graduation rate will increase to at least 90 percent.

Goal 3: By the year 2000, all students will leave grades 4, 8, and 12 having demonstrated competency over challenging subject matter including English, mathematics, science, foreign languages, civics and government, economics, arts, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our Nation's modern economy.

Goal 4: By the year 2000, the Nation's teaching force will have access to programs for the continued improvement of their professional skills and the opportunity to acquire the knowledge and skills needed to instruct and prepare all American students for the next century.

Goal 5: By the year 2000, U.S. students will be first in the world in mathematics and science achievement.

Goal 6: By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.

Goal 7: By the year 2000, every school in the U.S. will be free of drugs, violence, and the unauthorized presence of firearms and alcohol and will offer a disciplined environment conducive to learning.

> Goal 8: By the year 2000, every school will promote partnerships that will increase parental involvement and participation in promoting the social, emotional, and academic growth of children. (*Goals 2000: Educate America Act*, Section 102, 1994)

The similarities between this 1994 legislation and the goals first proposed as a result of the National Education Summit in 1989 are striking. Goals 1, 2, 3, 5, 6, and 7 are essentially the same; however, what the *Goals 2000: Educate America Act* does is to add Goal 4 Teacher Education and Professional Development, and is to add Goal 8 Parental Participation. Even though six of these goals were essentially the same as the six goals that emanated from the National Education Summit (Vinovskis, 1999), there are distinct and major differences. For example, Goal 4, which is new, stresses the need for teachers to have "access to programs for the continued improvement of their professional skills and the opportunity to acquire the knowledge and skills needed to instruct and prepare all American students for the next century" (*Goals 2000: Educate America Act*, Section 102). In the language of this legislation and throughout the 1990s in general the euphemism "prepare all students for the next century" refers specifically to the integration of technology in America's classrooms (Ferneding, 2003). In fact, this act ushers in the golden age of the federal government's involvement in and funding for technology in education (Ferneding, 2003; Sonnenberg, 2004).

In 1994, President Clinton's belief in technology in education, however, was not a new phenomenon because as far back as 1989 when Bill Clinton was still governor of Arkansas he proposed just three days prior to the National Education Summit seven goals as his suggestion for the agenda for the summit. His last goal was for schools to "have well-trained teachers and the modern technology they need to be competitive" (Vinovskis, 1999). Not surprisingly

President Clinton's professed belief in the importance in technology as he stated in 1989 is a focus on technology throughout the *Goals 2000: Educate America Act*. For example, Goal 3 states that all students should be prepared for "productive employment in our Nation's modern economy" (*Goals 2000: Educate America Act*, Section 102, 1994), again a euphemism for the integration of technology into schools. Objective 2 for Goal 4 declares that all teachers need the knowledge and the skills to "use emerging new methods, forms of assessment, and technologies" (*Goals 2000: Educate America Act*, Section 102, 1994). In Goal 6 the language again stresses technology by tying education to global economic forces when it states that every American should have the "knowledge and skills necessary to compete in the global economy" (*Goals 2000: Educate America Act*, Section 102, 1994). The Objective 2 of this Goal 6 goes further by articulating more succinctly a connection between technology and education when it states that every adult American will have the "opportunity to acquire the knowledge and skills, from basic to highly technical, needed to adapt to emerging new technologies, work methods, and markets through public and private educational, vocational, technical, workplace, or other programs" (*Goals 2000: Educate America Act*, Section 102, 1994).

In three of the eight goals in the *Goals 2000: Educate America Act (1994)* technology is a critical component for schools. Because of the criticality of technology in education as espoused in this act, when Congress wrote *Goals 2000: Educate America Act* it also created a new office within the Department of Education: the Office of Educational Technology (Section 233). This emphasis on technology is so pervasive throughout the act that there is an entire part dedicated to outlining how technology is to be used: "Part C – Leadership in Educational Technology." There are eight purposes listed in Part C, the first of which is to create a National Technology Plan by establishing a national vision and strategy to:

(A) Infuse technology and technology planning into all educational programs and training functions carried out within school systems at the state and local level

(B) Coordinate educational technology activities among the related federal and state departments or agencies, industry leaders, and interested educational and parental organizations

(C) Establish working guidelines to ensure maximum interoperability nationwide and ease of access for the emerging technologies so that no school system will be excluded from the technological revolution

(D) Ensure that federal technology-related policies and programs facilitate the use of technology in education. (*Goals 2000: Educate America Act*, Section 231)

One of the instructional technology strategies that this National Technology Plan was supposed to promote was the integration of technology into the curriculum (*Goals 2000: Educate America Act, 1994*, Section 232). Unfortunately, this issue of technology integration will surface over and over again as state and local educational institutions try to determine what technology integration means and how technology integration is to be accomplished. The struggle to effectively implement this strategy has lasted for over a decade, so far without any real resolution (Cuban, 2001; Ferneding, 2003; Hernandez-Ramos, 2005).

Improving America's Schools Act of 1994 (U.S.)

In 1965, the federal government passed the *Elementary and Secondary Education Act* (ESEA) (National Education Association, n.d.) as an attempt to provide funds to economically disadvantaged students. This act has been reauthorized approximately every five years since then growing in scope and growing in complexity as the federal government has attempted not only to level the playing field in the K-12 educational environment by providing extra funds for those

disadvantaged students but also to meet a growing variety of other worthwhile ideas such as bilingual education and such as safe and drug-free schools. As this act has grown beyond its original scope of providing economic assistance to the economically disadvantaged group of students, policy elites and politicians have seen ESEA as the funding unit for educational reform efforts spearheaded by the federal government. In its sixth reauthorization in 1996, the ESEA included a Title 3 section which provided funds for educational technology. This Title 3 section eventually became known by a separate name; it is called the *Technology for Education Act of 1994.*

Technology for Education Act of 1994 (U.S.)

Although the *Goals 2000: Educate America Act of 1994* promoted educational technology throughout the act, there are no specifics as to providing directives to the U.S. Department of Education concerning the implementation of some of the initiatives and concerning how funding was to be provided. In Part A of this act there is a list of 15 reasons why technology should be an important component in schools. These fifteen "findings" (Section 3111) of Congress state five reasons that the use of technology in education had been inhibited in the past. These five reasons are the:

(A) Absence of federal leadership

(B) Inability of many state and local educational agencies to invest in and to support needed technologies

(C) Limited exposure of students and teachers to the power of technology as a cost-effective tool to improve student learning and achievement

(D) Lack of appropriate electrical and telephone connections in the classroom

(E) Limited availability of appropriate technology-enhanced curriculum, instruction, professional development, and administrative support resources and services in the educational marketplace. (Section 3111)

In order to alleviate these inhibitors, the *Technology for Education Act* (1994) does many things not the least of which is to direct the Secretary of Education to publish within 12 months after the enactment of this act a National Technology Plan. Even though the *Goals 2000: Educate America Act* proposed the creation of a National Technology Plan, the *Technology for Education Act (1994)* actually specifies when this plan is to be published and specifies what the contents of this plan should be. Furthermore, the *Technology for Education Act* (1994) not only directs the U.S. Department of Education to create some programs that would encourage the use of technology in the K-12 environment (Section 3122), the *Technology for Education Act* (1994) also provides the funding for those programs (Subpart 2). Out of the *Technology for Education Act* (1994) comes the creation of numerous federal grant programs for technology in education including the Technology Literacy Challenge Fund (U.S. Department of Education, 2004a), the Technology Innovation Challenge Grant (U.S. Department of Education, 2004a), and Preparing Tomorrow's Teachers to use Technology (U.S. Department of Education, 2005). One of the most significant sections of the *Technology for Education Act (1994)* is, however, the section which directs the Office of Educational Technology to conduct "a study to evaluate … the feasibility of several alternative models for providing sustained and adequate funding for schools … so that such schools are able to acquire and maintain technology-enhanced curriculum, instruction, and administrative support resources and services" (Section 3123).

The significance of Section 3123 was not at first apparent; but by 1996, when Congress took up the reauthorization of the *Telecommunication Act of 1936*, the significance became

obvious. When the *Telecommunication Act of 1996* was approved, Congress had amended the original 1936 telecommunications act to provide discounted telecommunication services to schools as an alternative funding source for technology (U.S. Department of Education, 1997a; U.S. Department of Education, 1997b). The *Telecommunications Act of 1996* directed the Federal Communications Commission (FCC) to develop rules and regulations to manage these discounted funds. It took the FCC two years to develop the rules that governed this program even though the program used a funding mechanism, known as the Universal Service Fee, which was put into place by the original telecommunications act. Originally this Universal Service Fee was designed to assist the telephone companies in providing reasonably priced telephone service to rural customers by allowing the telephone companies to place a tax, albeit a very small tax, on every telephone service the telephone company provided to its customers. In this way urban customers helped provide phone service to rural customers.

Because of the added administrative responsibilities created by the *Telecommunication Act of 1996* in which the FCC would help provide funding for telecommunication services to schools by increasing the amount of Universal Service Fees added to each phone service, the FCC created the Universal Service Administrative Company (USAC), a private, non-profit company to take over the administration of this operation. The USAC was charged with the responsibilities of creating the rules for administering the Schools and Libraries Division of the USAC and for the disbursement of the funds that would be collected for educational technology. The funds collected for this purpose were to be used to help schools pay for their telecommunication needs; according to the USAC the schools would receive discounted rates which were called the Education Rate or E-Rate for short (Sonnenberg, 2004). This program turned out to be the most significant, as well as, the most politically controversial initiative of

President Clinton's educational technology vision for the nation (Policy, 1998; Zehr, 2000). This initiative is significant because, more than any other federal or state program earmarked for technology in K-12 education, this program has consistently provided a large source of funds for educational technology.

The E-Rate Program has granted $2.25 billion annually to K-12 schools since its inception in 1998; this is more than all the other federal technology grants combined. Since the first disbursements in 1998, E-Rate channeled over $14 billion into K-12 education technology in the first seven years (Trotter, 2005a). In addition to the old definition of telecommunications, by the time the regulations were written by the USAC to implement this part of the *Telecommunication Act of 1996*, telecommunication services included Internet access; and it also included internal connections, the networking equipment used by schools (U.S. Department of Education, 1997a; U.S. Department of Education, 1997b; U.S. Department of Education, 2000). The funds made available through this program and the revised definition of what constitutes telecommunication services allowed for K-12 schools to join the telecommunication revolution.

National Educational Technology Plan of 1996 (U.S.)

In 1996, the U.S. Department of Education published the first National Technology Plan. This new technology plan set forth four objectives: 1) equip all classrooms with modern computers, 2) connect all classrooms to the Internet, 3) develop engaging software and networked learning content to help all students meet high standards, and 4) prepare all teachers to integrate new technologies into the curriculum (U.S. Department of Education, 1998). It was very clear by the time the federal government published the *National Technology Plan of 1996* (Robelen, 1999) that the federal government was totally committed to the inclusion of technology into education. President Clinton, an early proponent of instructional technology as

was shown earlier, made political-like campaign tours and speeches touting the importance of technology in education and in the workplace. In September 1995, President Clinton proposed that every American classroom be connected to the Internet by the year 2000 (Sommerfeld, 1995). In addition, President Clinton staked out the importance of educational technology as early as 1995 when he spoke of how essential it is now to teach America's children reading, writing, arithmetic, and technology (as quoted in Sommerfeld, 1995, ¶ 3).

Public Education Reform Act of 1996 (Georgia)

Legislative action supporting educational technology was not limited to the federal level. For example, in 1996 the Georgia legislature amended the existing education law in order to make this law more in tune with the times and to make this law more responsive to the needs of the state. The words of Georgia's legislation are: "In order to prepare students for the demands of a complex work place and higher education, the following are necessary components of such a system: (A) a new type of classroom; (B) a decentralized school system; (C) new technologies" (*Public Education Reform Act of 1996*). Since this act appears only two years after the enactment of *Goals 2000: Educate America Act* it can be assumed that Georgia took up the torch that was lit with the passage of this federal law, although in a smaller way and in a more incremental way. Obviously the momentum for educational technology was gathering steam at the federal legislative level and at the Georgia state legislative level.

A Plus Education Reform Act of 2000 (Georgia)

Four years after the *Public Education Reform Act of 1996*, Georgia Governor Roy Barnes proposed and the Georgia state legislature passed a much more far-reaching law that dramatically changed the educational landscape in the state (Georgia Department of Education, 2000). The *A Plus Education Reform Act of 2000* made sweeping changes in education such as

reducing class size, eliminating tenure for teachers, and requiring that all teachers demonstrate a degree of technology competency by June 2006 (Georgia Department of Education, 2000). The *A Plus Education Reform Act of 2000* mandates that teachers demonstrate a level of technology competency by completing one of two options in order to teach in Georgia. To meet the requirements of this act, Georgia teachers had to either pass a computer skills test or had to take and had to successfully complete a technology integration course called InTech (Georgia Department of Education, "Requirements for Teachers"). InTech was originally created by Traci Redish at the Educational Technology Training Center at Kennesaw State University in 1997 as an attempt to provide for teachers the necessary skills and knowledge needed in order to teach in the Knowledge Age. This InTech program was so successful at Kennesaw that the remaining 12 Educational Technology Training Centers in Georgia soon adopted InTech as their technology training model (Traci Redish, personal communication, December 8, 2006).

It appears that a portion of the *A Plus Education Reform Act of 2000* borrowed heavily from the National Technology Plan of 1996 since the last objective of the National Technology Plan is "to prepare all teachers to integrate new technologies into the curriculum" (U.S. Department of Education, 1998). In the *A Plus Education Reform Act of 2000* teacher preparation to integrate technology is a core ingredient. Teacher preparation to integrate technology not only was a major factor for national and state legislatures in the 1990s, it was also a major focus for academic researchers throughout this decade. In fact, one of the consistent themes throughout the 1990s was the belief in the importance of professional development on the integration of technology (Cuban, 2001: Becker, 2001; Mouza, 2003). In fact, the U.S. Department of Education created a federal grant for teacher preparation programs at colleges and universities in order to develop a list of best practices called: Preparing Tomorrow's Teachers to Use

Technology Program. The Georgia InTech program, which pre-dated the Georgia *A Plus Education Reform Act of 2000,* was created partly in response to federal legislation – *Technology in Education Act of 1994* – and partly in response to federal policy – *National Technology Plan of 1996* – and partly in response to a perceived need (Traci Reddish, personal communication, March 10, 2003). The InTech program soon spread to other ETTCs throughout Georgia and, as such, became a mainstay for teachers wanting to receive technology professional development. However, when the Georgia legislature passed the *A Plus Education Reform Act of 2000,* which required a technology integration endorsement onto the Georgia teaching certificate before that certificate could be renewed, certain school districts, such as Rockdale and Forsyth, decided to develop and to seek approval of their own InTech-like training programs from the Professional Standards Commission (Grover Dailey, personal communication, April 23, 2005; Bailey Mitchell, personal communication, October 22, 2004). Other school districts such as Jasper and Newton hired a teacher to be trained as an InTech instructor by the local ETTC to redeliver the official InTech program to all the district's teachers without these teachers having to travel to the nearest ETTC (Beth Sullivan, personal communication, March 10, 2003). This element of the *A Plus Education Reform Act of 2000* put educational technology on the front burner in Georgia; and this element raised each teacher's awareness of educational technology as an alternative delivery model for instruction (Beth Sullivan, personal communication, November 10, 2006). Even as other federal laws, like *No Child Left Behind of 2001* and as other federal policies such as the elimination of the Preparing Tomorrow's Teachers to Use Technology Grant, forced a change in how the nation viewed educational technology after the millennium, it is apparent in Georgia that the *A Plus Education Reform Act of 2000* kept the integration of technology on the

educational front burner as literally tens of thousands of teachers filled computer labs throughout the state learning how to integrate technology in a constructivist manner.

No Child Left Behind Act of 2001 (U.S.)

In 2001, Congress passes the seventh reauthorization of the Elementary and Secondary Education Act; it is named *No Child Left Behind Act of 2001*; and it represents President George W. Bush's signature education effort (U.S. Department of Education, 2004a). This act embodies the principles of *A Nation at Risk*, *The National Education Summit*, and *Goals 2000: Educate America Act 1994* in the sense that it embraces accountability and responsibility. Unlike those three acts or policy statements, The *No Child Left Behind Act of 2001* takes a carrot and a stick approach to reforming education: the accountability sections and the responsibility sections, with the accompanying funding for underachieving schools in order to allow them to make "Adequate Yearly Progress" (AYP), are the carrot; the penalties of being listed as a "needing improvement" school, as a "needing corrective action" school, or as a "needing restructuring" school with progressively severe restrictions, are the stick (U.S. Department of Education, 2004a). Furthermore, the *No Child Left Behind Act of 2001* stresses the importance of scientifically-based research in order to determine best practices (U.S. Department of Education, 2004a). In fact, accountability and scientifically-based research are the cornerstones of this act with the word "accountability" being mentioned 80 times. The words "scientifically based research" are mention 69 times.

In reality, scientifically-based research means quantitative research or experimental research with control groups and with randomized selection. The problem with that mandate in this act is that experimental research provides explanation not understanding (Crotty, 1998); and according to Becker and Lovetts (2003) technology integration does not lend itself to an

experimental research design because the learning that takes place in a student-centered constructivist classroom is not easily measured by statistical correlations and/or by statistical effect size. Furthermore, there are severe ethical considerations for performing experimental research in educational settings (Becker & Lovetts).

The *No Child Left Behind Act of 2001* represents a turning point in educational technology in the U.S.; prior to this act, educational technology in general and the integration of educational technology specifically have been experiencing what now appears in retrospect to be the golden years of educational technology where money flows freely and where critics' words of caution, such as those voiced by Neil Postman and others, are drowned out by the hymn of inevitability and the buzz saw crush of gold rush fever as businesses in the educational technology market try to cash in on the free flow of technology dollars (Ferending, 2003). With the *No Child Left Behind Act of 2001* firmly in place, technology in education is moving more towards a direct instruction approach with the extensive use of Integrated Learning Systems because these systems lend themselves to being evaluated using an experimental design methodology. However, data show as the full impact of *No Child Left Behind Act of 2001* began to take effect that many teachers if not most teachers who were attempting to integrate technology using constructivist pedagogy and the district and school leaders who were supporting them began abandoning these efforts and began drifting toward the Integrated Learning Systems. After some evident excesses of the 1990s, data indicate that the instructional technology pendulum is swinging back towards where it began: drill and practice activities. On the other hand, the *No Child Left Behind Act of 2001* emphasizes scientifically-based research; but right now there is still very little scientifically-based research indicating that instructional technology has improved learning. As Becker and Lovetts (2003) articulated, educational

technology using a constructivist pedagogy produces learning that is not tested on standardized tests; and it is hard to create a research design looking for this type of learning.

National Educational Technology Plan of 2004

The second National Educational Technology Plan was completed in 2004 (U.S. Department of Education, Office of Educational Technology, 2004); and it recognized that technology was not being used in transformational ways, "Too often, schools have simply applied technology to existing ways of teaching and learning, with marginal results in student achievement" (U.S. Department of Education, Office of Educational Technology, 2004, p. 4). In spite of the billions of dollars pumped into educational technology by federal, state, and local governments in the decade prior to this report, in spite of the decrease in the student-to-computer ratio down from 92 students for every computer in 1984 (Ferneding, 2003) to 3.8 students per computer, in spite of all the public attention placed on educational technology by such high profile individuals such as President Clinton, technology had not been used in ways that the proponents had stated that it would be used. The reasons for this are evident in this second National Educational Technology Plan (U.S. Department of Education, Office of Educational Technology, 2004). Although this second National Educational Technology Plan (2004) concedes that the promise of technology has not been realized, it lays the blame squarely on the lack of adequate training on how to use technology stating that, "Providing the hardware without adequate training in its use . . . meant that the great promise of Internet technology was frequently unrealized" (U.S. Department of Education, Office of Educational Technology, 2004, p. 10). Although this second National Educational Technology Plan (2004) tries to paint an optimistic view of the future of technology in education by highlighting what it sees as examples of innovative uses of technology in various states, the plan also tries to hype the importance of

the *No Child Left Behind Act of 2001* legislation, a legislation that fundamentally altered the course of instructional technology by stressing accountability, by mandating standardized testing, and by providing penalties for schools that do not meet the requirements of this law (U.S. Department of Education, 2004a), while at the same time the Bush administration tries to eliminate funding for instructional technology initiatives (Trotter, 2005b). In other words, the *No Child Left Behind Act of 2001's* emphasis on standardized testing and on accountability has pushed instructional technology back into the "learning from" mentality by using computers to provide programmed instruction, the antithesis of what President Clinton had in mind in 1995.

The Changing Nature of Students

As the momentum grew for accountability and for the use of technology along an instructionist approach, many of the proponents of a constructivist approach to technology in education fought back with a new argument – the changing nature of the world and the changing nature of the students. The changing nature of the world was best described by Thomas Friedman (2005) in *The World is Flat: A Brief History of the 21st Century*. In this book Friedman describes a globalized world in which fiber optic telecommunications has allowed for instant communication anywhere in the world. In this new world time and distance cease to matter when it comes to communication and when it comes to economic transactions. At the same time that the world has shrunk, metaphorically speaking, the young people who are our students are living, working, and playing in this digital world. This changing nature of the world and this changing nature of the students have dramatically altered the educational environment.

As a result, a group of educational researchers and of media companies formed in 2005 an alliance called The New Media Consortium to promote a different understanding of education. Its primary premise is that education as it has been practiced for the last century in

this country will not prepare our students for the future, nor will it prepare our students to be the citizens in the new century. One of the reasons that students need to be taught differently is, "A profound shift is taking place in the way people communicate and express themselves. . . . [and as a result] a new concept of language – and what it means to be literate – is evolving" (The New Media, 2005, p. 1). This new language "occurs multimodally, incorporating visual and aural elements with textual elements, and an immediacy which itself is a dimension of the new language" (The New Media, 2005, p.1).

Even though the above argument may sound self-serving considering that companies such as Adobe, Inc., are members of this consortium, they are not the only people who are urging a different approach to teaching and to learning. Jane Healy (1990) researched how excessive exposure to modern media can affect the brain with results indicating children's minds are different today due to excessive exposure to modern media. As a result of her research Healy also believes that students need to be taught differently. Healy explains her findings by saying, "I became increasingly convinced that the changes went deeper . . . to the very ways in which [students] were absorbing and processing information" (p. 13). Additionally, there has been a flurry of commentaries and of essays from a variety of individuals explaining the changing nature of today's students. Leonard Schlain (2005), a neurologist in California who during his entire career has studied the brain and how the brain functions, explained in an essay in *Edutopia*, that today's youth are visual learners because of their constant exposure to television, video games, computers, and other multimedia stimulation. According to Schlain, if education wants to remain relevant to today's students then education must adapt to the new technologies. Furthermore, Howard Gardner, one of the foremost educational theorists in the country today, has studied how people learn and has studied what constitutes intelligence and knowledge. In a

commentary in *Education Week* in 2005, Gardner stressed the need for this country to move away from test scores as the sole measurable output of educational institutions and instead to look at "what kind of minds it wants to produce: 1) a disciplined mind (strong in a specific content area), 2) a synthesizing mind, 3) a creative mind, 4) a respectful mind (respectful of diversity), and 5) an ethical mind" (p. 44). Although Gardner does not address the role of technology in education in his commentary, he pointedly suggests that the trend in education towards high-stakes standardized tests and towards accountability has pushed education into a model that de-emphasizes creativity, problem-solving, and critical thinking, instead emphasizing rote memorization. There have been lesser know individuals as well who continue to beat the drum for educational change due to the changing nature of today's students. Will Richardson (2006), a former teacher and now an author and a lecturer, wrote an article for *Edutopia* entitled "The New Face of Learning." Patrick McCloskey (2006), a free-lance author, wrote "The Blogvangelist" for *Teacher Magazine*. The commonality for all these authors is their belief that students have changed, and that education must change to meet the changing "face of learning" (Richardson, 2006, p. 34).

What has altered students' perception of education more than anything else is the advent of Web 2.0 technologies (Richardson, 2006). These technologies allow for students to become active participants in society more than ever before. Unfortunately, K-12 education, for the most part, does not allow students to take a more participatory role in their education. Certainly students can ask questions and can take part in discussions; but how many teachers allow students to create products as part of their assessment (Richardson, 2006). Prensky (2006) gives a new name to today's students; he calls today's students "digital natives" (p. 8) because they were born into the digital world. These digital natives certainly are as creative as students have

ever been in the past; however, most of today's students are not being offered educational technology to meet their educational needs; most of today's students are not being presented educational technology that would be meeting the needs of their 21st Century education. Instead, today's students are spending vast amounts of time on non-educational technology: My Space pages, writing blogs, playing video games perhaps with other students maybe hundreds, if not thousands, of miles away. If these critics of the current trend in education are correct, the U.S. is facing a dilemma; and the solution to that dilemma rests squarely on the shoulders of the school leader even though the Federal government perhaps does not want to face the fact that there is an irreconcilable dilemma facing schools today. The 2004 National Technology Plan (U.S. Department of Education, Office of Educational Technology) endorses wholeheartedly the *No Child Left Behind Act of 2001* which requires high stakes standardized testing while proclaiming that the U.S. is on the cusp of innovative and of creative uses of technology to teach creativity, problem-solving, and critical thinking. Those two concepts – standardized testing and creative problem-solving – appear to be inherently incompatible; and yet the National Technology Plan 2004 believes that both can coexist independently of one another.

The implications for this changing nature in how today's students learn are tremendous both for the teacher and for the leadership of the school (Carroll, 2000; Schlain, 2005). Schools risk irrelevancy if teachers and if school leaders continue to believe that the students of today are the same as were the students of yesterday (Carroll, 2000; Pierce, Conclusion, 2003). No one believes that they could travel to the moon in a Model T Ford; yet teachers and school leaders still believe, for the most part, that the best way to teach today's students is to use the pedagogies of yesteryear (Carroll, 2000; Cuban, 2001). Unfortunately, shepherding change through an organization as complex and as diversified as most K-12 schools is a difficult task at best

(Creighton, 2003; Sergiovanni, 2006; Windchitl & Sahl, 2002). This difficulty is made the more complex due to the diversity of cultural practices at individual schools (Sergiovanni, 2006; Windchitl & Sahl, 2002). School leaders must be convinced that a change in educational philosophy is important and that a change in educational practice is imperative. The research is clear that it is best not to mandate that change but rather to use persuasion (Hofer, 2005; Sergiovanni, 2006, Creighton, 2003).

Educational Change and the Diffusion of Innovation

In 1970, Alvin Toffler wrote *Future Shock*. In it he declares a new epoch has begun. This new epoch would be characterized by ever accelerating change; those who are most adaptable are the only ones who will survive. Marc Prensky (2006) recognizes this change and recognizes how it is affecting the education of his "digital natives." What both of these individuals have in common is a vision of the world that has fundamentally changed in the last half of the 20th century, thus, a vision of humans living in a new period in human history. Larry Cuban (1993; 2001; 2004) recognizes this change; it is he who contends that education has not changed to match it, while others such as Henry Becker (2001) see change occurring in education at a slower, more measured pace. So, what is the truth, not from an epistemological or an ontological point of view, but from a practical point of view? More specifically, is the change occurring in education matching the change occurring throughout the world?

In 2001 when Larry Cuban wrote *Oversold and Underused: Computers in the Classroom* he describes his research which shows that technology in education is not changing the way teachers are teaching. This book countered the argument that if education does not embrace technology that education will become irrelevant (Ferending, 2003). This "technological determinism" (Ferending, 2003, p. 82) argument and the rhetoric of inevitability led few to

question the spending of billions of dollars on technology in education in the 1990s. Cuban's book, however, helped change that social dynamic and that political dynamic.

At the same time that critics of technology in education were regaining their voice, developments in the political arena with the passage of *No Child Left Behind Act of 2001* (NCLB) were creating significant problems for the integration of technology into the K-12 environment. NCLB represented the culmination of 18 years of effort to apply business practices (Ferending, 2003; Cuban, 2004) to education with the stipulation that each school will be held accountable for how their students perform on a standardized test. With the pressures exerted by this law, schools and teachers are more reluctant to try technology integration strategies (Ferending, 2003).

First-Order and Second-Order Change

Cuban's (2001) main thesis is that technology was being used only as a first-order of change. There are two types of change: first-order change and second-order change (Cuban, 1993; Fullan, 1993; Ertmer, 1999; Moursund, 2002). In first-order change current practices are not changed they are altered superficially to adapt to a new situation. Moursund calls this the amplification stage of change; current practices are just amplified not fundamentally changed. Ertmer calls this type of change external change, or change that is external to the individual, change which "adjust[s]' current practices, in an incremental fashion, making it more effective or efficient, while leaving underlying beliefs unchallenged" (p. 48). Second-order change is fundamental change; "second-order changes confront fundamental beliefs about current practice, thus leading to new goals, structures, or roles" (Ertmer, p. 48). Moursund calls this second-order change revolutionary, whereas, Ertmer calls second-order change internal. Both researchers are referring to deep, internalized changes, in deeply held beliefs, about teaching and learning.

Although Cuban (2001) wrote that he did not find many teachers who had fundamentally changed their belief structures, he reported that of the 13 teachers who were interviewed and shadowed, four reported changes in their classroom practices as a result of the infusion of technology. Four of thirteen teachers represents only a minority; but according to Everett Rogers' (2003) theory of the diffusion of innovations, the number needed to create a critical mass of adopters in any successful innovation is somewhere between 10% and 20%. Taking into account Rogers' (2003) theory, one could look at Cuban's (2001) findings differently.

In the journal article about this same study, Cuban, Kirkpatrick, and Peck (2001) also discovered that teachers' age, experience, and gender were not factors in explaining why technology was not being used in constructivist ways. What this study found is that a teacher's belief structure about teaching and learning is one of the most important factors that inhibited a teacher's adoption of the technology integration pedagogy. This coincides with research from Becker (2001), Windchitl and Sahl (2002), and Hernandez-Ramos (2005). What must be remembered is that the diffusion of innovation is a social process (Rogers, 2003), and that "an important factor regarding the adoption rate of an innovation is its compatibility with the values, beliefs, and past experiences of individuals in the social system" (p. 4). With this understanding of the rate of adoption, technology integration will most likely take longer than expected because most teachers would have to change their belief structure. What Cuban et al. also confirmed was that the time to learn how to use this technology, the lack of training in the use of this technology, and the unreliability of this technology were significant inhibitors to the adoption of technology integration strategies.

In spite of these inhibitors, Cuban, Kirkpatrick, and Peck (2001) theorized that there may be two other explanations for this lack of progress in the adoption of technology integration

strategies: the technology revolution is a slow process, “small changes accumulating over time create a slow-motion transformation” (p. 826); and the context of high schools emphasizes structure and time rigidity. Cuban et al. rejected the first explanation as implausible; but accepted the second explanation as valid. By rejecting the first explanation, Cuban et al. were ignoring a large body of research in diffusion of innovations indicating that adoption of innovation can take a very long time (Rogers, 2003). Rogers discusses education diffusion research that was done by Paul Mort at Columbia University saying, “Paul Mort and his colleagues found that a considerable time lag was required for the adoption of educational innovations. ‘The average American school lags 25 years behind the best practice’ (Mort, 1953)” (p. 61). Cuban and his colleagues may have been premature in declaring this diffusion as failed.

Teacher Attrition as a Contributing Factor

Associated with the lack of time and with the lack of training that were mentioned by Cuban, Kirkpatrick, and Peck (2001), there is one factor that this study mentioned which has not been mentioned anywhere else in the literature but may play a significant role in the lack of progress on this issue: “Teacher turnover undermines the implementing and institutionalizing of technological innovations and contributes to maintaining common teaching practices” (p. 829). Teacher attrition is probably an underlying reason that the diffusion of technology integration is slower in being adopted than is the average educational innovation. Even though teacher attrition is not mentioned in the educational technology literature, it is a regularly discussed topic in educational administration literature and is recognized as a major problem for school districts in achieving a quality teacher workforce (Darling-Hammond, 2003). This literature indicates that 33% of all first-year teachers will leave the teaching profession within the first five years. Since, as Ertmer (1999) points out, it takes five years for a teacher to evolve from a direct instruction

teacher to a constructivist teacher, and since there is such a high teacher turnover rate, it can be reasonably assumed that one of the reasons that most schools have not achieved the necessary number of technology integration early adopters to reach that critical mass stage is teacher attrition.

Henry Becker's Research on Instructional Technology

Pedro Hernández-Ramos (2005) did a follow-up study four years later in the same school district that is the subject of Cuban's (2001) study. Even though he did not work with the same teachers, Hernandez-Ramos' findings are significant in that they confirm Cuban's findings. In contrast, Henry Becker (2001) cast doubt on the Cuban findings. Using responses from thousands of teachers nationwide, Becker finds circumstances in which teachers did transform their teaching styles along constructivist lines. This contradiction is easily explained using Rogers' (2003) diffusion of innovations research. Of the five perceived attributes of innovations, the most important attributes are relative advantage and compatibility. Becker finds that for the teachers who had adopted a constructivist pedagogy they more easily adopted technology integration strategies as well because these technology integration strategies are relatively advantageous and are relatively compatible with these teachers' beliefs about teaching and learning. When weighing the merits of Cuban's findings against Becker's findings does one choose to believe the glass is half-empty or half-full?

Henry Becker's (2001) study tries to discern what factors contributed to a teacher's usage of technology integration along constructivist lines. Becker finds that there are four predictors determining which teachers use technology in a constructivist approach to teaching and learning: 1) the teacher's technical expertise and use of computers for professional use, 2) the teacher's involvement in informal leadership roles within and outside of school, 3) the number of

computers within the teacher's own classroom, and 4) the teacher's philosophical belief in teaching and learning. In addition to these predictors, Becker further discovers that there are three inhibitors to the use of technology integration practices. The first is the lack of access to computers within the teacher's classroom. This research indicates that if a teacher has five to eight computers in the classroom, that teacher is twice as likely to use computers in a constructivist manner. The second barrier that Becker identifies is the organizational structure of high schools where "the day is carved up into different classes" (p. 5) and where the teachers feel pressured to cover large amounts of curricula. The third barrier is the teachers' lack of technical expertise with using computers. These last two inhibitors coincide with the findings of Cuban (2001).

Teachers' Philosophical Beliefs about Teaching and Learning

Philosophical beliefs mentioned by Cuban (2001) and Becker (2001) and by many others are based upon a teacher's belief concerning how students learn best. In addition, there are two different teaching methods being used by teachers today. The first teaching method is based upon a direct-instruction pedagogy. This teaching method thinks of the student as a passive recipient of knowledge; it creates the role of teacher as the dispenser of all knowledge. This model, when used with computers, turns the computer into an electronic tutor providing programmed instruction primarily for remediation. Reeves (1998) called this method of using computers as "learning from" (p. 4) computers.

The second teaching method being used today is based on the philosophy of Jean Piaget (Jacob, 1984); and it is called constructivism. It is based upon the concept that students construct their own knowledge by building upon prior knowledge. The student is an active participant in creating this knowledge, not a passive recipient. In the constructivist model, the teacher becomes

the guide, the facilitator, helping the students construct their own knowledge. This model of teaching when used with computers turns the computer into a cognitive tool (Reeves, 1998) to be used by the student in the student's quest to construct and to display knowledge. Reeves called this method of using computers as "learning with" (p. 4) computers.

If a teacher's belief structure is a critical component in whether or not that teacher adopts technology integration instructional practices, then the question becomes, "Is it possible to change the belief structure?" The short answer is yes (Dwyer, 1995; Ertmer, 1999; Rogers, 2003); but it takes a great deal of time and a tremendous amount of professional learning opportunities (Dwyer, 1995; Mouza, 2003). The reason that the National Educational Technology Plan (U.S. Department of Education, Office of Educational Technology, 2004) listed that educational technology has failed to live up to its promise is that there is inadequate training for the teachers who had to implement technology into the classroom. This is a rather simplistic approach to this problem because the adoption of technology integration involves educational change (Fullan, 2001) and the diffusion of innovation (Rogers, 2003). Educational change never involves a simplistic solution; and the diffusion of innovation especially in education takes a great deal of time. Michael Fullan, in his authoritative study of educational change, reports that change is never simple, "Putting ideas into practice [is] a far more complex process than people realize" (p. 5). Furthermore, Fullan reports that people do not "resist change as much as they don't know how to cope with it" (p. xii). This inability to cope with change is caused by a feeling of "loss, anxiety, and struggle" (p. 30). Change, or innovation, takes teachers out of their comfort zone creating uncertainty and anxiety (Fullan, 2001; Rogers, 2003). Therefore, to ensure the successful adoption of any educational change, it is essential that teachers who are on the front line of any educational reform must have a shared meaning of that change (Fullan, 2001;

Sergiovanni, 2006) of why this reform will benefit the teaching and learning experience before the teacher will embrace change. Rogers (2003) points out that the diffusion of innovation takes place within a social system; however, as Sherry and Gibson (2002) explain there are problems applying Rogers' diffusion theory to schools because a school system is not a single social system. The educational system "is a centralized organization with embedded systems consisting of teachers within classrooms, within schools, within districts" (Sherry & Gibson, 2002, p. 179).

Fullan (2001) believes that a shared meaning helps alleviate the anxiety of implementing educational change. Without this shared meaning any reform effort is doomed to fail because educational reform must ultimately be translated into a change in practice on the part of teachers (Fullan, 2001). Therefore, getting teachers to understand and to internalize the importance of adopting an educational innovation and then to put that reform into practice in their classroom is the key to implementing a successful innovation. In addition, Fullan argues that:

> First, change will always fail until we find some way of developing infrastructures and processes that engage teachers in developing new understandings. Second, it turns out that we are talking not about surface meaning, but rather a deep meaning about new approaches to teaching and learning." (p. 37)

It is this deep meaning that goes to the heart of educational change that is necessary in implementing technology integrated classroom practices.

The reason that educational change efforts often fail (Cuban, 1993; Cuban, 1998; Fullan, 2001) is because that they do not take into account the culture of the schools. As Cuban (1993) points out the culture of a school is one of the most important factors in the success or in the failure of any educational technology reform agenda, a thesis supported by Fullan (2001). Furthermore, Fullan also describes the need to change the culture of the classroom and to change

the culture of the school. Fullan calls this change in culture as “reculturing” (p. 34), representing the questioning and the changing of one’s beliefs and of one’s habits. When it comes to adopting educational technology along constructivist concepts this reculturing must occur because if it does not then the adoption of this reform will only take place at the first order of change (Cuban, 1993; Ertmer, 1999; Cuban, 2001 Moursund, 2002). Furthermore, Becker (2001), Cuban (2001), and Hernandez-Ramos (2005) all found that the educational technology reform movement was not causing a reculturing in every classroom. One of the reasons for this, according to Fullan (2001), is because for any reform to be successful at the classroom level it must have the support of the layer above – the school leaders – a position supported by Hernandez-Ramos (2005), and Staples, Pugach, and Himes (2005).

If teachers’ philosophical belief structures about teaching and learning are a barrier to successfully implementing technology integration strategies (Dwyer, 1995; Becker, 2001; Cuban, 2001; Windchitl & Sahl, 2002; Hernandez-Ramos, 2005;) then one way to alter those beliefs is through professional learning opportunities; however, altering these beliefs, as Brinkerhoff (2006), Cuban (2001), Dwyer (1995), and Windchitl and Sahl (2002) found out, is a very difficult task. Brinkerhoff (2006) points out, “Transitioning teachers from novice technology users to effective technology integrators capable of supporting student learning generally takes three to five years” (p. 38). Brinkerhoff came to the conclusion that this change is a process, not an event; even though, Brinkerhoff’s “long-duration” (p. 22) professional development study lasted two years, this length of time was insufficient.

The lessons that can be learned from reviewing the history of technology integration in the K-12 educational environment is that technology integration is not easy to implement because it represents a second-order change. There are some steps that can be taken to help

teachers make that change such as increasing the number of computers in their classroom (Becker, 2001); but the most important step that can be taken is to develop a process of professional learning that creates a shared meaning about technology. It is this shared meaning which will allow teachers to overcome their uncertainty and their anxiety caused by this change. Ironically, journalist Thomas Friedman (2005) said it best when describing the economic changes that are sweeping the globe, “People don’t change when you tell them they should. They change when they tell themselves they must” (p. 462). Teachers must be convinced that implementing a technology integration pedagogy will improve student learning because when teachers are convinced they will tell themselves that they must change.

Technology Integration

Apple Classrooms of Tomorrow

In 1985, Apple Computer, Inc., started a research project called Apple Classrooms of Tomorrow (ACOT) in partnership with various universities (Dwyer, 1995). This project eventually lasted 13 years and spawned numerous research studies looking at various aspects of integration of technology in the K-12 environment; however worthy and well designed some, if not all, of these studies may be, there is one underlying component that casts a pall over all of these studies: a perception of a conflict of interest. Apple Computer, Inc., is a computer manufacturer; Apple Computer, Inc., originated this project and the research studies that resulted from it; Apple Computer, Inc., funded this project and all the research studies that emanated from it; Apple Computer, Inc., employees were primary researchers in some of these studies. In spite of this caveat, there are some aspects of this project and there are some conclusions reached in the various studies that emanated from this project that provided valuable insight that has led to further research by independent researchers at different locations. The 10 Year Report that

was published in 1995 (Dwyer), described the first study that was conducted by researchers at Apple Computer, Inc. This study used a qualitative case study approach that looked only at two different classrooms, one in each of two schools; and each school was located in different states – Oregon and Minnesota. The methodologies used were observations, teacher interviews, and teacher field notes. The evidence collected was primarily anecdotal even though an increase in test scores was reported.

The premise of this ACOT project was to determine how teaching and learning would be affected in a technology-enriched environment (Dwyer, 1995). The ACOT project defined technology-enriched as an environment in which every student had access to a computer every day, all day long. In this project every student and every teacher were provided with two computers – one to use at school and one to use at home – and the computers at school were not in a lab but were in the classroom. The ACOT project set as its goal that 99+% of all American classrooms would be technology-enriched within ten years despite the fact that in 1985 there were 92 students for every computer (Ferneding, 2003). The ubiquitous computing phenomena that this ACOT project envisioned gained greater acceptability and gained greater accessibility with the development of laptop computers. The enrichment goal of 99+% of American classrooms was a dramatic pronouncement yet unattainable since in a vast majority of American schools in 2005 there were on average 3.8 students for every computer (U.S. Department of Education, National Center for Educational Statistics, 2005). After three years of intensive exposure to technology, the ACOT researchers identified the emergence of several themes from their test sites; two of these themes were that there were “limitations of traditional assessment measures for capturing the changes [they] saw in the ACOT students”; and that “teachers’ practice was becoming more learner centered” over time (Dwyer, 1995, p. 5).

Measuring Student Learning in a Technology Enriched Environment

Both of these two themes that emerged after three years of research represent dilemmas for those wanting to see more integration of technology in education. It is easy to recognize the dilemma in the first of these two themes – inadequate assessment instruments – because the research indicated that portfolio-type assessments might better capture the learning that occurred (Dwyer, 1995). The educational laws that have been passed since the *A Nation at Risk (National Commission, 1983)* report was published have either created the expectation for local accountability such as in *Goals 2000: Educate America Act of 1994* or they have mandated local accountability such as in *No Child Left Behind Act of 2001*. This local accountability comes in the name of standardized tests which is the anathema to the learning that was being observed in the ACOT project. According to Henry Becker and Barbara Lovett (2003), standardized tests do not measure the learning that occurs in a technology-enriched, student-centered classroom. This is the paradox with which the 21st Century teachers and school leaders are confronted.

Teachers' Belief Structure About Teaching and Learning

The second dilemma that the ACOT project identified is that providing a technology-enriched learning environment does not quickly or automatically provide for student-centered, active learning classrooms (Dwyer, 1995). One of the main barriers to attaining this kind of learning environment that was identified by the ACOT project is the teachers' belief structure concerning teaching and learning. This belief structure can be classified as an instructivist approach to teaching and learning, as a constructivist approach to teaching and learning, or as existing along a continuum between these two polar opposites. This barrier to creating a student-centered learning environment has also been identified by numerous other researchers (Becker, 2001; Cuban, 1993; Cuban, 2001; Hernandez-Ramos, 2005; Windstahl & Sahl, 2002). Even

though this barrier was identified very early in this project, it took Apple Computer, Inc., seven years before they realized that just providing a technology-enriched environment will not change all of the teachers' belief structure, "The professional journey from instructionism to constructionism – and to effective integration of technology – is generally slow and arduous, and requires a high level of support" (Ringstaff & Yocam, 1992, p. 1).

Changing a teacher belief structure as ACOT found out is very difficult (Dwyer, 1995). The ACOT project, seven years after the initial implementation, initiated a very intensive professional development program whose purpose was to create in teachers a constructivist orientation to teaching and learning because, "Typically, teachers begin using technology to replicate old patterns of instruction; it is often years before they progress to the stage in which they truly integrate technology and use these tools to their fullest potential" (Ringstaff & Yocam, 1992, p. 1). This replication of old patterns of instruction was later described by Cuban, Kirkpatrick, and Peck (2001), by Ertmer (1999), by Hernandez-Ramos (2005), and by Windchitl and Sahl (2002). Unfortunately, the concept, that has permeated the instructional technology field since Seymour Papert (1980) wrote *Mindstorms: Children, Computers, and Powerful Ideas*, that the introduction of computers will revolutionize the teaching and learning paradigm, never coincided with the research on change. According to Fullan (1993) there are two orders of change; the first order of change involves an external change such as what happened with the introduction of computers in classrooms (Becker, 2001; Cuban, 2001; Hernandez-Ramos, 2005) when the only change that occurred was that the medium changed but not the practice – use computers to take attendance; and whereas the second order of change involves an internal change in the sense that the actual practice changes – use computers to allow students to construct their own knowledge.

Apple's Professional Development Program

Seven years after the beginning of the ACOT project, Apple Computer, Inc., initiated their ACOT Teacher Development Centers as an attempt to move teachers "towards more constructivists modes of teaching … because the staff development typically offered to teachers is inadequate" (Ringstaff & Yocam, 1992, p. 1). This new approach to professional development focused on an intense process of immersion where participants observed and worked with "accomplished ACOT teachers and students during actual school days" (Ringstaff & Yocam, 1992, p. 2) for a one-week practicum and then followed this up with a four-week summer workshop. Again the model of professional development that was created by the ACOT program demonstrated that this program had the financial backing of a major corporation and would prove impractical in a normal school environment. Unlike the 10 Year Report, the report that was written to explain the study that was conducted to judge the efficacy of this professional development program describes the methodologies and the results in detail and used triangulation to verify the results; however, this study was conducted by employees of Apple Computer, Inc., which casts a doubt over the objectivity of the results. Even though the overall ACOT project provides some worthwhile insight into the early beliefs about technology integration, the conflict of interest issue limits the usefulness of the results that were obtained from the various studies that were conducted.

Teachers' Belief Structure about Teaching and Learning

The issue of a teacher's belief structure being a barrier to the integration of technology which was first pointed out in the ACOT program has been well documented by various researchers since then (Becker, 2001; Cuban, 1993; Cuban, Kirkpatrick, & Peck, 2001; Ertmer, 1999; Garthwait & Weller, 2005; Hernandez-Ramos, 2005; Windchitl & Sahl, 2002). For

example, Larry Cuban in 1993 used data to show that technology was not being used in schools by teachers in a constructivist manner even though the density of computers in schools was increasing. He theorizes that the two reasons for this phenomenon are: first, cultural beliefs "about what teaching is, how learning occurs, [and] what knowledge is proper in schools" (p. 186); and second, the organizational structure of schools. It is these cultural beliefs that represent the belief structure first identified by the ACOT program. This article uses the historical approach that Cuban uses so often in defining a problem; however, this article does not use any other quantitative or qualitative methodologies in an attempt to further clarify this problem or to identify solutions to this problem. This article does, however, make a significant contribution to the literature by listing and by discussing the three "impulses" (p. 189-191) that led the policy makers to embrace technology as an educational reform agent in the 1980s and in the early 1990s. The first impulse was to prepare students for the future workforce in the Knowledge Age; the second impulse was to adopt a constructivist philosophy in education; and the third impulse was to make teaching and learning more efficient. These impulses provided a driving force in the educational law issues that were discussed earlier. The cultural beliefs about which Cuban (1993) theorizes, however, goes to the heart of why it is so difficult for teachers to adopt technology integration strategies. Even though new educational laws can proclaim the need of preparing students for the 21st Century workplace, teachers are constrained by their own beliefs in what is the best way to teach (Becker, 2001; Cuban, Kirkpatrick, & Peck, 2001). Cuban also theorizes that changing these cultural beliefs can occur but that it will take a tremendous amount of time. Moursund (2002) believes that the first change to take place is the first-order of change, a change which reinforces current practices but that does not fundamentally alter it; even though Ertmer's

(1999) work on the subject leads her to believe that the first-order of change does not necessarily have to come before the second-order of change.

The other reason that Cuban (1993) theorizes as to what causes a teacher's belief structure to be so difficult to change is the organizational nature of schools: self-contained classrooms, structured timing of the day, age-graded or subject-oriented classrooms. According to Cuban this formalized structure of school is a hindrance to teachers changing their belief structure because it reinforces the status quo and it limits teachers' abilities to adapt to a different pedagogy. This finding is backed up by the research conducted by Becker (2001).

In a 2001 study conducted at two high schools in Silicon Valley, California, Cuban, Kirkpatrick, and Peck documented the results of what Cuban (1993) had predicted eight years earlier. This time, however, Cuban was involved in a study that used a mixed methods approach using sound qualitative and quantitative research methodologies which reinforced Cuban's previous findings: changing teachers' belief structure is a very difficult process and takes a great deal of time if it is to occur at all, "We found that access to equipment and software seldom led to widespread teacher and student use" (p. 813). Even though the methodology used in this study followed acceptable research standards, the sample size was very small – only two high schools in one school district in California – which limits the usability of this study. In addition to reinforcing what by then was an accepted understanding, this study led to new information concerning why technology was not being adopted in innovative ways. First, this study discovered that teachers were not techno-phobes; they were quite the opposite, a great majority of the teachers used computers extensively at home for personal productivity and for professional needs – researching topics and developing lesson plans; but at school this study confirmed that technology "was used in limited, even simple ways, often sustaining rather than

transforming prevailing instructional practices" (p. 817). There were some teachers, four out of the 13 who were shadowed, who transformed their teaching as evidenced when they said that they "had modified their classroom in major ways . . . . They became more student-centered in their teaching; they had made fundamental changes in their pedagogy" (p. 824). Cuban, Kirkpatrick, and Peck dismissed these four teachers who only represented 31% of those shadowed as unrepresentative of the majority instead of looking at those four as the vanguard of the revolution, as the beginning of the diffusion. It would have been interesting and more illuminating if a follow-up study was done of those 13 teachers who were shadowed to find if the diffusion of constructivist practices was in fact taking place. Unfortunately, such a longitudinal approach was not done.

Other Factors Effecting the Integration of Technology

This study by Cuban, Kirkpatrick, and Peck (2001) also discovered that teachers' age, experience, and gender were not factors in explaining why technology was not being used in constructivist ways. What this study confirmed is that time to learn how to use the technology, the lack of training in the use of this technology, and the unreliability of this technology were significant inhibitors to the adoption of technology integration strategies. In spite of these inhibitors, Cuban, Kirkpatrick, and Peck theorize that there may be two other explanations for this lack of progress in the adoption of technology integration strategies: the technology revolution is a slow process, "Small changes accumulating over time create a slow-motion transformation" (p. 826); and the context of high schools that emphasizes structure and time rigidity. After considering both explanations, the researchers reject the first explanation as implausible, but accepted the second explanation as valid which falls in line with Cuban's preconceived ideas which he had asserted earlier (Cuban, 1993). Associated with the lack of time

and the lack of training, there is one factor that this study mentioned that has not been mentioned anywhere else in the literature but probably plays a significant role in the lack of progress on this issue and is in need for further research, “Teacher turnover undermines the implementing and institutionalizing of technological innovations and contributes to maintaining common teaching practices” (Cuban, Kirkpatrick & Peck, 2001, p. 829).

Teacher retention, or turnover, is a problem that is discussed in the educational administration and policy literature (Darling-Hammond, 2003) and is recognized as a major problem for school districts in achieving a quality teacher workforce with the 33% of the first year teachers leaving within their first five years. Since, as Ertmer (1999) points out, it takes five years for a teachers to evolve from a direct instruction teacher to a constructivist teacher; and since there is such a high teacher turnover rate, it can be reasonably assumed that one of the reasons that most schools have not achieved the necessary number of technology integration early adopters to reach that critical mass stage highlighted by Rogers (2003) is the teacher retention issue. More research needs to be done of this issue.

Interestingly, Henry Becker’s (2001) large scale, nation-wide quantitative study of teachers’ use of computers in their classrooms was presented at the American Educational Research Association conference in the same year that the Cuban, Kirkpatrick, and Peck’s (2001) study was published. Becker used a sample of teachers from over 1,600 schools throughout the country from a variety of circumstances. This study looked at how teachers, primarily high school teachers, were actually using technology in their classrooms “in order to highlight some of the important differences in computer use patterns, and thereby to at least slightly contextualize general discussions about teachers’ computers use” (p. 2). Becker found

there were four predictors that determine which teachers used a constructivist approach to teaching and learning:

> The strongest predictor of frequent use of [constructivist practices] … was [the teachers'] technical expertise and use of computers for professional purposes. The second strongest predictor was the extent of professional engagement by the teachers – involvement in informal leadership roles at school and in more formal roles beyond the school. The third strongest predictor was the number of computers in the teacher's own classroom. The teacher's philosophy was the fourth strongest predictor. (p. 25)

These findings by Becker confirms the findings of Dwyer (1995), Cuban, Kirkpatrick, and Peck (2001), and others that teachers' philosophy about the teaching and learning process plays a role in each teacher's adoption of constructivist practices and a key role in teachers' usage of computers; however, according Becker's research there are other factors as well that need further delineation and further clarification because if teacher's technical expertise and the use of computers for professional practices were more important than the teachers' philosophy about teaching and learning then that finding has tremendous implications for the direction of professional development in technology integration area.

One factor that Becker's 2001 study did not take into account when it looked at computer density is the inequality of computers – not all computers are new and have equal capabilities. In a 1998 article in *Theory into Practice*, Henry Becker looked at a four-year old dataset to discover if there are differences in computers' capability and, if so, how those differences affect the instructional usage of those computers. Not surprisingly, Becker discovered that in 1994 there was an inequality of computers in schools, "Roughly one-half of the installed base of school computers lack a modern operating system" ("Information Technologies"). Furthermore, "a large

fraction of the computers used by students [in 1994], for example, do not support CD-ROM-size databases, access to the Internet, or even complex analytic and creative software" ("The Age Mix of Technology"). Therefore, even though computer density in schools continues to increase, a distinction must be made to distinguish each computer's ability to meet the current needs considering that, as Toffler (1970) prophesied, "Change will continue to accelerate at an ever accelerating pace." This ever increasing rate of change will continue to put financial burdens on school districts as these districts try to maintain a capable computer base as well as try to increase that computer base in order to increase computer density.

Laptop Initiatives

If a minimum of five computers per classroom is a prerequisite for the adoption of a constructivist philosophy in the integration of technology by teachers, as was pointed out by Henry Becker (2001), then the adoption of a laptop program which is based on the one-to-one computing concept which, in a sense, was piloted by ACOT, must be successful. The Windchitl and Sahl study in 2002 used a case study approach to determine which criteria were essential factors in the successful implementation of this one-to-one computing initiative. Since the researchers focused only on two teachers during this case study, the results may be helpful; but being able to generalize from it is limited. Windchitl and Sahl found that one of the teachers that they followed adopted constructivist pedagogy while the other teacher did not. After analyzing all other factors, the researchers came to the conclusion that the teachers' initial belief structure was the critical factor in determining whether a teacher adopted a student-centered classroom and a technology-integrated classroom. These results seem to corroborate the results from the ACOT (Dwyer, 1995) program, from the Cuban, Kirkpatrick, and Peck (2001) study, and from the Becker (2001) study, which were all discussed earlier.

Garthwait and Weller (2005) also did a small, qualitative case study of two teachers attempting to implement a one-to-one computing initiative and came up with three findings. The first finding matches the results of Becker (2001), Cuban, Kirkpatrick, and Peck (2001), Hernandez-Ramos (2005), Penuel (2006), and Windchitl and Sahl (2002): a teacher's philosophical orientation towards a child-centered classroom or a teacher-centered classroom determines how technology will be used. Garthwait and Weller (2005) followed two teachers for the entire first year that they were involved in the state of Maine's one-to-one laptop computing initiative. The teacher whose belief structure about teaching and learning was centered around student-centered classrooms and about allowing students to construct their own knowledge building on previous knowledge used technology as a cognitive tool rather than as a dispenser of programmed information; whereas the teacher whose belief structure about teaching and learning was based around direct instruction wherein the teacher is the expert and directs all learning activities used technology only to augment this teacher's already established teaching practices.

The second finding that Garthwait and Weller (2005) discovered was that the teacher's formal preparedness for implementing instructional technology strategies determined how that technology would be used. The constructivist teacher had a Masters Degree in Instructional Technology while the instructivist teacher had only a Bachelors Degree, although this instructivist teacher did take some graduate level classes in preparation for participating in this initiative. Even though the constructivist teacher had early on demonstrated a commitment to lifelong learning which seems to confirm the findings of Becker (1994), it seems reasonable to assume that the choice of focus for that advanced degree – Instructional Technology – had more to do with how this teacher implemented this initiative than with the fact that he had an advanced degree. The issue that needed further exploration by the researchers is whether or not this

constructivist teacher adopted constructivist strategies because this teacher had an advanced degree; or had this teacher already adopted the philosophical orientation of constructivism which caused this teacher to seek more knowledge about this philosophy by seeking an advanced degree. This issue should have been explored in more detail because it goes to the validity of this Garthwait and Weller's finding.

The third finding that Garthwait and Weller (2005) discovered was that a teacher who wants to use technology in a constructivist manner must be flexible and must be adaptable to a changing environment. The constructivist teacher who Garthwait and Weller studied exhibited those traits whereby the instructivist teacher did not. The instructivist teacher frequently became frustrated with various technical issues and with policy issues which this instructivist teacher thought were being counter-productive. This issue could be viewed as having to do more with personality traits, as were described by Rogers (2001), that the technology initiative just magnified rather than as a result of using the technology in teaching and learning; however, integrating technology whether it be at the first-order of change or whether it be at the second-order of change is still change (Moursund, 2002); and change causes stress (Friedman, 2005; Fullan, 2001; Toffler, 1970); and some people cope with stress better than other people cope with stress (Friedman, 2005; Toffler, 1970). In this study Garthwait and Weller (2005) used one male teacher, who was not married, and one female teacher, who was married with children. Although the male teacher was the one who used constructivist practices, which would seem to confirm Becker's (1994) study, using such a small case study with other confounding variables, such as marital status which may place greater demands on the married participant, would negate this confirmation.

In 2006, Penuel did a meta-analysis of all the studies of one-to-one computing to reach a synthesis of understanding about the effectiveness of this concept. The reason for this movement towards a one-to-one computing environment is that one of the primary causes for the failure of technology to improve the education of the nation's students is that of accessibility (Becker, 1994; Becker, 2001; Dwyer, 1995). If this lack of access to technology is indeed a barrier to effective integration of technology then the research on the one-to-one computing environment would bear that out; however, Penuel's (2006) meta-analysis shows that one-to-one computing has its own barriers:

> All too often, new technological innovations have proven unusable to a wide variety of teachers, whether because schools lack the capacity to implement them well, policies are not congruent with technology use, or the culture of the school is not supportive of technology adoption. (p. 333)

Penuel (2006) does list three factors that assisted in making a successful one-to-one computing initiative: first, extensive formal professional development opportunities were a major factor in the success of any one-to-one computing initiative; second, readily available technical support within the building "also appears to be important for laptop programs to succeed" (p. 339); and, third, the reliability of the wireless network is crucial for the success of any one-to-one computing initiative. Even with a successful implementation of a one-to-one computing initiative, Penuel points out that there is still no definite proof that ubiquitous computing improves student learning. With that lack of research-based proof, one of the reasons driving one-to-one computing initiatives appears to be what Karen Ferneding (2003) calls "technological determinism" (p. 208). It is this sense of inevitability that technological reformers latch onto to

push for major computing initiatives including a one-to-one computing initiative in the absence of research evidence.

Individual Characteristics of Teachers

Tubin and Edit (2004) did a qualitative study that looked at how the planning process and at how the individual teacher's planning patterns affect the teachers' adoption of and implementation of technology integration in their classroom practices. Using all the teachers in one elementary school, Turbin and Edit discovered that three patterns of the planning process emerged when teachers began planning for the integration of technology: the "flow" pattern, the "flexible" pattern, and the "fulfiller" pattern. The teachers who used the flow pattern of planning for technology integration were most concerned with the process not the planning for the process; they wanted to be spontaneous and to be free to follow wherever the students wanted to go. This pattern would appear to fit the constructivist mode of teaching and learning by allowing the students to determine the direction of the learning.

The second pattern that emerged was the flexible pattern (Tubin & Edit; 2004). The teachers who used this pattern of planning for technology were most concerned with the output; they did extensive planning – input – but were willing to make adaptations as the circumstances dictated. This type of planner was concerned with the end result – output – and was willing and able to adjust to the unexpected circumstances as they presented themselves. The teachers who used a flexible pattern of planning were more likely to achieve the planned outcome because these teachers were willing to adapt as the process progressed.

The third pattern that emerged was the fulfiller pattern (Tubin & Edit; 2004). This type of teacher created detailed plans and did not or would not deviate from these plans. These teachers were most concerned with input. The major advantage with this pattern of planning is that it is

easier to implement because there is no variation or change to the plan as the process progresses; however, developing a plan at this level of detail is very time consuming; and implementation rarely meets expectation because of unforeseen circumstances.

The conclusion that Turbin and Edit (2004) reached is that the flexible planners are the most successful in the implementation of technology integration because these teachers focus on the outcome as opposed to focusing on the input or on the process. This conclusion is confirmed by the characteristics of early adopters as described by Rogers (2003). Also, these teachers experienced less frustration with the implementation process because of their willingness to adapt the process in order to keep it moving towards the expected outcome. These results are in line with the results from Garthwait and Weller (2005) who also found that the teacher who was the most flexible was the teacher who was the most successful in implementing technology integration, and in line with Staples, Pugach, and Himes (2005) who found that for technology integration to be successful it must be aligned with the curriculum, or the outcome.

What Type of Learning is Being Tested

Becker and Lovitts (2003) point out that what is being tested on the standardized tests does not reflect the kind of learning that is taking place when technology is properly integrated into the curriculum, the kind of learning that promotes higher-order thinking skills, that promotes creativity, that promotes collaborative team building. It is these skills, although they are not tested on the standardize tests, which, according to the Partnership for 21st Century Skills (n.d.), are in high demand in the 21st Century workplace environment. This position by Becker and Lovett (2003) is supported by learning theorists like Howard Gardner (2005) and by best-selling journalist Thomas Friedman (2005), who has studied the economic transformation that is sweeping the globe. This kind of learning has actually been promoted by every educational law

and policy since 1994 as evidenced by the *Goals 2000: Educate America Act* which desires the opportunity for all Americans "to acquire the knowledge and skills, from basic to highly technical, needed to adapt to emerging new technologies, work methods, and markets through public and private educational, vocational, technical, workplace, or other programs" (Section 102, 1994). Although *No Child Left Behind Act of 2001* wants students to have those same 21st Century skills, this latest education law applies financial sanctions if standardized tests' benchmarks are not achieved which effectively shut out any other means of measurement. It is the *No Child Left Behind Act of 2001* then that is moving educational technology away from the constructivist orientation and back towards the instructivist orientation of drill and practice of the basic skills.

Exemplary Technology Using Teachers

If teachers' philosophy of teaching and learning is a fundamental factor in the adoption of technology integration, as has been pointed out by Becker (2001), Cuban, Kirkpatrick, and Peck (2001), Dwyer (1995), Garthwait and Weller (2005), Hernandez-Ramos (2005), and Windchitl and Sahl (2002), then what other personal characteristics of teachers or of environmental characteristics in a school might encourage the development of exemplary technology integration teachers. Henry Becker (1994), using data that was six years old at the time, reanalyzed this data to determine how exemplary computer using teachers differed from other teachers. As in almost all of Becker's studies, he used large-scale, nation-wide quantitative methodologies by surveying teachers, principals, and technology coordinators in 1,400 schools. Although quantitative methodologies provide excellent statistical results such as correlations, significance, and effect size, quantitative methodologies cannot discern causation. In this particular study, Becker (1994) discovered "four factors in the teaching environment [that] made exemplary, computer users

more likely to be present" ("Abstract"). These four factors are: 1) collegiality among users, 2) school support for using computers for consequential activities, 3) resources allocated to staff development and computer coordination, and 4) smaller class sizes. In addition to identifying four environmental factors that correlated to the presence of exemplary, computer-using teachers, this study also identified several factors in the teachers' background that also correlated to these teachers being labeled as exemplary computer users. Surprisingly, one of these background factors was that exemplary technology-using teachers were more likely to have had a liberal arts major than to have had an education major. This finding is confirmed by Li (2007) in a recent study done in Canada. This finding may be one of the reasons why the diffusion of technology innovation in public schools has been so slow to develop because currently there are more education majors in education than there are liberal arts majors. Two other background factors that seemed significant are that exemplary, technology-using teachers are more likely to have advanced degrees, a finding that is backed up by Garthwait and Weller (2005). These exemplary technology-using teachers believe in life-long learning; and they are more likely to spend more time working on a computer each week than are other teachers – this is also supported by Garthwait and Weller's (2005) research.

Another surprising finding in Becker's (1994) study was that exemplary technology using teachers were not "overrepresented in high socioeconomic communities, nor did they disproportionately teach classes of high-ability students" ("Abstract"). Finally, Becker's research indicated that there is a gender difference in those teachers who are considered exemplary technology-using teachers. Becker found that there are statistically more males in this category than there are females; a finding that is disputed by Cuban, Kirkpatrick, and Peck's (2001) research done several years later. Realizing that Cuban, Kirkpatrick, and Peck's research took a

case study approach in only two high schools and basically used a qualitative methodology whereby Becker's research used a quantitative approach surveying over 1,400 schools nation-wide, then it would appear that Becker's study which is also confirmed by Garthwait and Weller (2005) may have greater validity.

Becker's (1994) criteria, for defining what is an exemplary computer-using teacher, were purely arbitrary because there is an "absence of any independent data on the teaching success of teachers with different [technology] scores" ("Method"). Even considering the arbitrariness of Becker's definition, it was not surprising that in 1988 there were only 3% of the teachers who could be considered exemplary technology-using teachers. Using these same criteria it would be interesting to know how the nation's schools now measure up twenty-one years later. Becker's 2001 study would indicate that the figure is much higher; but it still has not reached the tipping point of 10% to 20% (Rogers, 2003) of all teachers in the typical school that would create the diffusion of technology innovation to flourish assuming that Rogers' research on diffusion of innovation applies to the education environment.

The single most important environmental factor that correlates with the presence of exemplary technology using teachers is the existence of a social network of other computer using teachers (Becker, 1994):

> If [teachers] are to successfully incorporate a new and complex resource like computer software into their teaching practice, they must have access to other people from whom they can learn, either experts who have already mastered the resource or a community of teacher-learners who pool their efforts and share their exploratory findings. ("Social Networks")

Becker (1994) makes it clear that this social network creates, but is also created by, exemplary computer-using teachers. Another finding that Becker's study pointed out is that exemplary computer-using teachers were more likely to be present in schools in which the computer was used in activities that were consequential – computers were used in a student-centered, constructivist oriented classroom. It would appear from these correlations that success with technology breeds further success with technology. These findings can have tremendous significance for school leaders who want to shape a school culture that encourages the use of computers in innovative ways; thus, personnel decisions by the school leader can significantly impact how technology is used in a school.

Another finding in this study (Becker, 1994) indicates that exemplary computer-using teachers worked in school districts "that had invested heavily in staff development and on-site staff support for computer-using teachers" ("Computer Use"). This on-site support element is crucial because it shows up again in a later Becker (2001) study as the most important correlation with technology-using teachers. This on-site support can take the form of technical support on keeping the computers running; or it can take the form of instructional support on how to use particular software; or it can be both. This study did not make this distinction.

Barriers to the Integration of Technology

In 1999 Peggy Ertmer developed a framework for analyzing the barriers to the integration of technology that impede the evolution from instructivist practices to constructivist practices by teachers and then discussed the strategies that might be employed to overcome those barriers. Ertmer points out that the original belief of the ACOT program, that high access to computers would automatically cause teachers to adopt technology integration, was wrong because it did not take into account the complexity of schools and teaching, the complexity of technology

integration, and the nature of change, “Computer technology is not readily assimilated into teachers’ existing routines, typically requiring change along multiple dimensions of practice (e.g., personal, organizational, and pedagogical). In general, the more integrated one’s technology use becomes, the more fundamental the required change” (p. 47). Although these barriers to technology integration span multiple dimensions such as personal, organizational, and pedagogical dimensions, Ertmer points that that just one of these barriers alone can seriously impede the adoption of technology integration. In order to understand the change process as it related to technology integration, Ertmer describes first-order change as that change which “‘adjust[s]’ current practice, in an incremental fashion, making it more effective or efficient, while leaving underlying beliefs unchallenged” (p. 48). On the other hand, “second-order changes confront fundamental beliefs about current practice, this leading to new goals, structures, or roles” (p. 48). It is Ertmer’s contention that the barriers to technology integration are in essence barriers to the change process, and thusly can be categorized as the change process is categorized: first- and second-order barriers to change.

These barriers to the change process are, therefore, “the extrinsic and intrinsic factors that affect a teacher’s innovation implementation efforts” (Bricker as quoted in Ertmer, 1999, p. 48). The first-order barrier to change is those barriers which are extrinsic to teachers such as lack of access to computers, lack of time, inadequate training, and inadequate technical and/or administrative support; these extrinsic barriers are the easiest to remedy because they can be remedied, in many cases, just by the infusion of additional financial resources. The second-order barrier to change are the barriers which are intrinsic to teachers, such as: teachers’ philosophical beliefs about the teaching and learning process, teachers’ organizational and management styles, and teachers’ assessment procedures; these intrinsic barriers are the most difficult to change

because “they may not be immediately apparent to others or even to the teachers themselves” (p. 51); but these intrinsic barriers are not impossible to change because teachers retain a degree of autonomy inside their classroom that allows them to adopt, to adapt, or to reject any reform that involves instructional practices.

According to Ertmer (1999), the most important key to overcoming these barriers to technology integration is the “development of a vision of how to use technology to achieve important educational goals” (p. 54). According to the Office of Educational Research and Improvement, “Most teachers will find little incentive to tackle the technical and scheduling problems associated with technology (first-order barriers) unless they have a clear vision of how the technology can improve teaching and learning” (as quoted in Ertmer, 1999, p. 54). It is the vision that technology will improve the teaching and learning experience that will give teachers the wherewithal to overcome these first- and second-order barriers; and not only do individual teachers need to have this vision but this vision needs to be a shared belief among the various stakeholders within a school. This shared vision concept is a fundamental ingredient in the literature on educational change (Fullan, 2001; Sergiovanni, 2006).

Role of Leadership in the Integration of Technology

After three decades of trying to integrate technology into the K-12 environment most researchers admit that this innovation has not worked for a variety of reasons as was discussed earlier (Becker, 2001; Cuban, Kirkpatrick, & Peck, 2001; Ertmer, 1999; Hernandez-Ramos, 2005). Cuban (1993; 2001) has pointed out the organizational structure of schools and teachers’ philosophical beliefs are inconsistent with technology integration; Becker (2001) has identified lack of appropriate access, lack of support, and teachers’ philosophical beliefs as barriers; Ertmer (1999) has developed the concept that a lack of a clear vision on how technology can improve

the teaching and the learning process is the primary cause for this lack of adoption of technology integration. If the computer density in the nation's schools has increased from 92 students per computer in 1984 (Ferneding, 2003) to 3.8 students per computer in 2005 (U.S. Department of Education, National Center for Educational Statistics, 2005), if the Internet is ubiquitous in the nation's schools (U.S. Department of Education, National Center for Educational Statistics, 2006a; U.S. Department of Education, National Center for Educational Statistics, 2006b), if $5 billion to $7 billion is spent annually on technology for schools by federal, state, and local governments (Spending, 1998; Robelen, 1998; Carroll, 2000), and if most researchers (Ertmer, 1999; Cuban, Kirkpatrick, & Peck, 2001; Becker, 2001; Hernandez-Ramos, 2005) and most governmental reports (President's Panel on Educational Technology, 1997) indicate that a student-centered, constructivist pedagogy will be the most effective method in providing the learning environment which is most conducive to learning in the Knowledge Age, then what can be done to ensure that the integration of technology will be adopted by the teachers in the U.S.

Many in the educational technology field bristled at Cuban's thesis in 2001 in *Oversold and Underused: Computers in the Classroom*. These proponents of integrating technology along a constructionist epistemology stance felt betrayed by Cuban's attack (Sheekey, 2003). As a rebuttal to Cuban's thesis these proponents published their own book touting some examples of successes of integrating technology into teachers' classroom practices. To further this debate, the editor of *How to Ensure Ed/Tech is not Oversold and Underused* (Sheekey, 2003) asked Larry Cuban to write the "Forward" to his book. In this forward Cuban (2003) did not back down from his earlier assertions but did further define an area of study that is in need of research concerning the lack of change in teachers' classroom practices, "Organizational and political structures within and without the school continue to be ignored as substantial factors that help shape daily

teaching" (p. ix). In other words, the leadership in each school determines to a large degree how much technology integration takes place within that school. It is this area of focus to which this research attention now turns. Obstacles can be overcome; teachers' educational epistemologies can be changed; but unless the attitude of the school's leadership toward technology's purpose can evolve toward a constructivist epistemology then the constructivist view of technology integration will forever be the dog chasing its tail. In the latest iteration of the National Technology Plan (2004) the first recommendation is to "strengthen leadership" (U.S. Department of Education, Office of Educational Technology, 2004). This plan further articulates the role of leadership in shaping how technology is used in education, "For public education to benefit from the rapidly evolving development of information and communication technology, leaders at every level – school, district and state – must not only supervise, but provide informed, creative and ultimately transformative leadership for systemic change" (p. 39). Unfortunately this area of study is lacking in academic circles. So far research has been able to find only one book (Creighton, 2003) and only one journal article (Staples, Pugach, & Himes, 2005) that deal specifically with the role that leadership plays in the adoption of technology integration.

Cuban appears to imply that school leadership is one of the reasons that the integration of technology is just a dream instead of a reality. Currently, there is very little research literature on this phenomenon. There were two research projects (Hofer, 2005), one in 1994 and one in 2003, that attempted to delineate the reasons why certain institutions excelled at integrating technology. Even though these two studies were conducted at higher education institutions the implications from these studies can have direct implications for K-12 education. Hofer's (2005) meta-analysis of these two studies indicated that in the 1994 study there were eight factors that each institution which was studied had in common. In the 2003 study there were four common

factors. The two factors that all institutions had in common in both studies, however, were a culture of technology and were a culture of innovative leadership. In fact, in the 1994 study the number one factor that determined the success of technology integration was leadership. In the 2003 study, the one variable that was, "most often cited and most often emphasized was leadership" (p. 8). Therefore, if school leadership is a primary factor in determining if teachers integrate technology into their classroom strategies (Dikkers, Hughes, & McLeod, 2005) and if technology integration is a desirable goal, then what, if anything, can a district administrator do to increase the usage of technology integration at the building level?

In order to increase the usage of technology integration at the building level a district administrator can develop a district vision for learning that includes the integration of technology; and a district administrator can create strategies aimed at persuading the leadership of individual schools to adopt this vision. District administrators must convince the school leaders that, to improve student achievement in the 21st Century, schools must be willing to appeal to the 21st Century student. Appealing to the 21st Century student is not an easy task especially for a 20th Century adult, especially one who is a "digital immigrant" (Prensky, 2006, page 8). According to Leonard Shlain (2005) learners of the 21st Century are becoming more balanced in their thought processes. In the past millennia the human brain had become primarily one-sided with the emphasis on the left side of the brain to process the data needed for language acquisition and for mathematical computations. However, in the last decade the young people of the world, due principally to the explosion of digital media (Schlain, 2005), have become more balanced in their brain functioning with a growing emphasis on visualization, kinesiology, holistic approaches, and media-enriched digital content.

Professional Development

After seven years of providing a ubiquitous computer environment and only seeing small incremental changes in teachers' behavior, Apple Classrooms of Tomorrow program initiated an intensive professional development program (Ringstaff & Yocum, 1992). This new program showed significant results; however, the model used, even though it was instructive, was also impractical in a normal K-12 environment because of its financial costs and because of its human resources cost. On the other hand, Mouza (2003) and Koehler and Mishra (2005) describe professional development models that are replicable. Mouza's qualitative case study looks at the various contextual factors that either were inhibitors or were enablers to teachers' technology integration; these contextual factors were administrative support, student needs, collegiality, and access to technological resources. Mouza studied how professional development can improve teachers' adoption of technology integration strategies; but professional development will have only "short-term and isolated benefits" (p. 274) unless administrative support is present. Mouza's research shows that, "Improvements and innovations are more likely to occur when both teachers and principals work collaboratively in adapting new educational innovations" (p. 274).

Unlike Mouza's study with inservice teachers, Koehler and Mishra's (2005) study involved preservice teachers; however, their work has implications for inservice teachers' professional development programs in schools. Koehler and Mishra cite research that teacher training programs which are designed to prepare teachers to use technology are ineffective; they found that "formal stand-alone IT coursework does not correlate well with technology skills and the ability to integrate technology into teaching" (p. 94). Koehler and Mishra further argue that traditional courses teach teachers how to use technology tools; what is needed, however, is an approach that helps teachers "develop deeper understandings of the nuances and complexities of

technology integration" (p. 95). This approach required the development of a complex, situated form of knowledge as opposed to the traditional skills-based approach that relies on teaching skills and then just hoping those skills translate into pedagogical practices.

The traditional skills-based approach in technology professional development programs as described by Koehler and Mishra (2005) does not work because it takes a very simplistic view of technology integration and not an holistic view of technology. Dexter, Anderson, and Becker (1999) took this holistic approach in studying teachers' perceptions of computers as a catalyst for change. This study indicated that for "teachers to implement the use of educational technology in a constructivist manner, they must have opportunities to construct pedagogical knowledge in a supportive climate" (p. 221). This supportive climate refers to a collegial atmosphere (Becker, 1994; Becker, 2001; Ertmer, 1999; Mousa, 2003) and to official administrative support and encouragement (Becker, 2001; Ertmer, 1999; Hernandez-Ramos, 2005; Mouza, 2003; Windchitl & Sahl, 2002).

In a study that looked at a professional development program that was extended over two years, Jonathan Brinkerhoff (2006) tried to eliminate the administrative support barrier by choosing only participants who provided "a signed administrative endorsement from both their principal and their superintendent. This design methodology intended to ensure that the district administration was both aware of and supportive of the teacher's participation in the academy" (p. 25). The results from this study yielded only mixed results. Some of the goals were reached; but the main goal of changing the teachers' instructional practices to include constructivist strategies did not occur. Brinkerhoff justified his failure to achieve his primary goal by citing research that states it take three to five years to change a teachers' philosophical orientation to teaching and learning.

Lack of Administrative Support

Another obvious response as to why teachers are not using constructivist strategies is the lack of support or is the lack of encouragement they are receiving from the principal as these teachers attempt to alter their pedagogical practices. Pedro Hernandez-Ramos (2005) stated that:

> It may be argued that the struggles to make sense of the presence of computers and related technologies (such as the Internet) in the classroom have less to do with the technologies than to do with school practices, educational cultures, and power struggles among stakeholders in the process. (p. 40)

As a result of these forces lined up against the teacher's adoption of technology integration practices, the innovative teacher feels overwhelmed and questions their ability to overcome the forces (Ertmer, 1999). As Michael Fullan (2001) and Thomas Sergiovanni (2006) both point out, however, for any educational reform to be successful it is because the teachers and the principal have a shared vision that this reform will be beneficial for the students. Peggy Ertmer's (1999) research on barriers to the change process makes this point as well when it comes to the integration of technology into teachers' classroom practices. Teachers and the principal must have a shared vision. Without administrative support, teachers' adoption of technology integration will be difficult if not impossible. This concept is backed up by research studies of Mouza (2002) and of Staples, Pugach, and Himes (2005).

Role of the School Leader

Therefore, for teachers to accept the challenge of attempting to integrate technology, those teachers must be encouraged by the principal to be risk-takers. Unfortunately, the literature on principals' and/or on school district leaders' role in the technology integration issue is sketchy at best. Very few studies have focused on the role the school leader plays in this technology

integration debate. With a few exceptions, literature that does mention the role of school leaders does so only tangentially (Ertmer, 1999; Mousa, 2005; Hernandez-Ramos, 2005). One study that did focus on a school leader's role in the integration of technology was done by Staples, Pugach, and Himes (2005). This study was part of the federal Preparing Tomorrow's Teachers for Technology grant program; it conducted a three-year case study of three urban schools in an attempt to discern which technology integration methods were most successful and why. These researchers discovered that there were three conditions that were needed to be in place before a technology integration strategy could be successful. Two of these three conditions aligned with other studies such as with Ertmer (1999) and Becker (2001) – an ample professional development program and an adequate technology infrastructure – however, the third condition has not been mentioned specifically by other educational technology researchers even though it has been alluded to by Fullan (2001), Sergiovanni (2006), and Turbin and Edit (2004) – the idea that the technology must support the curriculum. Furthermore, Staples, Pugach, and Himes (2005) discovered that for technology integration to be successful it must be part of an overall school reform effort, a view that is supported by Fullan (2001). Technology of and by itself will fail. This is where the role of the principal comes into play.

In the Staples, Pugach, and Himes (2005) study, all three principals had a positive view of technology and expressed a commitment to the integration of technology in the teachers' classroom practices. This study, however, showed that the principals' positive view of and commitment to technology was not enough; this study did show that the actions of the principal played an essential role in the successful integration of technology and in the sustainability of that integration once the grant funding ended. The one school in this study which successfully implemented technology into the culture of the school had a principal who set policy but who

also worked at building capacity within the school in order to encourage risk taking and in order to build teacher leaders. It is within this school culture that technology flourished and that technology became an instructional tool that supported the curriculum, that supported student learning, and that supported the creation of a community of learners. This principal had a shared vision (Ertmer, 1999) with the teachers in this school on the purpose of technology and on how it supports the curriculum, a key ingredient in creating a school culture that assists and that encourages teachers' movement from an instructivist paradigm to a constructivist paradigm.

Creating a Culture that Supports Technology Integration

This concept of teachers and of the principal working together to create a culture that values technology integration in the teaching of students is supported by several scholars: Peggy Ertmer (1999) discusses the development of a shared vision in the use of technology integration; Sergiovanni (2006) describes school culture as a negotiated product between the teachers and the principal; Fullan (2001) states that for any school innovation to be accepted by the various stakeholders the teachers and the principal involved must have a shared meaning of that innovation and of how it will benefit the students.

As has been mentioned by numerous researchers, one of the greatest barriers to technology integration is teachers' philosophical belief structure about teaching and about learning (Becker, 2001; Cuban, Kirkpatrick, & Peck, 2001; Dwyer, 1995; Hernandez-Ramos, 2005; Windchitl & Sahl, 2002); however, altering these beliefs, as Cuban (2001) and Windchitl and Sahl (2002) found out, is a very difficult task. Brinkerhoff (2006) points out that "transitioning teachers from novice technology users to effective technology integrators capable of supporting student learning generally takes three to five years" (p. 38). In 2006 Brinkerhoff came to the conclusion that this change is a process not an event that occurred in his two-year

study that looked at turning a novice technology teacher into a technology integrator. The Apple Classroom-of-Tomorrow project came to a similar conclusion (Dwyer, 1995).

Hernandez-Ramos (2005) believes that for teachers to alter their philosophical orientation about teaching and learning that involves the use of technology, a school-wide educational change must take place because these changes must "come not from the technologies themselves, but [from] the deep changes in school organization" (p. 41). Fullan (2001) states the any educational change will fail unless teachers develop new understandings and deeper meanings about what is good teaching and about how students learn best. This alteration of teachers' beliefs is addressed by Fullan (2001); he calls it reculturing or the questioning and the changing of a teacher's own beliefs, habits, and practices because educational change represents a change in practice. This process of reculturing is the basis of educational change and is the foundation for developing a technology integration strategy (Mouza, 2003); and this process of reculturing cannot occur without the support of the principal (Fullan, 2001; Mouza, 2003; Sergiovanni, 2006). Ironically, journalist Thomas Friedman (2005) stated this principle of reculturing most succinctly when he said that individuals change not because they are told they should; but individuals change when they tell themselves they must. The collegiality mentioned by Becker (1993), Ertmer (1999), and Mouza (2003) as essential elements in teachers' adoption of technology integration classroom practices are all part of the shared vision concept described by Ertmer and of the shared meaning concept described by Fullan which is impossible to achieve without the full participation of the principal (Fullan, 2001; Sergiovanni, 2006). Even though there is very little literature that directly focuses on school leaders as agents for change when it comes to the integration of technology into the teaching practices of teachers and into the curriculum of the schools, the other literature that does tangentially touch on this subject

specifically points to school leaders as an essential collaborative partner with the teachers in this change process.

Conclusion

In the last 29 years instructional technology has failed to achieve its goal of developing a technology-enriched, constructivist classroom in a majority of the nation's classrooms. As this review of the literature has indicated, the integration of technology into the classroom practices of teachers in a very complex subject that involves a variety of disciplines. To understand the complexity of this subject the researcher must understand educational law and policy and how these laws and policies affect the implementation of any technology integration strategy. Furthermore, the researcher must also understand educational change and how innovation diffusion research affects how technology integration fits into this educational change paradigm. In addition, the researcher must understand the difficulties associated with technology integration and how the extant barriers to technology integration limit the use of technology by teachers. Finally, the researcher must understand the role that a school's leader plays in assisting teachers' attempts at integrating technology. The intersecting of these four disciplines creates a complex environment to study; but, without understanding the dynamics that are created by bringing these four disciplines together, then the researcher will never understand what the ingredients are that make possible the integration of technology into the classroom practices of teachers.

CHAPTER THREE

METHODOLOGY

Subjectivities Statement

In 1997 as the first course in my Masters Program I took a class in technology and the media in education and became convinced of the power of technology to transform education. I found technology to be exciting and to be motivating. I would work for hours on projects that I would have had a problem concentrating on for ten minutes if it had been just reading a textbook. Few things engaged my mind more than technology; and as a result, I wanted to find a way to us technology in the classroom in an effective way. I thought that task would be easy; I found just the opposite; it was difficult. I am now 12 years into that quest of searching for the key to effectively integrating technology into teachers' classroom practices. This quest has led me from the classroom to a central office leadership position; it has also led me into a Ph.D. program in Instructional Technology. This quest has become my purpose for my professional life.

In addition to being a doctoral student in Instructional Technology, I am also Director of Technology in a suburban school district outside a large urban area in the southeastern part of the United States. As a result of my position of authority in this school district I am able to gain access into the schools in this district; and I chose four middle schools for this study for several reasons. I wanted to concentrate on one level of schooling to add validity to the study by eliminating as many confounding variables as possible that might limit the validity of the results. I also focused on several schools in order to have a constant comparison of data thus reaching more reliable conclusions. Finally, I studied multiple schools because individual school's

dynamics and contexts could skew the results gathered whereby making the conclusions invalid. I worked with two distinct groups of people. First I worked with teachers in an attempt to discern their attitude toward technology integration and their attitude towards extant barriers that prevent successful technology integration. The teachers that were interviewed were those chosen by their peers in a survey. All the teachers selected in each school formed a focus group; and this focus group was interviewed one time. I believe that for the purposes of this study my experiences as a classroom teacher who struggled with the same issues these teachers are struggling with when it comes to technology integration and my experiences as Director of Technology who works with teachers regularly in an effort to mitigate the barriers that inhibit technology integration overcame any positionality that may have existed. Then realizing that there might have been a tendency on the part of the teachers or on the part of the school leader to "tell me what I want to hear," every effort was made not to influence the results of the interview answers by imposing my positionality upon the interview environment. My biggest challenge was to maintain the objectivity of a researcher since I had extensive prior knowledge of this school system and of these participants. I believe that I successfully maintained that objectivity by letting the data speak for itself.

Research Hierarchy

Michael Crotty (2003) in *The Foundations of Social Research* proposes that when approaching an area of study the researcher must initially decide what the questions are that the researcher is going to investigate. Once that is settled the researcher must then decide on the answers to two questions which will guide this research effort: "What methodologies and methods will we be employing in the research we propose to do?" (p. 2) and "How do we justify this choice and use of methodologies and methods?" (p. 2). These two questions go to the

essence of how the research is conceived and is carried out by the researcher; in other words, the ontological and epistemological beliefs that the researcher has will guide the researcher's research agenda.

To understand these basic assumptions that underlie the methodological and method choices, Crotty (2003) developed a four tier framework that constitutes his research hierarchy. At the top level of this hierarchy is the issue of epistemology, or "how we know what we know" (p. 8). This is the most basic of questions because it determines our sense of reality. The next level below epistemology is the theoretical perspective; this is the "philosophical stance that lies behind our chosen methodology" (Crotty, 2003, p. 7). It is within this philosophical stance upon which our assumptions are based and upon which our methodologies are chosen. Once the theoretical perspective is chosen, the next level down in this hierarchy is methodology. The methodology is basically our strategy or our action plan for carrying out our research. This is the research design upon which the research proceeded. The methodology to some extent determined exactly which data gathering methods were employed during the research process. According to Crotty'se (2003) research hierarchy, methods are at the bottom because the methods are the instruments by which the researcher gathers and analyzes the data. The methods chosen were shaped and were determined by the research questions but also to a greater degree by the choices the researcher made concerning the epistemology, the theoretical perspective, and the methodology. According to Crotty, the research hierarchy can be displayed visually as illustrated in Figure 2 below:

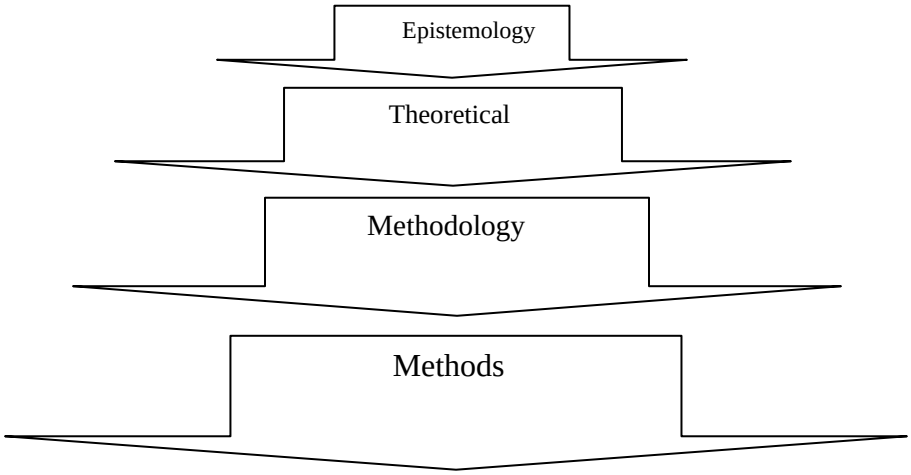

Figure 2

Epistemology

I believe knowledge is situated and socially constructed, that individuals construct knowledge as they interact with their environment and with the objects in this environment. The epistemology used was constructivism. This research studied two subgroups of people within the context of the culture of a public school environment and their interaction with one another. The first subgroup was the teachers and the second subgroup was the school leaders. A review of the literature showed there were several factors researchers identified that were perceived by teachers to inhibit the integration of technology within their classrooms. Several of these barriers were outside the scope of this research; however, the barriers that were the primary focus of this study included the teachers' belief structure about teaching and learning, and included how a school is organized instructionally. The problem with integrating technology into a school environment is that the barriers to technology integration seem insurmountable in the everyday life of the teachers; therefore, if the teacher cannot surmount these barriers by themselves, can the school leader, acting on behalf of these teachers, surmount these barriers? The answers were

found within the context of a school and of the interaction between the school leader and the teachers working within that school culture that led to understanding what a school leader can do to influence the teachers' attitudes towards the adoption of technology integration strategies. In the schools in this study the term school leader refers specifically to the principal of that school except in one instance to include the assistant principal with the principal. Because of the factors listed above, the epistemological framework from which this research was conducted is constructivism.

Theoretical Perspective

According to Michael Crotty (2003) there are two approaches to research: Verstehen or understanding and Erklären or explaining. Understanding is focused on the human or social sciences; explaining is focused on the natural sciences. Therefore in an attempt to interpret the culture of schools and in how that culture either encourages or discourages the adoption of technology integration strategies by teachers, this study attempted to understand the interaction between the school leaders and the teachers who worked in this school and how that interaction affected the usage of technology for instructional purposes. As a result, Symbolic Interactionism was the theoretical perspective from which this study was conducted.

The interaction between cultural subgroups, such as between school leaders and teachers, was first postulated by George Herbert Mead (Blumer, 1969; Crotty, 2003) in the early part of the 20th century and is based on the symbols of language, thus the name Symbolic Interactionism. In order to understand this interaction between school leaders and teachers it is best to first comprehend the theoretical perspective from which this study was based. Herbert Blumer outlined the three basic premises that are the basis for the Symbolic Interactionism theoretical perspective: 1) human beings act towards things on the basis of the meaning those

things have for them; 2) the meaning of such things is derived from, or arises out of, the social interaction that one has with one's fellow humans; and 3) these meanings are handled in, and are modified through, an interpretive process used by the person in dealing with the things he or she encounters.

As a result of the first premise it becomes apparent that for most teachers in a K-12 school environment the meaning that technology has for these teachers is one of research and of administrative functions but is not one of instruction. The research conducted by Becker (2001), Cuban (2001), Hernández-Ramos (2005), and Windchitl and Sahl (2002) all indicate that most teachers use technology only for administrative functions, for research in planning lessons, and for personal productivity. Teachers do not use technology to transform their instructional practices into a constructivist framework because the teachers' belief structure does not support this transformation. Henry Becker's (1994) research has shown that technology integration more likely will be present if the teacher believes in constructivist teaching practices. If the instructional use of technology is a goal, then knowing where the teacher or teachers are on this continuum is important in determining if technology is being integrated into teachers' classroom practices.

What makes the school leader's role so difficult is that this interaction is being played out within the context of the culture of the school. Furthermore, teachers are notoriously resistant to change (Fullan, 2001) as Cuban (2001) pointed out in his study of technology use by teachers in several Silicon Valley schools. Contrary to Cuban's original assumption, teachers did not transform their teaching style just because computer technology was added to their classrooms and just because professional development opportunities were provided. This study was confirmed by the research done by Windchitl and Sahl (2002) who concluded that even

ubiquitous one-to-one computing did not push teachers into using technology more or into adopting a more constructivist stance towards instructional practices. Cuban's (2001) conclusions were also confirmed by a study done by Hernández-Ramos (2005) who studied the same geographical area that was the focus of Cuban's study – Silicone Valley. Cuban's study further concluded that teachers just adapted technology into their traditional modes of teaching rather than adopted technology to transform their practices. Even Rod Paige, the former Secretary of Education, recognized this institutional reluctance to embrace technology in transformational ways since he said, "Schools remain unchanged for the most part despite numerous reforms and increased investments in computers and networks" (U.S. Department of Education, 2004a).

Since technology in and of itself cannot change teachers' teaching styles (Becker, 2001; Cuban, 2001; Hernández-Ramos, 2005; Windchitl & Sahl, 2002), then maybe a transformational school leader can provide the influence necessary to effect change. This research investigated the interaction between the school leader and the teachers to determine what impact the school leader has on the teachers' adoption of technology integration strategies. It was my hypothesis that understanding this interaction between the school leader and the teachers and that understanding how this interaction can significantly impact the culture of schools and the attitudes of teachers toward technology integration is the key to effectively using technology to enhance student achievement. Although Symbolic Interactionism has been criticized for viewing problems only from the microsociological perspective, Sandstrom, Martin, and Fine (2001) point out that some recent Symbolic Interactionists have focused on the mesostructural level resulting in research on organizations and on institutions. It is from this mesostructural perspective that

this study proceeded focusing on the culture of schools, on the culture of teaching, and on the interaction between school leaders and teachers.

Methodology

As discussed earlier this study was interested in understanding the teachers' reluctance to embrace technology integration into their teaching strategies and in understanding how that reluctance could be mitigated by steps or by actions taken by the school leader. To study these phenomena I needed to understand the school culture and how this school culture and the interaction between two of the subgroups within this school culture impacted the attitude of teachers toward the use of technology within their instructional setting. It was within the context of this school culture that this study was conducted. Since this was a study of understanding the culture of this school and the interaction of the subgroups mentioned earlier within the context of this school culture, it was obvious that this research was an ethnography (Esterberg, 2002; Crotty, 2003). Understanding the culture of each of the schools chosen for this research and understanding the interaction between the school leader and the teachers within the context of the school culture was paramount to understanding how a school leader mitigates the factors that cause teachers not to resist change and that cause teachers to adopt technology integrated teaching practices.

Methods

I used the case study method in this research. According to Robert Stake (2005) a case study is not a methodological choice; but it is defined by what is to be studied; whereas Michael Crotty (2003) places case study clearly in the Methods' tier on his research hierarchy. Whether case study is a methodology or is a method, it seems clear that in the field of Instructional Technology the case study method of inquiry is widely used in researching the use of technology

integration within the K-12 environment. Cuban (2001), Hernandez-Ramos (2005), Staples, Pugach, and Himes, (2005), and Windchitl and Stahl (2002) all used the case study method in their research. This study was an ethnographic case study.

Although Robert Stake (2005) does not try to categorize the case study approach into a research hierarchy, he does define case study simply as the "interest in an individual case" (p. 443). He further describes the one characteristic that uniquely makes a study a case study: boundedness or specificity. By boundedness, Stake means that a case study is a system that has discreet boundaries; it is a specific inquiry into an individual case. Stake describes the case study as "both the process of inquiry about the case and the product of that inquiry" (p. 444). According to Patricia Hays (2004) the case study researcher "is not to study everything going on in the site, but to focus on specific issues, problems, or programs" (p. 225). It is this focus on the specific that Stake means when he describes a case study as being bounded. In this study, the specific aspect of this case was how school leaders can impact teachers' adoption of technology integrated practices within their classroom.

There are three types of case studies: intrinsic, instrumental, and collective (Stake, 2005). The intrinsic case study is one in which the purpose is to investigate a particular case for its inherent value not because it represents a whole or not because it can be used to generalize. The instrumental case study is undertaken because it represents a larger issue and could be used to generalize. The collective case study is an "instrumental study extended to several cases" (Stake, 2005, p. 445-6). I used the collective case study method to do my research since I studied four middle schools and since I studied how the dynamics between the school leader and the teachers impacted the use of technology integration within each school.

Semi-structured interviews were used as a primary data collection method in this case study; however, a survey was used at the beginning of this study in order to assist in defining the boundaries of this case as well as a document review was used to verify some of the data collected during the interviews. The survey was used to determine what the teachers' visions were concerning the use of technology and what the teachers thought the principal's vision was concerning the use of technology. This survey was used to determine teachers' perceptions concerning barriers to the integration of technology that existed within each school.

Research Setting and Participants

Daniell County School District

This study was conducted using four middle schools within a medium to large suburban school district in the southeastern part of the United States. These were the only middle schools in the Daniell County School District[1]. This district was listed in 2006 as one of the fastest growing counties in the state and in the nation due to outward migration from the more urbanized sections of this metropolitan area and due to rust-belt to sun-belt migration that is occurring throughout the United States. Between 2001 and 2005, the population of Daniell County grew by 29%; building permits issued for residential dwellings averaged 2,078 annually; and the school system added 5,100 students, a 41% increase. By any definition, Daniell County experienced tremendous growth. In addition to the growth, the student demographic data shifted during the same time. For example, between 2004 and 2007 the student White population dropped from 56% to 44% while the Afro-American population grew from 38% to 47% and the Hispanic population grew from 3% to 5%. Furthermore, the economically disadvantaged student population grew between 2004 and 2007 from 43% to 52%. As the student population grew in

[1] All the proper names used in this dissertation are pseudonyms.

numbers, it also grew in ethnic diversity and in economic disabilities. These factors created tremendous challenges for the leaders of the school district and for the leaders of the four middle schools.

In addition to the challenges of a growing student population, a growing diversity of students, and a growing level of poverty within the student population, the school district and the four middle schools faced increasing demands of the federal education law, *No Child Left Behind Act of 2001* (NCLB). The law mandates that all schools must make sure that every child is educated. To measure this, each school had to annually test each student in order to determine each student's proficiency on specific skills within each learning domain. For the last five years Washington Middle School failed to attain the goals specified and thus failed to make Adequate Yearly Progress (AYP). AYP is the measuring yardstick by which the federal government and, as a result, the state government judges if a school is providing an adequate education to its students. The NCLB federal law specifies that 100% of the students must meet the specified level of proficiency by the year 2014. In order to reach 100% by 2014, the law specifies a phased-in process with the percentage of acceptability raising every couple of years until the percentage of acceptability reaches the goal of 100%. In 2006, the acceptable percentage of students meeting or exceeding the proficiency goal was pegged at 65%. In the 2007-2008 school year, the acceptable percentage of students meeting or exceeding proficiency moved up to 73%.

In the spring of 2006, Daniell County Middle School Director Dr. Anita Granrose began searching for a technical solution to increase test scores of the four middle schools. She had heard that a neighboring school district was using an Integrated Learning System called New Century in an effort to build the basic skill levels in Reading, English/Language Arts, and Mathematics of students who were performing below the acceptable level of the State Criteria

Referenced Competency Test (CRCT). New Century is a computer based software program that professes to offer diagnostic and prescriptive solutions for students' basic skill remediation. All students are tested with the New Century diagnostic program to determine their level of proficiency in the various areas of skills in each learning domain. If a student was deemed deficient according to where that student should be at their grade level in a certain area then New Century prescribed a series of lessons that taught and that reinforced teaching in the area or subarea of deficiency. Dr. Granrose bought New Century in April 2006 in an effort to raise the test scores of the students not meeting the prescribed level of proficiency in all domains of learning for their grade level.

Each middle school had three computer labs; two of these were, however, aligned with the a exploratory program which allowed each student to have the opportunity to experience a series of electives ranging from foreign languages like Spanish or French to artistic endeavors like art, band, or chorus, to physical education, to computer applications, and to technical applications such as hydraulics and as aerodynamics. The third computer lab was originally designated for teachers to take their classes to work on special projects. Since the implementation of New Century this third computer lab became the New Century lab; and teachers were not allowed to sign up to use this lab. The 30 licenses for each middle school for this New Century implementation plan devised by Dr. Granrose were paid for by the Central Office. Technology in these four middle schools was driven by the need to remediate basic skills for a minority of the students who were not meeting the level of proficiency mandate by NCLB.

Adams Middle School

Adams Middle School had a more balanced student pollution make-up with the student population consisting of 47% White, 45% Afro-American, 4% Hispanic, 2% Asian, and 2%

Mixed Race. Adams Middle School had always made AYP. In the 2007-2008 school year, Adams Middle School was the recipient of 137 students that originally had been zoned to attend Washington Middle School due to the school choice mandate of NCLB. Adams Middle School had 54% of its students who were economically disadvantaged. Students at Adams Middle School historically scored well on the CRCT test.

The principal of Adams Middle School was Marcy Buchanan, a 22 year veteran of education. She was an elementary school principal for four years in Daniell County before she was transferred to Adams Middle School at the beginning of the 2005-2006 school year. Mrs. Buchanan was an affable, unflappable individual whose calm demeanor belied the intensity in which she approached her job.

Jefferson Middle School

Jefferson Middle School had the highest percentage of White students. By November 2007 there were 55% White, 38% Afro-American, 2% Hispanic, 1% Asian, and 4% Mixed Race. In addition to the highest percentage of White students, Jefferson Middle School also had the lowest percentage of economically disadvantaged students at 47%. Jefferson Middle School was the beneficiary of 179 students who transferred from Washington Middle School due to the school choice provision of NCLB. Jefferson Middle had at the time of this study 1,321 students and was using 19 mobile classrooms. To accommodate the larger number of students, Jefferson Middle School increased the number of computers in the instructional computer lab from 30 to 36 in August 2007.

Joseph Callifano became the principal of Jefferson Middle School at the beginning of the 2005-2006 school year. Prior to this role, Mr. Callifano served four years as the assistant principal in Jefferson Middle School. His students consistently scored very high on the CRCT.

Madison Middle School

Madison Middle School had a student population that was closest to the school district percentages. As of October 2007 there were 38% White, 54% Afro-American, 4% Hispanic, 1% Asian, and 3% Mixed Race. Furthermore, 57% of Madison Middle School students were economically disadvantaged. Madison Middle School added another instructional computer lab in the 2006-2007 school year in order to accommodate its growth. Madison Middle School was not designated as a recipient school so it was spared the difficulties of trying to accommodate transfer students from Washington Middle School in the 2007-2008 school year.

Lynda Duncan was the original assistant principal at Madison Middle School when it was built in 2001. By August 2005, she was named principal after this school's original principal retired. Like most principals, Mrs. Duncan had some very firmly held beliefs about how a school should be run. She did not take directions well from the Central Office.

Washington Middle School

The changing nature of the Daniell County School District was also reflected in the changing nature of the various schools. Even though Washington Middle School had the most demographically homogenous student population of any other researched middle school, this was only because of the high concentration of Afro-American students. For example, there were only 12% White students while there were 74% Afro-American students, 9% Hispanics, 1% Asian, and 12% Multi-racial. Furthermore, Washington Middle School had the highest percentage of any of the middle schools with economically disadvantaged students at 69%. Since the 2003-2004 school year, Washington Middle School had not made AYP and, as a result, had been labeled a "Needs Improvement" school. An analysis of this school's test data revealed that every subgroup of students met AYP except for Students with Disabilities. After four years of being

labeled “Needs Improvement,” many of the parents of the students assigned to Washington Middle School decided to move their children. This provision of NCLB is called “school choice”; at the beginning of the 2007-2008 school year, 316 students chose to move to another middle school. In addition to losing many students due to school choice, Washington Middle School had also experienced a heavy turnover in teachers, losing over 50% of its faculty to retirement, to resignations, and to transfers, at the end of the 2006-2007 school year.

Washington Middle School added a second small instructional computer lab in November 2006 to provide basic skills remediation for students with disabilities. This lab was paid for out of school improvement funds that were made available to Washington Middle School due to its “Needs Improvement” status. Furthermore, the school also added some technological interactivity components such as interactive writing pads to selected regular classrooms in an effort to expand the availability of technology.

Dorothea Almond was in her 20th year in education. She took over the principalship of Washington Middle School in February 2003 after the former principal accepted the superintendency of a rural school district in another part of the state. This was her first principalship after serving six years as an assistant principal. Her initial leadership style was autocratic but had modified this somewhat in recent years to a more collaborative style.

Research participants

Each school’s principal was interviewed for this study. A focus group of teachers selected by their peers through the use of a survey was interviewed. The survey asked all teachers at each school to list those teachers they considered to be technology leaders within their school. It is from the list provided by the survey that a Focus Group of teachers were selected.

Conclusion

The purpose of this study was to determine if school leaders effect teachers' attitudes toward the integration of technology into their classroom practices. The research was designed to find the answers to the following questions:

1. Can school leaders influence teachers' adoption of technology integration classroom practices?
2. How do school leaders influence teachers' adoption of technology integration classroom practices?

2.1 Who are the technology leaders within each school?

2.2 How can a leader assist teachers in overcoming barriers that prevent the integration of technology?

2.3 In what ways do teachers feel encouraged and/or supported when they take risks concerning integrating technology into their classroom practices?

2.4 How do the teachers' vision for why technology should be integrated within a classroom differ from the principal's vision for why technology should be integrated within a classroom?

2.5 Does the principal's expectations for technology integration influence teachers' integration of technology into their classroom practices?

A case study of four middle schools in a suburban county in the southeastern part of the United States relied on interviews of selected participants and on a survey given to all the teachers in an attempt to narrow the focus of the research. The research literature listed a variety of reasons why the integration of technology had not lived up to its promises of transforming education. What the research literature did not specifically address was the role of the school

leader in shaping and/or influencing teachers' attitudes about adopting technology integration strategies. This research studies this issue. Approaching this research study from a constructivist epistemology, I conducted this research from the theoretical perspective of Symbolic Interactionism while using an ethnography case study methodology and method. Interviews, a survey, and a review of documentation were the data collection methods in this case study of four middle schools. Table 1 below lists the research questions and the methods used to answer those questions.

Table 1

The Research Questions and the Methods Used to Answer Them

Research Questions	Methods Used
1. Can school leaders influence teachers' adoption of technology integrated classroom practices?	Principal Interviews Focus Group Interviews
2. How do school leaders influence teachers' adoption of technology integrated classroom practices?	Principal Interviews Focus Group Interviews
2.1 Who are the technology leaders within each school?	Pre-Survey
2.2 How can a leader assist teachers in overcoming barriers that prevent the integration of technology?	Pre-Survey Principal Interviews Focus Group Interviews Documentation Review
2.3 In what ways do teachers feel encouraged and/or supported when they take risks concerning integrating technology into their classroom practices?	Principal Interviews Focus Group Interviews

2.4 How do the teachers' vision for why technology should be integrated within a classroom differ from the principal's vision for why technology should be integrated within a classroom?	Pre-Survey Principal Interviews Focus Group Interviews
2.5 Does the principal's expectations for technology integration influence teachers' integration of technology into their classroom practices?	Pre-Survey Principal Interviews Focus Group Interviews

CHAPTER FOUR

RESEARCH RESULTS

The Research Plan

In May of 2008, every teacher in the four middle schools was sent a Pre-Survey (see Appendix A) for which the primary purposes were to identify who the teachers thought were the technology leaders in their school and to identify what were the most pressing concerns facing teachers as they tried to integrate technology into their classroom practices. In late May and in early June, I conducted in-depth interviews (see Appendix B) with the principal of each school. While making arrangements for the interview with the principal at Madison Middle School the principal asked if he could include the assistant principal for curriculum in this interview. I agreed. Following the principals' interview, I conducted a focus group interview (see Appendix C) with a group of teachers and staff who had been identified in the Pre-Survey as being a technology leader in their school. Two of these Focus Group interviews had to be conducted in the fall due to scheduling conflicts with these teacher leaders.

Pre-Survey

Even though the Pre-Survey's primary purposes were to identify the technology leaders within each school and to identify specific issues concerning the integration of technology within each school there were several common threads that appeared in all four schools. In the Pre-Survey the teachers were asked if the principal, the assistant principals, and/or the media specialist were technology leaders in their school. Furthermore, the teachers were asked to identify any other school personnel whom the teachers considered to be technology leaders.

Although there were discrepancies in the answers between the schools there were surprising similarities to certain questions. For example, when asked to identify teachers whom they considered to be technology leaders, the responders to the Pre-Survey uniformly named many teachers. For example, at Madison Middle School, teachers filling out this survey named 30 different individuals as technology leaders (see Table 2); at Adams Middle School 24 different individuals were named. The profusion of so many different individuals led to one conclusion; the instructional organization of a middle school, with the student body divided up into three grade levels – 6^{th}, 7^{th}, and 8^{th} – and each grade level divided up into several different teams, was conducive towards teachers having close interactions with only the few teachers on their team. As a result of this distributive organization, it is no wonder that teachers looked for technology leaders within the team within which they were assigned. If a teacher could not find a technology leader within their team then that teacher could search for one within the grade level to which this teacher was assigned. Finally, a teacher could search for a technology leader beyond their grade level. This explained the overabundance of teachers listed as technology leaders, most of whom received only one or two votes. The existence of this small social network within a middle school worked to the advantage of those who tried to promote a specific agenda such as that of technology integration. In 1993, Henry Becker identified this phenomenon of social networking building capacity for technology integration within a school in his study of what constitutes an exemplary technology-using teacher.

Some other similarities between these schools on the Pre-Survey were not surprising. First is the general acceptance that the media specialist was a technology leader. Second is the computer lab para-professional was considered to be a technology leader. Third is teachers at

each middle school overwhelmingly agreed that the lack of technology resources was the most important barrier to the integration of technology.

Table 2

Focus Group Selection and Participation

School	n	Number of Teachers Selected	Number of Teachers Invited	Number of Participants
Adams	25	24	6	5
Jefferson	36	34	10	4
Madison	27	30	4	4
Washington	18	19	4	4

However, there is some dissimilarity between the schools. The administration at each school is viewed differently by their faculty when it comes to the administration being technology leaders. At Jefferson Middle School and at Madison Middle School, the principal and one of the assistant principals are named by the faculty of those schools as technology leaders; whereas, at Adams Middle School and at Washington Middle School the principal and the assistant principals are not named as being technology leaders.

One of the most important findings from the Pre-Survey are the disparate views that the teachers have concerning vision and expectations (see Table 3). In the Pre-Survey I asked two questions that dealt with why technology should be used within the classroom. These were the vision questions. The first vision question asked the teacher what the teacher's vision was; and the second vision question asked the teacher what the teacher thought the principal's vision was. Unexpectedly, the teacher's idea about her own vision does not necessarily align with the

teacher's idea about the principal's vision. This misalignment becomes a significant factor that is discussed during the case studies and in more depth in Chapter 5.

Table 3

Comparison of Percentage of Teachers' Perspectives Concerning What Is Their Vision and What They Think is the Principal's Vision

School	Perspective	Reward Students	Basic Skills	Prepare for Future	Critical Thinking	Motivation	Do Not Know
Adams	Personal	3	13	12	35	26	-
	Principal's	-	13	-	25	21	42
Jefferson	Personal	-	9	33	24	33	-
	Principal's	1	32	18	15	6	26
Madison	Personal	-	19	23	12	46	-
	Principal's	-	15	30	15	30	11
Washington	Personal	-	16	11	37	37	-
	Principal's	-	33	17	6	17	28

In addition to the two vision questions, there was one question in the Pre-Survey that dealt with the teacher's perception of what the expectations for technology use were in the teacher's school (see Table 4). There are significant differences between schools in how teachers answered this question. For example, the percentage of respondents to the Pre-Survey who think their school's expectation for the use of technology is to prepare students for standardized tests are as follows: Adams Middle School, 33%; Jefferson Middle School, 29%; Madison Middle School, 13%; and Washington Middle School, 42%. Three schools have a relatively high percentage of respondents who select this answer while at a fourth school a relatively low

percentage of respondents select that same answer. Likewise, the same school groupings occur when the percentage of respondents to the Pre-Survey said they do not believe that their school has any expectation for the use of technology; they are as follows: Adams Middle School, 17%, Jefferson Middle School, 24%; Madison Middle School, 4%; and Washington Middle School, 26%. The results from this question in the Pre-Survey are discussed in the case studies section and are analyzed in depth in Chapter 5.

Table 4

Percentage of Respondents to Pre-Survey When Asked What Their School's Expectations Are Concerning Technology Use

School	To Prepare for Standardized Tests	To Take Accelerated Reader Tests	To Prepare for 21st Century	No Expectations
Adams	33	13	38	17
Jefferson	29	21	26	24
Madison	13	4	75	4
Washington	42	-	32	26

Furthermore, there is an anomaly in the Pre-Surveys of all four middle schools that is beyond the scope of this research; nevertheless, this anomaly deserves further study because it may have tremendous consequences on the integration of technology within schools. There is a sizable minority of teachers whose belief structure, about how students learn best did not align with their teaching practices. Cuban (2001), Becker (2001), and Ertmer (2006) all agree that teachers' belief structure about the teaching-learning paradigm can be a major inhibitor to the successful integration of technology into classroom practices; their research results indicate that

a majority of teachers use a teacher-centered teaching style. The results from my Pre-Survey, however, suggest that just changing the belief structure of teachers may not be enough in the pursuit of finding the key elements to the successful integration of technology because there is a sizable minority of teachers who believe that students learn best in a student-centered classroom; and yet, these very same teachers self-report that they use a teacher-centered pedagogy.

Principal Interviews

Each principal of these four middle schools was interviewed between the end of May 2008 and the middle of June 2008. The purpose of each interview was to understand the leadership style of each principal, to ascertain each principal's commitment to technology integration, to comprehend each principal's perception of technology, and to identify how technology could be leveraged to better administer a school. All the principals' interviews lasted approximately an hour in length; and all interviews were conducted during that working period after which school was completed for the year and the vacation period began. Using this time frame allowed for a more relaxed atmosphere and prevented interruptions.

Each principal professes a belief that integrating technology is important in education and perceive themselves to be supporting that endeavor. An analysis of these interviews and the Focus Group interviews that occurred later reveal that each principal's perceptions, with the exception of one, are skewed to present themselves and their schools in the best possible light. Each principal view themselves as being technology leaders in their school even though only two of the four principals are viewed by their faculty as being technology leaders.

Focus Group Interviews

Focus Group interviews for each school were conducted after the principal was interviewed. In each school, the Focus Group participants were selected by the teachers in each

school on the Pre-Survey as being technology leaders (see Table 2). This Focus Group interview provides a cross check for the data that were collected during the principals' interviews. The Pre-Survey was sent out to determine who the teachers in each school feel are the technology leaders in that school. In the Pre-Survey the teachers could list as many teachers as they wanted; as a result, there are so many teachers selected as technology leaders it became imperative to create a criterion to lessen the number of technology leaders who would be invited to participate in the Focus Group interview (see Table 2). After analyzing the results from the Pre-Surveys, I determined that for a teacher to be invited to the technology leaders' Focus Group interview a teacher must have received at least five votes. There is a wide variance between schools as to how many teachers receive the requisite five votes, with one school having 10 different nominees and with two schools having four different nominees (See Table 2). Those individuals receiving at least five votes are invited to attend a Focus Group meeting during late May 2008 or late July 2008. The Focus Group interviews lasted approximately one hour.

The data gathered during these Focus Group interviews are instrumental in cross-checking the data from the principals' interviews and are instructional in understanding formal leadership's role in teachers' adoption of technology integrated classroom practices. Out of these Focus Group interviews it becomes apparent that there are two technology leadership roles at work within a school: the formal or administration's technology leadership role, and the informal or teachers' technology leadership role. Also apparent in the data are that each role is vitally important for a school's teachers to be willing to adopt technology integration strategies into their classroom practices. Each role serves an important function in influencing teachers to adopt a technology integration strategy; but the synergy that is created when both technology

leadership roles are present raises the level of technology integration exponentially as will be evident when each school's case study is detailed.

Documentation Review

After the principals' interviews and after the Focus Group interviews are analyzed there are several areas of disagreement that need further clarification. In order to resolve these disagreements I decided to review district-level documentation to get a better understanding of the underlying facts that either support or that do not support these various perspectives. The basis for these conflicts is the availability of funds to support the addition of technology resources and the willingness of school administrators to allow teachers to participate in district level professional learning. The lack of resources is the number one barrier that teachers list on the Pre-Survey to their adoption of technology integrated classroom practices. Another major barrier listed by the teachers is the lack of knowledge on how to integrate technology into the teachers' classroom. A review of the documentation illuminates these two issues.

During the Focus Group interviews the issue of lack of resources comes up repeatedly at Washington Middle School and at Jefferson Middle School, and comes up less often at Adams Middle School. It almost never comes up at Madison Middle School. During the principal's interview at Madison Middle School I discover that the principal used Title 1 monies to fund a massive expansion of technology resources. As a result of this discovery I decided to research the availability of Title 1 funds for each middle school (see Table 5) and to research if any of those funds were spent to increase the technology resources during the 2007-2008 school year (see Table 6). Table 5 lists the total amount of funds allocated to each school, as well as, the amount of the total funds that the Central Office designated to be spent on teachers' salaries. The

difference between these two numbers is the amount of funds each principal spends at the principal's discretion.

Table 5

Availability of Title 1 Funds per School

School	Total Allocation	Amount Spent for Staff Salaries	Amount Spent at Principal's Discretion
Adams	$145,125	$114,136	$30,989
Jefferson	$203,450	$97,870	$105,580
Madison	$185,750	$136,379	$49,371
Washington	$185,500	$148,101	$37,399

On the other hand, Table 6 illustrates the total amount of Title 1 discretionary funds that are spent on technology resources by each principal during the 2007-2008 school year. Furthermore, Table 6 lists what percentage of the total discretionary funds available at each school is spent on technology resources.

Table 6

Percentage of Discretionary Funds Spent on Technology Resources

School	Amount Spent at Principal's Discretion	Amount Spent on Technology	Percentage Spent on Technology
Adams	$30,989	$25,411	82%
Jefferson	$105,580	$11,614	11%
Madison	$49,371	$44,928	91%
Washington	$37,399	$2,992	8%

Understanding Technology Use Within Each School

Before looking at each school in-depth, there are several general observations that need to be made about all the schools. First, all four middle schools were built between 1994 and 2001 using basically the same floor plan. As a result, there is not a large difference between the physical layout from one school to another that would affect the use of technology by the teachers in each school. Second, even though these four middle schools are relatively new, they were built based upon a relatively old understanding of technology use. Therefore, the number of computer drops or receptacles in each classroom range from one to four, an inadequate number of drops for an intensive use of technology. Third, during the early part of the 2007-2008 school year the Daniell County School District completed the technology renovations at two of the four middle schools: Adams Middle School and Washington Middle School. These renovations were funded, for the most part, by the federal E-Rate grant program. All the data cabling and equipment, and all the video distribution cabling and equipment were replaced; and the number of network drops per classroom was increased to 10. Fourth, through the use of the Pre-Survey at every school I was able to find teachers who are integrating technology into their classroom lessons and who are trying to impart the knowledge of how to do this with the other teachers in their school. These teacher leaders are very dedicated to promoting the use of technology within their school. Lastly, when comparing the principal's interview with the Focus Group's interview at each school I discover that there are discrepancies between the perceptions of the principal and the perceptions of the teacher leaders who were part of the Focus Group. This misalignment between the perceptions of the principal and the perceptions of the teacher leaders will be discussed in detail in Chapter 5; but, this misalignment is a symptom of a dysfunctionality within the school. The more severe the misalignment, the more technologically dysfunctional is the

school. At Madison Middle School there is an almost exact alignment between the principal's perceptions about technology and the Focus Group's perceptions about technology. At the other three schools, however, there is a varying level of misalignment from Adams Middle School whose misalignment is only slight to Washington Middle School whose misalignment is most severe.

Case Studies

Washington Middle School

By any definition, the situation at Washington Middle School is challenging. According to the criteria of the *No Child Left Behind Act of 2001*, Washington has been in the Needs Improvement category for the last five years. Even though Washington made AYP[2] for the 2007-2008 school year, according to the law the state was required to appoint an administrator to oversee this school for the current school year. According to Federal law a school or a school district has to make AYP for two consecutive years before the school or the school district can be removed from the Needs Improvement category; likewise, a school or a school district has to fail to meet AYP for two consecutive years before that school or before that school district is placed into the Needs Improvement category. Due to the Choice provisions of the *No Child Left Behind Act of 2001*, Washington Middle School had to offer its students the choice to move to another middle school. In the 2006-2007 school year 226 students chose to move – 96 to Adams Middle School and 130 to Jefferson Middle School; whereas in the 2007-2008 school year 322 students chose to move – 160 to Adams Middle School and 162 to Madison Middle School. The demographics of Washington Middle School also represent a challenge for the school's administration. The school has the highest percentage of students who are economically

[2] AYP stands for Adequate Yearly Progress. It is a designation described in the *No Child Left Behind Act of 2001* which indicates that the school has met or has exceeded its annual criteria, and is, therefore, a successful school.

disadvantaged; and this subgroup has traditionally performed less well on the standardized tests (see Table 7). When compared with the other middle schools (see Table 7), Washington has the highest minority population with 88.1%; and Washington also has a student population with the highest poverty rate with 68.8% of the students qualifying for the Free and Reduced Lunch Program; and it has the highest ELL[3] student population.

Table 7

Student Demographics by Percentage at Each Middle School – Fall 2007

School	Ethnicity		Economically Disadvantage	Special Needs	ELL
Adams Middle School	Asian	1.8	54.4	17.9	1.7
	Black	44.8			
	Hispanic	3.9			
	Indian	-			
	Multi-racial	2.3			
	White	47.2			
Jefferson Middle School	Asian	0.6	47.2	14.0	-
	Black	37.8			
	Hispanic	2.3			
	Indian	0.2			
	Multi-racial	4.0			
	White	55.0			

[3] The acronym ELL stands for English Language Learners which represents those students who speak English as a second language.

Madison Middle School	Asian	1.2	57.0	14.5	0.9
	Black	53.5			
	Hispanic	4.4			
	Indian	.2			
	Multi-racial	2.8			
	White	37.8			
Washington Middle School	Asian	0.9	68.8	13.2	2.7
	Black	74.4			
	Hispanic	8.8			
	Indian	.2			
	Multi-racial	3.7			
	White	11.9			

Washington Middle School is one of two middle schools in which the misalignment is severe between the perceptions of the principal about technology integration and the perceptions of those teachers selected as technology leaders by their peers in the Pre-Survey. The principal of Washington Middle School is Dorothea Almond who has been the principal for six years. During the principal's interview, Mrs. Almond states that she considers herself to be a technology leader in her school. In contrast, only 6% of the teachers who filled out the Pre-Survey judge her to be a technology leader. There is a misalignment between what the teachers' perceptions are and what the principal's perception is that has contributed to Washington's lack of progress toward the development of a focused approach to the use of technology. While answering a question during

her interview, Mrs. Almond comments that she needs to use PowerPoint more frequently at faculty meetings as a confirmation of her belief that she is a technology leader in her school. She never mentions using email or using the school's Intranet as a form of communication within her school. She never speaks of setting expectations for technology use for her teachers. She never speaks of encouraging her teachers to adopt technology integrated classroom practices. But she speaks of herself as being technology competent saying, "When the teachers know that the principal is technology savvy enough to know how the programs are to be used [they use them more]." On the other hand, the Focus Group paints a very different picture about Mrs. Almond's technology competency as well as about her leadership role in promoting the use of technology. In fact, one teacher[4] states that Mrs. Almond has used email earlier but has stopped when she realized that email, as an official communication record, is subject to Open Records requests.

> I think that the principal is computer phobic. She has often told me that she does not know what to do or how to do it. She got very good at email but then got scared of it because it is in writing; and she might get in trouble for it; so she backed off of it . . . . [One Assistant Principal stood] up in a faculty meeting and [said] that he does not know anything about computers and does not want to know; and do not ask him because he is computer illiterate. That sets the tone for technology. The administrators are telling the faculty that they do not know anything about technology and do not want to know anything about it. (Andrew, teacher, Washington Middle School)

The data seem to suggest that with an administration that is technology challenged it is difficult for teachers of that school to adopt a pedagogy that integrates technology into their classroom practices.

[4] I am being purposely vague in identifying the focus group members' identities in Washington Middle School in an effort to protect their confidentiality due to the critical nature of some of their comments.

When the question was posed of what the expectations are of the teachers to use technology, Mrs. Almond never once mentions expectations. Instead she only talks about how she leads her faculty by modeling the use of technology at faculty meetings, or at other in-service activities and talks about how technology has to be coupled with assessment:

> [A] thing to look at is lesson plans and the things the teachers have planned for students to do. We want to be able to see where they are integrating that technology and . . . [if] that assessment piece . . . is coming from the curriculum; and if that assessment piece is working. What I mean by that is they may want to do the assessment first and then add from that the curriculum with the technology and see how the students' scores [are] at the very end of the assessment, and see if they see greater gains and student retention of working through something using the technology piece. (Mrs. Almond, principal, Washington Middle School)

The members of the Focus Group all agreed that the principal and that the other administrators have not articulated their expectations for the use of technology by the teachers. Thus, it is evident that the difficulty with setting expectations for technology use by this principal is that the teachers do not view this principal as a technology user herself. One of the teachers expresses it in these words, "One of things I wondered about is how can they question a teacher's use of technology and incorporating it in their curriculum if they themselves do not use it" (Shelley, teacher, Washington Middle School). Another teacher, Andrew, reinforced this point when he said, "They cannot hold the teachers accountable for something they themselves do not understand." Again, the perceptions expressed by Mrs. Almond about her expectations for the integration of technology by her teachers are quite different from the perceptions expressed by the members of the Focus Group. There are obviously very differing views about the status of

technology and about the status of the use of technology within Washington Middle School between the principal and the teachers.

Another issue that highlights the differing perceptions between the principal and the teachers as represented by the members of the Focus Group is the availability of technology resources within Washington Middle School. As Becker (2001) has illustrated, the more resources that teachers have available to use within their classrooms the more likely the teachers are to integrate technology. Mrs. Almond, however, blames this lack of computer resources on "Central Office policies" and on "the lack of funding" even though, as Table 6 depicts, Mrs. Almond has available, at her discretion, the use of $37,399 from Title 1 funds during the 2007-2008 school year. Of that amount, she spends only 8% on technology-related items: three laptop computers for the administrators. Furthermore, Washington Middle School is allocated $61,506 in the 2007-2008 school year as part of the School Improvement Program through the *No Child Left Behind Act of 2001*. From those funds she spends only 16% on technology-related items: one interactive whiteboard, two interactive slates, and a subscription to a basic skills remediation website. For those teachers who filled out the Pre-Survey, 56% lists lack of resources as a barrier to their ability to integrate technology; and, yet, Mrs. Almond chooses not to invest in technology even though funds are available to do so.

It is unclear why Mrs. Almond does not spend very much of her available funds on technology. One possible explanation can be attributed to a lack of vision about how technology can transform education. This lack of vision conclusion is supported by the results from the Pre-Survey when 28% of the teachers at Washington Middle School indicated that they do not know what the principal's vision is concerning the use of technology; and another 33% think that the principal's vision is to teach basic skills. To further illustrate this point, Washington Middle

School has one computer lab that was originally designed as an instruction lab for teachers to sign-up to use. Mrs. Almond turned this computer lab into a remediation lab for low achieving students thus depriving the middle achieving students and the high achieving students access to this lab. When teachers were asked in the Pre-Survey if lack of access to the computer lab is a barrier to their integration of technology, 56% of the teachers respond positively; yet, when Mrs. Almond is asked during her interview if teachers have access to the computer lab her answer is that they do. What she is referring to is that teachers could send individual students to the lab if one or more desks are available. Teachers cannot take their entire class into the lab to work on a special project or program. Mrs. Almond expresses to me that her vision for technology use within her school is one of differentiating instruction. One of the Focus Group participants expresses the situation at Washington Middle School this way:

> The best way I heard it described is that this is a rudderless ship. We just stand around, stand around, stand around; there is not port we are aiming for. We all know we want to make AYP; that is our end sight. We start down one path to get there and then deviate; we start on another one and deviate. We do not stick with anything long enough; and this is what I see going on with technology; we are not sticking with a plan that will carry us to the future. And that is why you see pockets of technology being used in this building. That is why if someone does not have the ability to use technology, they don't. We are real lucky; we have 90 graphing calculators in this school. They have never once left the library. Number one, the teachers do not know how to use them. That is a lot of technology just sitting there; yet [the administration] thinks that if technology is available [the teachers] will use it. (Andrew, teacher, Washington Middle School)

Jefferson Middle School

Jefferson Middle School is the only middle school which has a majority of white students and is the only middle school which has fewer than 50% of its students which are economically disadvantaged (see Table 7). Jefferson does face challenges, however. Jefferson has the second highest percentage of special needs students at 14%. Another challenge that Jefferson is dealing with is a large increase in its student population due to the Choice provisions of the *No Child Left Behind Act of 2001*. Jefferson Middle School has experienced a sizeable in-migration of students from Washington Middle School in August 2007 when 130 students transferred into Jefferson. Currently Jefferson Middle School has the largest student population of all four middle schools; and because of this, Jefferson has 19 portable classrooms.

When I asked the principal of Jefferson Middle School, Joseph Callifano, if he considers himself to be a technology leader, he responds that he does. Likewise, 80% of those teachers who respond to the Pre-Survey indicate that they think the principal is a technology leader. Mr. Callifano admits that he does not know a lot about technology; but he tries to use technology in a variety of different ways. An example of his technology leadership is that he participates in the Professional Learning opportunity that dealt with creating an online course using a course management system that was offered by the Central Office. Mr. Callifano then uses these skills he learned in this professional learning opportunity to create professional learning opportunities for his teachers such as using the Discussion feature in his online course to allow for book study opportunities. In addition to encouraging teachers to use technology for their own professional learning, Mr. Callifano says he is encouraging the teachers to use technology in their classroom practices.

> If a teacher comes with an idea on how to use technology, usually they will come with a plan, a proposal, an idea; and it spells out what they need, and why they are going to use

> it, how they are going to begin, and what the outcomes will be, what . . . they think will happen. The encouragement that they receive from me is that, "Let's do it, let's see what happens. Let's figure out a way to get this done, because if it is a great idea then it is going to help the kids; so why not try it and see what happens." (Mr. Callifano, principal, Jefferson Middle School)

When I asked the Focus Group teachers if they felt they were encouraged to integrate technology into their classroom practices their perspective differs from Mr. Callifano's perspective. One of these Focus Group teachers responds, "When I am around my colleagues, I do. I feel I get lip service from above the collegial level. 'Make us look good,'" (Jonas, teacher, Jefferson Middle School)[5]. This "make us look good" comment is referring to how students score on the standardized test. This sole focus on the standardized test seems to pervade all aspects of Jefferson Middle School as will be illustrated.

Mr. Callifano also says he is encouraging all his teachers to use interactive whiteboards even though there are only six of these interactive whiteboards in his school. Mr. Callifano accomplishes this by mandating those teachers who have interactive whiteboards in their classroom to make their classrooms available to other teachers so they can experience interactive technology. Considering the fact that there are only six teachers who have these interactive whiteboards and considering the fact that Jefferson Middle School has over 80 teachers this effort seems somewhat futile at best. Mr. Callifano also admitted that he is trying to make the teachers who do not have the interactive whiteboards "jealous" of those teachers who do. It is unclear what his purpose is for creating jealousy among the teachers.

[5] I am being purposely vague in identifying the focus group members' identities in Jefferson Middle School in an effort to protect their confidentiality due to the critical nature of some of their comments.

For those teachers who are interviewed during the Focus Group interview, this issue with the interactive whiteboards is just another example of the lack of technology resources available to the teachers and, thus, to the students. The lack of technology resources is cited by 77% of the respondents to the Pre-Survey as a barrier to their use of technology. Mr. Callifano states that he is aware of the problem of a lack of resources; and his attempts to alleviate the lack of resources have not always been successful. He blames a lack of resources on the lack of funds he receives from the Central Office to support the necessary purchases; however, a review of Central Office documentation reveals (see Table 6) that Mr. Callifano has, at his discretion, Title 1 funds in the amount of $105,580 of which he spends only 11% to purchase technology resources. One teacher, who was a member of the Focus Group, said that the only way he can integrate technology is to buy the technology himself. For example, he purchased with his own money two laptop computers, a data projector, an interactive slate, a TV, a DVD player, and a projection screen. Unfortunately, this teacher is not alone according to the members of the Focus Group. There are other teachers at Jefferson Middle School who have resorted to purchasing their own technology resources. This lack of resources extends to other technologies besides interactive technologies. For example, the Media Center has only two data projectors for check out. This lack of resources has become a major barrier for teachers to integrate technology into their lessons. Mr. Callifano admits that this is a huge problem when he said, “If you do not have the resources [the teachers] need, then [technology] becomes a frustrator.”

In addition to a lack of classroom resources listed in the Pre-Survey, 77% of Jefferson Middle School’s teachers list the inaccessibility of the instructional computer lab as a barrier to their ability to integrate technology. Mr. Callifano refutes this assertion. From his perspective, the computer lab is open for blocks of time during the day for whole classes and for individual

students all day long. The Focus Group participants have a different perspective from Mr. Callifano's perspective. From Shekelia's perspective, another Focus Group teacher who is very familiar with the computer lab, this is simply not true. Jonas, a math teacher who is a member of the Focus Group, says that he would like to use a software program that is already loaded onto the computers in the lab called Geometric Sketchpad because it illustrates geometry concepts in ways that make it much easier for students to understand. Since the computer lab is unavailable, Geometric Sketchpad is unavailable. The reason the lab is unavailable is because it is being used full time to provide remediation to those students who need help learning basic skills. This computer lab is being run by three Title 1 teachers; and the students who are scheduled into this lab are allowed to use only programmed instruction using an Integrated Learning System. Unfortunately those students who are scoring at grade level or above on the standardized tests and who do not need remediation just to pass the standardized tests do not have access to this lab. Furthermore, regular education teachers are not allowed to schedule whole classes into this lab.

> The lab is not available for regular classroom use. If our lab was available it would make it a lot easier for me. It would make it a lot easier for . . . me because we could at least bring our classes in; but there are some scheduling issues; and with the other classes that are being offered, we don't have that option anymore. (Valerie, teacher, Jefferson Middle School)

Therefore, teachers do not have access to technology within the classroom unless they buy the technology themselves; neither do they have access to technology in school-wide facilities like the instructional computer lab.

The reason that the lab is unavailable to whole classes and the reason that technology is unavailable to teachers within their classroom can be said to be due to a different vision for technology and to a different set of expectations for technology use. It appears that Mr. Callifano's vision for technology is limited to that of providing remediation in basic skills for the low achieving students.

> It has always been justified by, 'We need to get our test scores up.' Between the title schools and the subgroups, and the test scores, that is who were chosen to participate in using [the Integrated Learning System]. Yes, that is a minority [of the students]; but they look at it as being for the good of the school because it affects the overall AYP; and that is the do-all, be-all, and end-all for the school whether that means that the student as a whole learned or not. The thought process seems to be, 'OK, those students that you have can pass the test whether you do your fun and interactive lesson, or fun and educational, or educational lesson. It doesn't matter. Those [low achieving] students we need to bring them up; and that way the whole school [makes AYP]. (Valerie, teacher, Jefferson Middle School)

Two years ago Mr. Callifano purchased eight additional computers using Title 1 funds to increase the number of computers in the instructional computer lab to 40 computers. It seems that the purpose of this purchase is to increase the number of low achieving student that could be served in this computer lab at one time, but at what cost to the other students. However, Mr. Callifano states that regular students have access to the computer lab. Later in his interview he claims that these regular students have access to "a computer" but only once every two weeks in a group setting.

When I asked Mr. Callifano what his expectations were for teachers integrating technology into their classroom practices he replies that his expectations are implied, “Those expectations are there, I don’t really have to say anything.” Later he said that, “I think that it is really hard to have that expectation when I can’t provide [the teachers] with the resources they need.” Valerie of the Focus Group teachers says there are no expectations of technology use; whereas, Antonio another one of the Focus Group teachers said that, “There were expectations that technology be included in a teacher’s lesson plans; but in reality it will not happen because the lack of resources makes it impossible.” Another Focus Group teacher states, “My technology is a lot of time finding a PowerPoint or something, making transparencies, and then [putting them] on the overhead” (Valerie, teacher, Jefferson Middle School).

Mr. Callifano indicates that he uses a shared governance leadership style by utilizing his Building Leadership Team (BLT) to help make decisions that concern the school and the instruction. He feels that the school could run itself without him because all the decisions, except personnel decisions, are made jointly by the faculty representatives and himself, “Teachers create their own team, decide how the budget will be spent . . . determine the schedule . . . . It is a good group of teachers who make these determinations,” (Mr. Callifano, principal, Jefferson Middle School). However, Damien, one of the Focus Group teachers who serves on one of these Building Leadership Teams, offers a slightly different perspective to this spirit of collaboration. When it came time for budget deliberations, Damien came prepared with his list of needs only to be given a slip of paper with his budget number on it as soon as he walked into the room. Mr. Callifano professed his belief that he wants a spirit of collaboration with his teachers; that he is open to teachers’ ideas, is willing to listen to everyone, and that no one is afraid to express a contrary view. Again, Antonio has a very different perspective about this spirit of collaboration.

When I asked the members of the Focus Group if they had addressed the principal concerning the issue of accessibility to the computer lab, that was mentioned earlier, Antonio says that he had; but, “I was put in my place. To say the least, I was put in my place. I was so firmly put in my place I wouldn’t dare mention [it again].”

Last year, Jefferson Middle School had available more Title 1 funds than any of the four middle schools (see Table 5); yet only 11% was spent on technology. The rest of the Title 1 funds were used to buy consumable print material targeted to the low achieving students. Since the Title 1 program is supposed to benefit low income, low achieving students then this allocation of funds is legitimate and is proper. Thus, the issue becomes one of vision about how technology can be used to help students succeed. Obviously, Mr. Callifano’s vision for technology use is to help the low achieving students master their basic skills to increase their test scores so the school can make AYP. This vision, if used exclusively as it is being used at Jefferson Middle School, is a detriment for using technology in a more enriching way by integrating technology into each teacher’s pedagogy. One teacher said it best when he said, “I was told [by Mr. Callifano], ‘your kids are the top kids; they will make it anyway’” (Antonio, teacher, Jefferson Middle School).

Not only do the teachers at Jefferson Middle School have a different perspective from the perspective of their principal on how technology should be used, they also recognize this difference. In the Pre-Survey the teachers were asked, “What is your vision for technology utilization?” Only 9% selected the answer “To Teach Basic Skills.” On a different question, the teachers were asked what they thought the principal’s vision was for technology utilization; 32% selected the answer “To Teach Basic Skills.” This wide disparity between the principal’s vision and the teachers’ vision could spell leadership problems in the future.

When discussing the spending priorities at Jefferson Middle School, Mr. Callifano emphasizes the point that the BLT set all spending priorities. He says that the BLT looked for initiatives that will benefit all teachers and all students. This is his justification for not taking the measured approach which is to buy some technology each year until all teachers have the resources they need to integrate technology into their classroom. For Mr. Callifano, it has to be an all or nothing proposition; but since it could not be all the first year, it remains nothing in the first year and in all subsequent years.

Adams Middle School

Adams Middle School has many of the same challenges as do the other middle schools. For example, the student ethnic demographics are the most balanced of all the middle schools; but Adams has the highest percentage of special needs students and the second highest population of ELL students (see Table 7). In addition, Adams has the smallest student population of the four middle schools until the beginning of the 2007-2008 school year when it receives 160 students from Washington Middle School as a result of the "Choice" provisions of *No Child Left Behind Act of 2001*; combine that number with the 96 students that transferred from Washington in August 2007, Adams has absorbed 256 students in the last two years just from transfers. The number of students who qualify for Free and Reduced Lunch has been over 50% for the last four years qualifying Adams as a Title 1 School and thus qualifying for additional funds. As a result, Marcy Buchanan, the principal of Adams Middle School, spends 82% of her discretionary Title 1 funds during the 2007-2008 school year (see Table 6) on technology-related items in an effort to increase the availability of technology resources for her teachers.

When I compared the perceptions of the principal with the perceptions of the teacher leaders as it concerns the use of technology, there is only a slight misalignment between these

two perceptions. Mrs. Buchanan, for example, views herself as a technology leader within her school because she tries "to use a lot of different things," even though only 32% of the teachers who respond to the Pre-Survey considered her to be a technology leader. Mrs. Buchanan mentions using PowerPoint, Outlook, and mentions publishing an electronic newsletter. She talks at length about how she is now using the "Attend a Meeting" request feature in Outlook to remind teachers of faculty meetings. Throughout the entire one hour interview, however, Mrs. Buchanan never once mentions modeling technology use. Not surprisingly, only 32% of her teachers consider her to be a technology leader.

Although Mrs. Buchanan's technology expertise obviously is limited, she sees the value of technology; and she promotes the use of technology by the teachers. She mentions on several occasions of observing teachers integrating technology into their classroom strategies and of being amazed at how engaged the students are in these lessons. As a result of seeing technology being used in classrooms, Mrs. Buchanan says that technology:

> . . . has become part of the instructional dialogue with our staff. It becomes more [pause] it becomes part of what we talk about in our staff meetings which I think has been good for our staff because it is not some kind of [pause] plague or something to visit or revisit from time to time. I hope it is something we do from time to time. (Mrs. Buchanan, principal, Adams Middle School)

Although technology is beginning to reach center stage at Adams Middle School in the sense that it is becoming part of the instructional dialogue, there is a certain resistance to technology or at least hesitancy evident in Mrs. Buchanan's choice of words by calling technology a "plague." Even though I do not believe she considers technology to be a plague, that "slip" of the tongue probably says more about her acceptance of technology as an

instructional tool as anything else she says during her interview. Furthermore, there does not appear to be a clear vision about how technology should be used within the classroom by individual teachers nor does there seem to be a passion by a majority of teachers for technology in their classroom. When the teachers were asked in the Pre-Survey what was the principal's vision toward technology, 42% of the teachers indicated they do not know what is the principal's vision.

This lack of clear vision is more apparent during the Focus Group interviews. Jonas, 8th grade Science teacher, expresses concern that the new technology is just replacing the old technology but is not changing the pedagogy of the teachers. This sentiment is echoed by Clarence, a 7th grade Social Studies teacher, who thinks that most teachers are not correctly using the technology they have been given:

> Unfortunately, there are teachers who have these resources in their room; and they are nothing more than a glorified overhead projector. When they use to put transparencies on an overhead, now they just flash it on the screen; and they have no idea how to use the other technology in their room. (Clarence, Adams Middle School)

The other technology to which this teacher is referring is to the interactive whiteboards. This problem of using technology to reinforce current practices, or first-order change, has been well documented by various researchers (Becker, 2001; Cuban, 2001; Ertmer, 2006).

When comparing two teachers whom Mrs. Buchanan observed teaching the exact same lesson, one with technology and one without, the principal comes to the conclusion that the students in the technology-enriched classroom are more involved in their lesson:

> It was quite interesting and I think in their own way, the kids were all learning; but the kids who had the ActivBoard were very, very much more into wanting to go up and

> interact with content. They were more engaged; I think they were particularly more excited and doing . . . you know this whole stigma about going up in front of the class, some of that was eliminated just because they wanted to go up and write on the whiteboard. Both teachers were effective in their own way; but with the technology, the kids were a little bit more involved. (Mrs. Buchanan, principal, Adams Middle School)

In spite of the fact that Mrs. Buchanan experienced, first-hand, the power of technology to engage students in their lessons, she is still a little hesitant about technology in the classroom. For example, when asked what her expectations are for technology use in her school, Mrs. Buchanan says that she does not "want to get to the point where we got teachers who feel like they can't do their job because the technology gets in their way." In other words, Mrs. Buchanan is not willing to articulate a set of expectations for the use of technology in the classroom. She is not completely committed to technology; she is willing to allow some teachers to refuse to use technology in her school.

This lack of expectations has led to other problems as well. During the Focus Group interviews a discussion ensued about which teachers were assigned classrooms that had interactive whiteboards. One teacher explained that there was some dissention among the faculty members about room assignments:

> A lot of new people who are [new] this year got the ActivBoards and that kind of equipment; and they have no idea how to use it. There are people who have been here for quite some time; and they are all in the core content areas; and they say, "Why did they get one and I didn't?" I have heard a lot of groaning and bickering about this because there are people who have been here for years; and they do not get one. People who are just out of college and have no clue about what these things can do . . . have one in their

> room; and they are just there. (Francis, 6th Grade Language Arts teacher, Adams Middle School)

Without setting high expectations concerning the integration of technology within classroom instruction, Mrs. Buchanan is insuring for the most part that the change that takes place within Adams Middle School classrooms is only first-order change.

Mrs. Buchanan realizes that funding is a major obstacle to providing the level of technology resources requested by the teachers. To counteract this dilemma, Mrs. Buchanan commits to spending a majority of her Title 1 discretionary funds (see Table 6) on technology purchases. She buys three interactive whiteboards which includes a projector, three interactive slates and accompanying projectors, two laptop computers, two student response systems, and two projection carts which each include a projector, sound system, and DVD player. Although all the purchases are needed and would be put to good use by the teachers, the sheer variety of purchases seems to indicate a lack of focus as to how Mrs. Buchanan sees technology being used in the classroom.

Madison Middle School

Madison Middle School is in the middle of the four middle schools when the student demographics are compared. Its student population consists of 62.2% ethnic minorities, 57% economically disadvantaged, and 14.5% special needs students. As a result, Madison faces the same challenges as the other middle schools face. Furthermore, in August 2007 Madison absorbed more than 200 Choice students from Washington Middle School resulting in the increase of an additional seven portable classrooms. Although Madison Middle School does not make AYP for the 2007-2008 school year, it had made AYP in the previous years meaning that Madison is not yet a Needs Improvement school. The one thing that Madison Middle School

does have that the other three middle schools do not have is an alignment of perspectives between the administration and the teachers. It is this alignment of perspectives that allows the teachers at Madison to integrate technology in a manner that engages all the students in the learning process in a manner that allows for their bright future in the 21st Century.

When I was setting up my interview with the principal, Mrs. Lynda Duncan, she asked if her assistant principal for curriculum, Mr. James Robinson, could be included in the interview process. I agreed. This decision turned out to be extremely beneficial because Mr. Robinson has been given the responsibility of ensuring that technology is adopted by all teachers. This is my first indication that Madison Middle School's attitude about the use of technology is significantly different than what I found at the other middle schools. Technology has become essential to how Madison Middle School functions; technology has become the essence of the school. At the very beginning of the interview Mrs. Duncan states that earlier in her administrative career as an assistant principal at Madison Middle School she was responsible for curriculum. This event "changed my career path. . . . I realized that you could truly impact education for all students by affecting curriculum issues." Therefore, one of her goals when she became principal was to make Madison Middle School more technology literate. The one way she feels she could accomplish this is to model technology literate behavior. A couple of years after being named the principal of Madison Middle School, Mrs. Duncan is presented with the opportunity of hiring a new assistant principal. It is this opportunity and the person chosen which fulfills Mrs. Duncan's vision of making Madison Middle School technology literate. Mrs. Duncan hires a relatively young, energetic math teacher who regularly integrated technology into his classroom practices to take over as the assistant principal for curriculum. This decision proves to be instrumental as

Mrs. Duncan articulates, “So he was really the vehicle for us to model the technology from my administration stand point.”

This modeling of technology starts the very first day. When the teachers report back from their summer vacation, Mrs. Duncan takes them all on a retreat. It is at this retreat on the first day that Mr. Robinson begins modeling technology use and begins articulating the administration’s expectation that every teacher use technology every day. Mr. Robinson’s strategy that brings all the teachers onboard includes using technology for three different purposes. This strategy is purposefully implemented. First, Mr. Robinson wants to use technology to make school information more accessible and to make communication easier to use. To do this, the administration refuses to use paper as the method of notification for communication; instead, Mr. Robinson begins sending out a daily email to all school employees listing all the activities for their school for that day. Although this one step seems simplistic it is effective in getting all teachers to use email every day. The teachers in the Focus Group credit this one simple step from Mr. Robinson in getting everyone to buy into using technology to communicate. In addition to using email to communicate, Mr. Robinson also begins using the district-wide Intranet to store documents that can be accessible for teachers to use such as curriculum guides and such as pacing guides.

The second purpose for which Mr. Robinson wants to use technology is to make record keeping easier. In the past, teachers were not required to use the electronic gradebook or to take attendance electronically. When Mr. Robinson becomes assistant principal he insists that all teachers use the electronic gradebook and that all teachers use the electronic attendance program. To enforce this mandate, Mr. Robinson does not hand out paper-based gradebooks which has been done in each of the previous years.

Finally, Mr. Robinson wants to use technology instructionally. He implements this purpose by modeling technology integration during his weekly grade level curriculum meetings. The teachers who participated in the Focus Group interview give credit to Mr. Robinson for providing the enthusiasm to use technology. Jeannie, a non-core subject teacher says, “The Assistant Principal, Mr. Robinson, is the main reason that technology is being accepted so well in this school.” The Media Specialist echoes this feeling, “You know when you are really excited about something; it is contagious.”

This strategy that Mr. Robinson devises to get the teachers to begin using technology actually begins before school starts at the beginning of the 2007-2008 school year. In another purposeful move, the administration shows the teachers during pre-planning how they can use technology to graph their students’ test scores in Excel to see areas of weakness. Even though this professional learning opportunity is led by Mr. Robinson, all the teachers know that Mrs. Duncan is the impetus behind the technology initiative.

Mr. Robinson also knows that this modeling of technology could not stop once pre-planning is over; so when he conducts his grade level curriculum meetings with the teachers after the students return, he models technology use, “They weren’t going to use the projector, they weren’t going to use their slates, they weren’t going to present information to their students in a digital format unless I was doing it to them.” Modeling technology use and setting clear and uncompromising expectations become some of the key elements that brings all the teachers onboard:

> I remember last year [pause] a couple of years ago we had teachers refuse to use technology. We do not have them anymore, even the ones that have been teaching 20

> years; they are realizing that . . . we are going to have to learn this. (Jeannie, computer teacher, Madison Middle School)

Mrs. Duncan talks about changing the culture of her school as the reason for this transformation:

> I think it is a testimony to the attitude we've got at this school, and then the culture we are developing, and people willing to move forward. That is the thing; I have not seen anybody resistant to change. Some people are intimidated by change; some people are intimidated by technology; but I haven't seen anyone on our staff that has been resistant to change. (Mrs. Duncan, principal, Madison Middle School)

Another element that Mrs. Duncan realized must be addresses is the lack of resources that plagues all four middle schools. Mrs. Duncan makes the commitment to invest in technology so the teachers can have the resources they need by buying 12 interactive slates and projectors worth approximately $7,000 in August 2007; additionally, in the spring of 2008, using Title 1 funds, she buys interactive slates and projectors worth $38,000. This expenditure represents 91% of Madison Middle School's Title 1 allocation for that year (see Table 6). Mrs. Duncan expresses her vision about investing in technology in this way, "We are either moving ahead or moving behind; there is no standing still."

It is this vision about technology being on the move that is another of those key elements that is fueling this technological transformation at Madison Middle School. Mr. Robinson succinctly articulates this visionary approach to technology:

> It requires more than just a single person to set the vision; it takes everyone being on the same page, same direction. . . . We need that teamwork and that single direction so that our resources are maximized and that we . . . have a common understanding where we are

> heading. . . . part of what we are trying to do here is let folks know this is the avenue we're going; and this is the direction. (James Robinson, assistant principal, Madison Middle School)

This common understanding that Mr. Robinson mentions is what Michael Fullan (2001) calls shared meaning. According to Fullan, this shared meaning is essential for the kind of second-order change that Mrs. Duncan is trying to implement at Madison Middle School.

Another key element to this technological transformation is professional learning. At Madison Middle School, Mr. Robinson provides most of the formal professional learning for the teachers; but professional learning does not stop there. The teachers who are selected as technology leaders by their peers in the Pre-Survey are providing informal professional learning on how to use technology within their curricular areas. They are going into classrooms; and they are presenting model lessons that integrate technology for individual teachers who request this help. The other professional learning opportunities that are available to teachers are those offered from the Central Office during the school year and during the summer. The synergy that is taking place at Madison Middle School is paying huge dividends:

> I think there is excitement among the faculty. It really tickled me to see how many teachers had signed up for the technology classes that are being offered this summer. Summers are precious; and for people to take part of their summer to attend classes really shows a movement towards wanting to use more technology. (Rita, media specialist, Madison Middle School)

Conclusion

This research study started off as an attempt to determine if the school leaders influence teachers' adoption of technology integrated classroom practices. The answer to that question is

relatively simple. They do. But the answers that are harder to discern are how. How do formal leaders persuade teachers to adopt a new pedagogy? Fortunately, I was able to compare four middle schools that, as it turns out, have very different types of leaders with very different types of leadership styles, and with very different types of visions concerning how technology should be used. By comparing these four leaders, by comparing the context of these four schools through the eyes of teacher technology leaders, a muddled picture becomes clearer. The implications of these findings will be discussed in detail in Chapter 5; however, this study has led me to come to one basic conclusion. If a formal school leader wants the teachers in that leader's school to adopt technology integrated classroom practices, that leader must "reculture" the teachers in the school. Michael Fullan (2001) defined reculturing as the process of teachers questioning their beliefs and questioning their classroom practices. Research concludes that to accomplish this reculturing process, as it pertains to the integration of technology, a school leader must adopt eight strategies or practices (see Table 8). It appears that these eight strategies must be adopted en masse, not selectively chosen. In this study there are certain principals who adopted several of these strategies but not all; and, as a result, these principals are unsuccessful in reculturing their schools. There is only one principal, Lynda Duncan, who adopts all eight strategies; and her school, Madison Middle School, is the only school in which reculturing is taking place. Interestingly, only in this one school has the principal articulated a clear vision for the integration of technology. Although it is tempting to state that vision is the most important strategy; and as long as the principal has the vision then the school will be recultured; however, without adequate resources, or without the other strategies this vision will not take root. A more thorough discussion of these eight strategies occurs in Chapter 5. The eight strategies are: having a vision for technological transformation; modeling that vision; setting clear expectations for

accomplishing that vision; providing the resources necessary to implement that vision; providing the encouragement to teachers who are trying to implement that vision; creating human capital by hiring with technology use in mind; providing the right kind of professional learning to reinforce that vision; and building a community of leaders within a building.

Table 8

Analysis of Which Schools are Implementing the Eight Strategies

Strategy	Adams MS	Jefferson MS	Madison MS	Washington MS
Vision			Complete	
Modeling	Partial	Partial	Complete	Partial
Expectations		Partial	Complete	
Resources	Complete		Complete	
Encouragement	Complete	Partial	Partial	
Hiring			Complete	
Professional Learning	Partial	Partial	Complete	Partial
Building Capacity	Complete		Complete	

CHAPTER FIVE

ANALYSES

Overall Analysis

The first goal of this study is to understand if school leaders can influence teachers into adopting the integration of technology into their classroom practices; the second goal of this study is to understand how school leaders can influence teachers to accomplish the first goal. The data collected provides evidence that school leaders influence teachers into adopting technology integration classroom practices; but, more importantly, the data indicate that there are eight key strategies (see Table 9) that school leaders must use if they want to become a technology leader in their school and if they want to influence how much technology is integrated by the teachers. After analyzing the Pre-Survey, the principal interviews, the Focus Group interviews, and the documentation, it becomes very clear that Madison Middle School is fully implementing seven of these eight key strategies and is in the process of implementing the eighth strategy; Adams Middle School is fully implementing three of these eight key strategies and is in the process of implementing two other strategies; Jefferson Middle School is in the process of implementing four of the eight strategies; and Washington Middle School is in the process of implementing only two of these eight strategies. The differences between these four schools can be viewed as to the degree of acceptance that each principal has in the eight strategies for becoming an effective technology leader within their school.

Table 9

Eight Strategies that School Leaders Must Employ to Positively Influence Teachers into Adopting Technology Integrated Classroom Practices

Vision	This is the most important strategy. It sets the direction for the use of technology integrated classroom practices.
Modeling	The administrators within a school must model the use of technology if they expect their teachers to use technology.
Expectations	School leader must articulate what their expectations are concerning the use of technology.
Resources	One of the most inhibiting barriers to the integration of technology is the lack of resources. School leaders must help provide technology resources.
Encouragement	Integrating technology can be very difficult to achieve due to the many extant barriers. School leaders must encourage risk taking in an effort to promote technology integrated classroom practices.
Human Capital	Hiring is the second most important strategy that a school leader can implement because the teachers are the ones who must turn the school leader's vision into reality.
Professional Learning	Ample and sustained professional learning is extremely important in the transformational process of making technology a viable instructional practice.

Capacity Building	In order to implement their vision, school leaders need to develop a core of early adopters who become advocates for technology use and thus start the process of capacity building

The Eight Strategies

These eight strategies represent the methods that school leaders must employ to make sure the school leaders are not only transformational leaders but also are technology transformational leaders. As schools continue into the 21st Century it becomes more essential than ever for school leaders to leverage instructional technology in order to provide the education needed for their students to thrive in this new century. The skills needed for 21st Century learners are: problem-solving, critical thinking, collaboration, communication, cultural literacy, global awareness, and technology literacy. In order for these needed skills to become integrated into every teachers' classroom practices, school leaders must use the eight strategies listed in Table 9. Even though these eight key strategies are equally important, the strategy that is first among equals is vision; without vision a school becomes a "rudderless ship" not knowing from where it came nor knowing to where it is headed. Vision provides the direction in which school leaders want to take their school. Vision represents what Michael Fullan (2001) referred to as "shared meaning"; both the school leader and the teachers within the school must agree to what this vision is, because if the teachers do not share in this vision then this vision will not be implemented. The second strategy is modeling. For a school leader to get the teachers to take ownership of this vision, the school leader must also exhibit their belief in the vision by not only talking the talk but also by walking the walk. The third strategy is expectations. The school leader must set very clear expectations for the use of technology and must articulate these expectations to the teachers. The

fourth strategy is resources. Unfortunately, teachers trying to integrate technology often run into barriers that make this task more difficult. One of the most pervasive barriers is the lack of technology resources. School leaders must work on providing the technology resources that teachers must have in order to integrate technology into their classroom practices. The fifth strategy is encouragement. School leaders must encourage their teachers to be risk takers. A word of encouragement often goes a long way in relieving the fears and the anxieties teachers have in integrating technology. The sixth strategy is human resources. The most important decisions school leaders make are hiring decisions because it is the teachers who make sure the vision is implemented. The seventh strategy is providing ample and sustainable professional learning. For most teachers integrating technology into their classroom practices is a paradigm shift. To assist teachers into changing their pedagogy from a teacher-centric pedagogy into a student-centric pedagogy, it will require substantial professional learning opportunities. The final strategy is capacity building. School leaders must first start out with building a core group of early adopters and then nurture this core group to make sure the core group grows in size and in scope. This building of a core group and then of nurturing the core group will build the capacity within the school necessary to ensure that everyone eventually comes onboard. A more detailed look at each of these eight strategies follows.

Strategy 1: Vision

An analysis of the Pre-Survey, the principals' interviews, the Focus Group interviews, and the documentation provides insights into the necessary ingredients a principal has to adopt if the principal wants to become a technology leader for that principal's school. Obviously, everyone has a vision; but, the key to creating a successful organization is that everyone within that organization must share the same vision (Fullan, 2001; Sergiovanni, 2006). This is particularly

true in education because teachers have a great deal of autonomy within their classroom; and if a teacher's vision is not aligned with the principal's vision then the principal's vision will not be implemented (Fullan). The Pre-Survey contains two questions that deals with vision. The first question asks the teachers what their vision is concerning how technology should be used within their classroom. The second question asks the teachers what they think the principal's vision is concerning how technology should be used within their classroom.

Analysis of the Pre-Survey reveals that only in Madison Middle School is there an alignment between the teachers' vision of technology use and the teachers' perception of the principal's vision of technology use (see Table 3). In every category at Madison Middle School the teachers' vision for technology use and the teachers' perception of the principal's vision of technology use is no more than a difference of 16 percentage points. In four of the five categories, the difference in percentage points is seven or less. When compared to the other schools this alignment at Madison Middle School is a close alignment. The average difference in the five categories in percentage points at Madison Middle School between the teachers' vision and the teachers' perception of the principal's vision is 6.0. When the principal's interview and the Focus Group's interview are factored into this analysis, the alignment of vision becomes even stronger.

When the data, from the five categories that focused on vision from the Pre-Survey that comes from Madison Middle School, is compared to the same datasets from the other three middle schools, some interesting data are obtained. Adams Middle School has a very close alignment similar to the data from Madison Middle School: their average difference in percentage points is 6.2 between the five categories. On the other hand, there is severe misalignment between the teachers' vision of technology use and the teachers' perception of the

principal's vision of technology use at Jefferson Middle School and at Washington Middle School. At Washington Middle School the average difference in percentage points between the five categories is 14.8; at Jefferson Middle School the average difference is 15.0. Therefore, in two schools there is a close alignment and in two schools there is not a close alignment. Before a conclusion can be drawn from this data, however, another dataset needs to be examined. On the two questions from the Pre-Survey that are concerned with vision, one of the answers the teachers have the option of selecting is not knowing what the principal's vision is concerning the use of technology. When these data are factored into the analysis, Madison Middle School's alignment becomes even more closely aligned but Adams' alignment becomes more misaligned. The data from this answer for Madison Middle School are that only 11% of the teachers responded that they do not know what the principal's vision is towards technology use. When this number is compared to the percentage of teachers who responded the same way at the other three schools, then the true significance of this number is revealed. Compared to Madison Middle School's 11%, the other schools' percentages for this answer were much higher: Jefferson Middle School's 26%; Washington Middle School's 28%; Adams Middle School's 42%. The percentage of teachers at Madison Middle School who report not knowing the principal's vision is less than half the percentage of the next lowest school, Jefferson Middle School at 26%. The significance of this alignment cannot be overstated because unless the teachers and the principal of a school can work together for a common purpose, then all the other strategies will fail to elevate technology into a position in which technology can assist in creating a viable learning environment and into which technology can assist in improving student achievement. This is the crux of Michael Fullan's (2001) research on educational change. He

states that for educational change to be realized the principal and the teachers must have a shared meaning on what this change represents.

Strategy 2: Modeling

Although all the principals talk about modeling the use of technology in their school, only the assistant principal at Madison Middle School models technology use every day. During the interview with Mrs. Duncan and Mr. Robinson, the words "model" or "modeling" are mentioned nine times. Mr. Robinson expresses his firm belief in the need to model technology use if he expects the teachers to use it when he says, "I was modeling it, modeling using technology in the grade level meetings . . . . This is verified by those teachers who are members of the Focus Group. They credit Mr. Robinson for transforming the teachers into technology users because Mr. Robinson models technology every day.

At Jefferson Middle School, Mr. Callifano models technology, but the difference is that he does not model it every day. During Mr. Callifano's interview he uses the word "modeling" only once even though he explains several instances in which he models technology use. He models technology only on special occasions not on an everyday basis.

> I actually had a teacher, a social studies teacher, right during post planning come to me and said, 'Let me show you what I have done. I have been using the graphic organizer Open Mind.' He went into Open Mind and he had a 360 degree chart that when he clicked on one standard up popped all the activities and under the activities it popped up (unintelligible). He is doing that with the 8th grade social studies teachers. We went to a meeting to talk about social studies; and I did a presentation for the other social studies teachers using his material; and they went back to their classroom and began using it

> once they saw what benefit it was providing for organization and for lesson planning. (Mr. Callifano, principal, Jefferson Middle School)

Likewise, Mrs. Almond at Washington Middle school uses the word "modeling" only once; but she explains how she uses a data projector to project a PowerPoint presentation occasionally at faculty meetings. Mrs. Buchanan at Adams Middle school does not mention modeling to her faculty; but she talks about allowing some of the teacher leaders to model technology use to the faculty. The impact that modeling can have on the faculty is somewhat lost if the principal or the assistant principal are not the ones doing the modeling. The data seems to indicate that consistent and frequent modeling is necessary to influence teachers to adopt technology integrated classroom practices.

Strategy 3: Expectations

When comparing the data from the Pre-Survey, the data from the principals' interviews, and the data from the Focus Group interviews a similar pattern emerges with this strategy on expectations as emerged for the strategy on vision. When the teachers are asked in the Pre-Survey what the expectations are in their school for the teachers' use of technology only 4% of Madison Middle School teachers answer that there are no expectations (see Table 4). In comparison, the percentage of teachers at the other three middle schools is much higher. For example, at Adams Middle School it is 17%; at Jefferson Middle School it is 24%; at Washington Middle School it is 26%.

During the interview with the principal and the assistant principal at Madison Middle School the word "expectations" is mentioned seven times:

> We started with day one this year with modeling technology and with that expectation with the fact that we are going to put [technology] into everybody's hands, and then

> expect [pause] to give them the training, and then expect them to use it to benefit student achievement. (Mr. Robinson, assistant principal, Madison Middle School)

In addition to impacting instructional practices, the principal makes the decision that her school is going to use technology in every aspect of its operations. In the past, the school handed out paper-based gradebooks; but in August 2007 that changes:

> Most people did not use [the paper gradebooks]; they entered their grades on the computer; so we made a pretty quick, pretty firm decision to go straight to the electronic version of the gradebook, and pretty much give the teachers training, and made the expectation that they do that. (Mr. Robinson, assistant principal, Madison Middle School)

During the interviews with the other principals it is clear that these school leaders do not explicitly tell their faculties what their expectations are. For example, in the interview with Mrs. Almond, the principal at Washington Middle School, the word "expectations" is never mentioned even though one of my interview questions is, "What are your expectations for your teachers to integrate technology?" Another example of the lack of communicating clear expectations comes from Jefferson Middle School's Mr. Callifano who says that he never explicitly tells his faculty what his expectations are. He thinks that by modeling the use of technology he is sending a clear message what his expectation are even though they are implied:

> Those expectations are there. I don't really have to say anything. Those teachers automatically understand that I would expect them to be doing it; and sometimes they do it better. They will come back and say, 'Hey, I figured out we could do this and this on the eLearn site and they could link it with SharePoint.' We are talking about that; and the expectations are really not scripted anywhere; they see what I am doing; and they

> presume I understand that I would expect them to do it. (Mr. Callifano, principal, Jefferson Middle School)

Clearly, his assumption is not working with 24% of his faculty saying they do not know what his expectations are.

At Adams Middle School the principal uses the word “expectations” only once during our interview. When I asked her what her expectations are for her teachers integrating technology, she responds, “I want our teachers to use the technology that they have and use it to the point that it becomes effective.” What she never says is how she articulates those expectations to her teachers. Considering that 17% of the teachers at Adams Middle School state that there are no expectations at their school about technology use, then it is reasonable to assume that the principal is not articulating her expectations about technology use very effectively if at all.

Strategy 4: Resources

Not having enough technology resources is the one topic in which there appears to be uniform agreement among all the principals during their interview, among all the teachers who responded to the Pre-Survey, and among all the teachers who participated in the Focus Group interviews. On the Pre-Survey, the teachers in every school list the lack of technology resources as the number one barrier they face as they try to integrate technology. The percentage of teachers who list this answer as a barrier ranges from 56% at Washington Middle School to 78% at Madison Middle School. The only other barrier that comes close to these numbers is the lack of access to the computer lab which is, in a sense, also a lack of access to technology resources. The percentage of teachers who choose this choice ranges from 56% at Washington Middle School to 77% at Jefferson Middle School.

Even though every school faces the same problem of lack of resources, after analyzing the spending of Title 1 funds for the 2007-2008 school year (see Table 5 and Table 6) I concluded that two of the principals, Mr. Buchanan at Adams Middle School and Mrs. Duncan at Madison Middle School, decide to mitigate this problem by expending significant sums of their Title 1 funds on technology purchases during the summer of 2008. At these two schools the principals exhibit technology leadership. Since the Pre-Survey is conducted in the spring of 2008 three months before these purchases become available to teachers, the responses on this survey do not reflect this infusion of resources which occurs several months later. It is reasonable to assume that the responses to this question in the Pre-Survey for these two schools would be different if another survey is conducted after this infusion of technology purchases.

During each Focus Group interview there is a consensus among all the teachers that the lack of resources is a major barrier to the integration of technology.

> When schools begin to get some technology, but not enough for every teacher, that created some dissension among the staff. A lot of the new people who are here this year got the ActivBoards and that kind of equipment; and they have no idea how to use it. There are people who have been here for quite some time; and they are all in the core content areas; and they say, "Why did they get one and I didn't?" I have heard a lot of groaning and bickering about this because there are people who have been here for years; and they do not get one. (Francis, 6th grade language arts teacher, Adams Middle School)

Trying to prevent that dissension is what Mr. Callifano at Jefferson Middle School attempts to do by not buying anything. What he actually accomplishes is to make every teacher dissatisfied with the technology situation at his school.

Strategy 5: Encouragement

When attempting to promote technology use, the encouragement strategy is the companion opposite of expectations. Encouragement to promote technology use without explicit expectations is empty rhetoric; explicit expectations to integrate technology without frequent encouragement are pernicious dogma. Each must occur frequently and consistently. In three of the four schools the principals offer encouragement and even encourage creative lesson planning. Mr. Callifano, for example, becomes animated when he expresses his attitude about encouraging teachers to use technology.

> The encouragement [to integrate technology] that they receive from me is that, "Let's do it, let's see what happens. Let's figure out a way to get this done because if it is a great idea then it is going to help the kids; so why not try it and see what happens." (Mr. Callifano, principal, Jefferson Middle School)

At Washington Middle School the opposite is happening; teachers are not encouraged to integrate technology; they are bullied. Instead of defending her teachers, Mrs. Almond unjustifiably criticizes them.

> The technician responsible for [preparing report cards before printing] sends out an email to the principal about how messy the report cards are; and the principal gets on the intercom and blest us out totally about what a mess they were in; and this is something that we had [no] control over. (Pamela, teacher, Washington Middle School)

This kind of criticism of the teachers creates dissension among the teachers, lowers morale, and takes the focus off the purpose of schooling – the education of children.

Integrating technology into classroom practices is difficult enough without the support and the encouragement of the school leader (Mousa, 2003) especially considering the lack of

resources available to all teachers that are prevalent in each school. To overcome these barriers teachers need to feel that their efforts are appreciated and that their efforts are encouraged.

Strategy 6: Creating Human Capital

Jim Collins (2002) in his book *Good to Great: Why Some Companies Make the Leap … and Others Don't* explains the findings from his research on how good companies become great companies. One of the most important findings in his research easily applies to education; one of the most important functions of a leader, if not the most important, is the hiring of the right people. He explains who the right person is: the person who shares the core values of the organization and the person who does not have to be managed. He uses a metaphor for this hiring process; he calls it getting the right people on the bus and getting the wrong people off the bus. In all the principal interviews I conducted, only one of the principals expressed an interest in hiring teachers or in hiring assistant principals who have technical expertise. When Mrs. Duncan talked about the process she went through in hiring a new assistant principal, she said she looked for three characteristics in the person she would hire: passion, energy, and technology literacy.

> So I went out looking for [an assistant principal] to bring passion and energy to our school. That is what I told him in the beginning that was his goal [since he had taught in high school]. I could teach him what I needed to about middle school as long as he brought the passion and energy . . . . There are more people who are technology literate, who have the nuts and bolts of technology; but it is the combination of [passion, energy, and technology literacy]. It is being able to see the vision, be[ing] able to identify the weakness and then be[ing] able to bring people into your beliefs and into your fold. (Mrs. Duncan, principal, Madison Middle School)

Mrs. Duncan talked about a vision to bring technology literacy to Madison Middle School ever since she became the principal. Unfortunately, it takes her several years before she has the proper team in place to implement this vision. The last step in her process of transforming Madison Middle School is the hiring of Mr. Robinson. Even the teachers in the Focus Group recognize the importance of that hiring decision, "The assistant principal, [Mr. Robinson], is the main reason that technology is being accepted so well in this school" (Jeannie, computer teacher, Madison Middle School). According to Jim Collins, if the school leader does not get the right people on the bus, then the leader's vision will never be implemented. Mrs. Duncan got the right person on the technology bus when she hired Mr. Robinson.

Strategy: 7: Professional Learning

Since the integration of technology represents change for most teachers, then sufficient professional learning is required. After trying for five years in the late 1980s and early 1990s to transform classrooms into student-centered technology integrated classrooms, the Apple Classroom of Tomorrow program concluded that intensive, formalized professional training is necessary (Ringstaff & Yocam, 1992). The principals at Adams Middle School, Jefferson Middle School, and Madison Middle School all talk extensively about providing onsite professional learning opportunities for their teachers. Mrs. Almond at Washington Middle School talks only briefly about inservice training. The Focus Group teachers at Washington Middle School complain about receiving the same professional learning program two years in a row. At Adams Middle School, the onsite technology-focused professional learning is delivered by its teacher leaders; whereas, at Jefferson Middle School it is delivered by Mr. Callifano. At Madison Middle School the onsite technology-focused professional learning opportunities are delivered both by the assistant principal and by the technology teacher leaders.

In order to quantify this commitment to technology-focused professional learning I analyzed the number of teachers who participated in two different programs offered from the Central Office during the summer of 2008. These two programs are "eLearn," a three day course on a distance learning component for regular classroom teachers, and "Teaching and Learning in the 21st Century Classroom," a five day course on learning to use an interactive whiteboard and on learning to integrate eLearn into the teachers' classroom practices. There are 26 teachers from Adams Middle School who participated in these technology-focused professional learning opportunities while from Washington Middle School there are 29 teachers who participated, from Adams Middle School there are 32 who participated, and from Madison Middle School there are 54 who participated. From these numbers it appears that Madison Middle School is more committed to having their teachers trained in how to use technology in their classrooms.

Strategy 8: Building Capacity within the School

In Fullan's (2001) book on educational change and in Sergiovanni's (2006) book on school principals, one of the most significant determinants for successful school leaders is creating a sense of community, a feeling of connectiveness, a common purpose. Sergiovanni explained this sense of community as a group of individuals bonded together by relationships but also bound together by shared ideas and ideals. This bonding and binding of individuals to common goals, shared values, and shared beliefs is what Sergiovanni calls the community of mind. By creating this community of mind within the culture of the school, the principal is creating an authentic community in which the whole is greater than the sum of its parts. Mr. Callifano at Jefferson Middle School talks extensively about creating a school with "shared governance," one of the elements of a community of mind.

> Shared governance at Jefferson is a true establishment of shared governance. There is very little hierarchy . . . . We make decision about who and what we will be teaching next year based upon what is best for children and based upon the data that we have about individual students. Teachers create their own team, decide how the budget will be spent, will determine the schedule . . . and it is a good group of teachers who make these determinations. (Mr. Callifano, principal, Jefferson Middle School)

In contrast, Mrs. Almond at Washington Middle School does not express any desire to have a community of mind. When I asked how she tries to build community within her school, she only talks about what she is doing to engage the parents of the students. She never once talks about building a sense of community among her teachers. After analyzing the Focus Group interview at Washington Middle School, data show no sense of community. The teachers who participated in the Focus Group all express a willingness to help other teachers with their technology questions; but, as far as a school-wide sense of community that does not exist.

At Adams Middle Mrs. Buchanan hinted at creating a community of leaders; but at Madison Middle, this sense of community of mind was being created due to the leadership of Mrs. Duncan. Teacher leaders exist at all four schools who promoted the use of technology; but only at Madison were these teachers actively modeling technology integration within other teachers' classrooms. These activities are helping to create a community of mind and, as a result, are building capacity within Madison Middle School.

The technology teacher leaders at Adams Middle School and at Madison Middle School are trying to create a community of mind within their building; however, only at Madison Middle School is this effort reaching fruition. At each school, there were three teachers who received a large number of votes in the Pre-Survey. In each case these three teachers acted as technology

teacher leaders for the whole school teaching teachers how to integrate technology. Other teachers provide the same support at the team level and at the grade level. At Adams Middle School this effort to build a community of mind about the use of technology is only having limited success apparently because the principal has not totally committed to technology. On the other hand, Madison Middle School is creating a common purpose about why and how technology is used. The school leaders are committed to this endeavor; and, as a result, Madison is building capacity within the building by creating a community of mind.

> If you go in and model it for them and show them it is alright if you make a mistake, it is just like learning a new concept. They get more comfortable with it and want to use it; and the kids get all excited about it; and then it becomes old hat; and it becomes common place. (Rita, media specialist, Madison Middle School)

CHAPTER SIX

IMPLICATIONS

Four Implications

To persuade school leaders that this new vision for learning includes technology integration, then a district administrator must do three things. First, school leaders must be convinced that this is in the best interest of the learners to adopt this new vision of learning; second, a district administrator must persuade school leaders that, in most cases, the culture in a school is resistant to change thus requiring school leaders to find a way to mitigate that resistance; and third, a district administrator must persuade school leaders that technology integration will increase student achievement.

In the 2003 study highlighted in Hofer's (2005) meta-analysis the results indicated that adopters of technology integration did so because it was in the best interest of the learners. Another result of that study concluded that adopters of technology did so because the learners demanded it. In other words, technology integration becomes learner driven. Sergiovanni (2006) concurs with the conclusion that teachers adopt this new vision of learning because it is best for the learners. Sergiovanni believes that individuals act in specific ways because they feel that it is the right thing to do. This is Sergiovanni's (2006) third rule of motivational strategy. If technology integration is in the best interest of the students, then technology integration will become the right thing to do. According to Henry Becker (2001) technology enhances student learning; and technology creates student motivation. Furthermore, technology integration prepares these 21st Century learners to take their place in the world of the 21st Century.

As a school district moves forward in the 21st Century, it must adopt a new vision for learning that allows its students to become active participants in the Knowledge Age by providing them with a third wave education (Toffler, 1970). Without this third wave education the future of our students is indeed bleak. Even the federal government recognizes the changes which are occurring globally in the 21st Century and the need for K-12 educational institutions to adapt to this change. In the *No Child Left Behind* legislation passed in 2001 there is a provision that all 8th grade students be technology literate (Partnership, 2005). The Educational Testing Service also recognizes the need to adapt to these changes because it began pilot-testing in 2005 an Information and Communication Technology Literacy Assessment for college students (Partnership, 2005). The issue then which confronts a school district is what is their vision for learning; what kind of student does a school district want to produce? In *Hamlet*, Shakespeare wrote, "We know what we are but not what we may be" (Act IV, scene v). So, what kind of people do school districts want their graduates to be in 10 years, in 20 years? The literature indicates that school districts should want their students to be adaptable, to be flexible, and to know how to learn so that they will to be able to thrive in the Knowledge Age yet to come (Prensky, 2006; Toffler, 1970).

At the conclusion of the analysis of the data it becomes clear that there is one school which is positively influencing teachers into adopting technology integration classroom practices; and there are three schools which are not exercising all eight strategies; therefore, the teachers in these schools are not wholeheartedly adopting technology integration. This study reached the conclusion that for a school leader to also become a technology leader in her school, this school leader must begin using the eight strategies outlined in Chapter 5. This study has many implications such as how school leaders are prepared in graduate school, as well as, which

professional development programs are created, how technical resources are allocated, and how additional research studies are developed.

Implication 1: Changes in School Leadership Preparation

As schools and as school districts move forward in the 21st Century, a school leader must be aware of the need to transform this leader's school into a 21st Century learning environment in order to meet the needs of today's students. Technology has become essential in schools for administrative purposes; more and more technology is becoming equally as essential for instructional purposes. To allow students to graduate from high school without a solid grounding in technology use is handcuffing students in their future endeavors. School leaders, therefore, need to be technology leaders for their school. If school leaders are hostile to or are ambivalent towards technology this situation will create a school culture in which technology is not valued. Graduate schools of education need to reevaluate their curriculum in order to include a course for education leaders that deals with technology issues. This course should be designed around the eight strategies described in Chapter Five, in addition to other topics such as to technology planning, media services, and evaluation of technology-enhanced lessons plans.

Unfortunately, school leadership preparation programs at state universities are designed to meet the certification standards set by their state regulatory agency. If the certification standards do not include a technology component then it is highly unlikely that an individual university school leadership preparation program will include that component in their required courses. With all the emphasis today on technology for administrative functions so that administrators can make data driven decisions, it is a disservice to the students that technology integrated classroom practices is being ignored by school leadership preparation programs.

Technology has the power to transform a didactic, dull, learning environment into an engaging, stimulating learning environment.

Implication 2: Technology Professional Development Program

Another implication of this study is that a well thought out professional development program needs to be created that provides teachers with not only the technical skills they need to become successful in a technology-enriched classroom, but also with the pedagogical skills they need in order to integrate technology in a way that engages the students in the learning process and in a way that teaches students higher cognitive skills, problem solving skills, creativity skills, and collaboration skills. Students today will be solving problems in 20 to 30 years that, today, we do not know will be problems. It is impossible, therefore, to teach these students the exact skills and the exact knowledge they need for their future endeavors. What we need to be teaching these students is how to ask insightful questions, how to have inquisitive minds, how to be self-learners, and how to be lifelong learners. That is education's goal in the 21st Century. To achieve this goal, a purposeful professional development program that teaches administrators and teachers these skills is essential. Past research speaks to this need (Creighton, 2003; Dwyer, 1995; Mouza, 2003).

Researchers working on the Apple Classroom of Tomorrow (Dwyer, 1995) discovered after five years of only minimal success in getting teachers to adopt technology integration classroom practices that a strong purposeful professional development program is essential for any technology integration program to be successful. Furthermore, Brinkerhoff (2006) learned to his dismay that a professional development program will only become successful if it is sustainable over at least three years. He studied a two year professional development program and concluded that two years is insufficient. He concluded that it takes three to five years of

professional development to change a teacher's belief structure. School leaders and district leaders must be willing to commit to a technology professional development program for the long haul.

Implication 3: Provide Necessary Technology Resources

A third implication is that the lack of technology resources can be a major inhibitor for teachers trying to integrate technology. School leaders must be cognizant of this and of other barriers in order to adjust their expectations accordingly. Although school leaders often do not have the direct authority to rectify the technology resource barrier, they can have an indirect effect by lobbying district level policy makers for additional resources. Furthermore, school leaders can lobby their state legislators and their Congressional lawmakers for additional funds for technology resources.

Implication 4: Additional Research

The last implication of this study is that additional research needs to be conducted on this topic. The role of leadership in teachers' adoption of technology integrated classroom practices has basically been ignored by the instructional technology research community. It can be assumed that the reason instructional technology researchers have not considered the school leadership factor is because it is a different discipline; and most instructional technology researchers do not have a background in or have experience in school leadership. As a result of this limitation, additional research is needed in these combined fields. Furthermore, this research model could be extended further up the administrative organization. For example, what influence does the district leadership have on teachers' adoption of technology integration? What influence does the district leadership have on principals' adoption of the eight strategies? How many of these eight strategies apply to district administrators, especially to the superintendent?

This study focuses on middle schools. Additional research needs to be done at elementary schools and at high schools; research needs to be done at urban schools and at rural schools; research needs to be done in other sections of the country. In other words, research on the interaction between school leaders and on teachers is a field that needs attention. Understanding the change process and understanding the difficulties teachers have of achieving second-order change (Ertmer, 2005) are important for school leaders if these same leaders want to be transformational leaders in the 21st Century. If teachers are going to be expected to integrate technology into their classroom practices, these teachers need their principals to be exercising the eight strategies described in Chapter 5; these teachers need their principals to be not only school managers, and to be not only instructional leaders, these teachers need their principals to be the technology leader in their school.

Even though understanding if technology integration can affect student achievement is beyond the scope of this dissertation research, this topic nevertheless is of upmost importance to the instructional technology research community and needs to be studied. This dissertation and the various journal articles that emanate from it will be a shot across the bow for the instructional technology research community to awaken this community up to the a multi-disciplinary area of study that could solve the riddle first proposed by Larry Cuban in 2001.

Conclusion

I think it is self-evident from this study that school leaders can influence teachers' adoption of technology integrated classroom practices. The real question is how. A thorough analysis of the various datasets has led me to conclude that there is one school, Madison Middle School, which is influencing teachers to adopt technology integrated classroom practices; and that there are three schools which are at various points along this path of technology integration;

but none of these three schools has achieved complete success. I decided to find out what was different between the one school which was being successful in its pursuit of technology integration and the other three schools. Through the use of the constant comparison method the data uncovers eight strategies for successful technology integration; these are the leadership strategies that need to be implemented to achieve technology integration in a school. It appears that the data in this study indicate that all eight strategies need to be implemented en masse; however, that is just a preliminary conclusion that requires further research to verify. Vision, the first of the strategies, is akin to the lead dog on a sled dog team; the lead dog provides the direction and the pace for the rest of the team. However, the other sled dogs also provide a vital function; the sled cannot traverse its terrain to reach its destination without the other sled dogs. Likewise, the other strategies are vitally important for the school leader who wants teachers in his school to integrate technology into their classroom practices. All the strategies are equally important just as all the dogs in a sled dog team are equally important because neither the school leader nor the musher can reach their destination without these strategies for technology integration or without the dogs attached to the musher's line. School leaders' selectively choosing strategies they want to implement and leaving the others alone will be the musher who leaves half the dog team back at the house; both are destined to fail.

In 2001, Larry Cuban in his landmark book *Oversold and Underused: Computers in the Classroom* declared that technology integration is only being used at the first-order of change and that the promise of technology in education is destined to fail. What Cuban did not comprehend is the importance of school leaders in influencing teachers' attitudes and practices. The key, therefore, is the alignment between the principal's vision for technology integration with the teachers' vision for technology integration. This alignment is crucial. Of course, all this

is dependent upon the principal not only being a school leader but also being a technology leader for the school. The path to dispelling Cuban's thesis, the path to achieving technology's promise, the path to achieving technology integration success, is the path of eight strategies leading to principal and teacher alignment, and, as a result, to student success.

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APPENDICES

APPENDIX A

Pre-Survey Questions

1. How many years teaching experience do you have?
    a. Less than one full year
    b. 1-2
    c. 3-10
    d. 10-20
    e. 21+

2. How many years teaching experience do you have in this school?
    a. Less than one full year
    b. 1-2
    c. 3-5
    d. 6-10
    e. 11+

3. Which content area do you teach?
    a. Language Arts
    b. Math
    c. Science
    d. Social Studies
    e. Other

4. Who are the technology leaders within each school? List them in order of importance with one being the most important.
    a. Principal
    b. Assistant Principal(s) (please list by name)
    c. Media Specialist
    d. Teacher(s) (please list by name)
    e. Para Professional(s) (please list by name)
    f. Other(s) (please list by name)

5. What barriers do you encounter when you try to utilize technology within your classroom practices? (Check all that apply)
    a. Lack of time to plan effectively
    b. Lack of time to implement effectively
    c. Lack of time to learn software programs
    d. Lack of knowledge on how to use technology effectively
    e. Lack of Professional Development opportunities
    f. Lack of personal technical skills
    g. Lack of technical assistance
    h. Lack of instructional assistance
    i. Unreliability of equipment
    j. Lack of technical resources within your classroom (i.e. computers, projector)
    k. Lack of access to computer lab
    l. Lack of support from administration
    m. Too restrictive policies on accessing web content
    n. Overemphasis of standardized tests
    o. Other

6. If you encounter a barrier, either technically or instructionally, to your utilization of technology within your classroom, who do you ask for help to overcome this barrier?
    a. Principal
    b. Assistant Principal
    c. Media Specialist
    d. Teacher(s) (please list by name)
    e. Para Professional(s) (please list by name)
    f. Other

7. In what ways can the technology leaders in this school assist you in overcoming these barriers? (Free response)

8. Do you feel encouraged to use technology within your classroom?
    a. All the time
    b. Most of the time
    c. Some of the time
    d. Infrequently
    e. Never

9. Would you feel comfortable being a technology innovator as far as your classroom practices are concerned?
    a. All the time
    b. Most of the time
    c. Some of the time
    d. Infrequently
    e. Never

10. How would you describe your classroom practice along the continuum between direct instruction (teacher-centered) and constructivism (student-centered)?
    a. 100% teacher-centered
    b. 90% teacher-centered and 10% student-centered
    c. 80% teacher-centered and 20% student-centered
    d. 70% teacher-centered and 30% student-centered
    e. 60% teacher-centered and 40% student-centered
    f. 50% teacher-centered and 50% student-centered
    g. 40% teacher-centered and 60% student-centered
    h. 30% teacher-centered and 70% student-centered
    i. 20% teacher-centered and 80% student-centered
    j. 10% teacher-centered and 90% student-centered
    k. 100% student-centered

11. In which instructional environment do students learn best?
    a. In a teacher-centered classroom
    b. In a student-centered classroom

12. Why do you use technology in your classroom?
    a. Because students enjoy using technology
    b. Because it helps teach basic skills
    c. Because it allows students to work on the computer while the teacher can be helping other students individually
    d. Because using technology is preparing students for the 21st Century
    e. Because it is expected in this school
    f. Because my colleagues use technology
    g. I do not know why
    h. I do not use technology
    i. Other

13. What is your vision concerning how technology should be used within your classroom? (Choose only one answer)
    a. To reward students for finishing their regular work early
    b. To teach or to reinforce basic skills
    c. To prepare the students for college or for the future workplace
    d. To teach higher cognitive skills such as critical thinking
    e. To teach social networking skills
    f. To teach communication skills
    g. To motivate students to learn
    h. I do not think technology should be used

14. What do you believe is your principal's vision concerning how technology should be used within your classroom?
    a. To reward students for finishing their regular work early
    b. To teach or to reinforce basic skills
    c. To prepared the students for college or for the future workplace
    d. To teach higher cognitive skills such as critical thinking
    e. To teach social networking skills
    f. To teach communication skills
    g. To motivate students to learn
    h. I do not know what the principal's vision is concerning technology

15. In which instructional environment do students learn best?
    a. In a teacher-centered classroom
    b. In a student-centered classroom

16. How often do you integrate technology into your classroom practices?
    a. Daily
    b. Multiple times per week
    c. Once per week
    d. 2 or 3 times per month
    e. Once per month
    f. Once per 9-week grading period
    g. Once per semester
    h. Once per year
    i. Never

17. Which technologies do you use in your instructional practices during the course of a year? (Check all that apply)
    a. Interactive devices – board or pad
    b. Student response system
    c. Internet
    d. PowerPoint
    e. Word
    f. Excel
    g. Camera (video or still)
    h. eLearn
    i. Other

18. Which technologies do your students use in your classroom? (Check all that apply)
    a. Accelerated Reader
    b. New Century
    c. Interactive devices – board or pad
    d. Student response system
    e. Internet
    f. PowerPoint
    g. Word
    h. Excel
    i. Camera (video or still)
    j. eLearn
    k. Other

19. How many computers in your classroom are available for students?
    a. None
    b. 1
    c. 2-3
    d. 4-5
    e. 6+

20. Assume you have only one student computer and one teacher computer in your classroom, what one type of technology would you add? (Choose only one answer)
    a. More computers
    b. A mounted projector
    c. An interactive whiteboard (this includes a mounted projector)
    d. A student response system
    e. A camera
    f. I would not add any more technology

21. What are the expectations in this school concerning teachers' utilization of technology within the classroom?
    a. There are no expectations
    b. To prepare for the standardized tests
    c. To take AR tests
    d. To prepare students for the 21st Century

22. How often are you expected to use technology within your classroom?
    a. There are no expectations
    b. Once per day
    c. Once per week
    d. Once per month
    e. Once per semester

APPENDIX B

Principal's Interview Questions

1. How many years in education do you have?

2. How many years in a formal leadership position do you have?

3. How long have you been a principal of this school?

4. Have you been a principal of another school before this assignment?

5. Would you consider yourself a technology leader in this school? If yes, why? If no, who do you think is/are the technology leader(s)?

6. What do you consider to be the barriers that prevent teachers from using technology within their classroom? How can you assist teachers in overcoming these barriers?

7. Do you feel it is important for teachers to integrate technology into their classroom lessons? If yes, what do you do to encourage them? If not, do you do anything overtly to discourage them?

8. Do you feel the teachers within your school feel comfortable becoming a technology innovator in their classroom practices? If yes, what do you do to encourage them? If no, why not?

9. How do you feel students learn best – in a teacher-centered classroom or in a student-centered classroom? Do you feel that integrating technology into teachers' pedagogy is important? If yes, how should teachers do that? If no, why not?

10. How is technology being used within the school and within each classroom? Is it being used the way you believe it should be used? Have you ever discussed with your faculty how you believe technology should be used? If yes, how and when? If no, why not?

11. What are your expectations concerning the utilization of technology within this school's classrooms? How do you articulate those expectations? Do you include technology utilization as part of your teacher evaluation?

APPENDIX C

Focus Group's Interview Questions

1. How many years in education do you have?

2. How long have you been at this school and what is your position at this school?

3. What content area do/did you teach?

4.T he teachers of this school listed you as one of the technology leaders of this school. Do you consider yourself to be a technology leader within this school? If yes, why? If no, why not?

5. What do you consider to be the barriers that prevent teachers from using technology within their classroom practices? How can you assist teachers in overcoming these barriers?

6. Do you feel it is important for teachers to integrate technology into their classroom lessons? If yes, what do you do to encourage them? If not, do you do anything overtly to discourage them?

7. Do you feel the teachers within your school feel comfortable being a technology innovator in their classroom practices? If yes, what do you do to encourage them? If no, why not?

8. How do you feel students learn best – in a teacher-centered classroom or in a student-centered classroom? Do you feel that integrating technology into teachers' pedagogy is important? If yes, how should teachers do that? Is no, why not?
9. On the average, how often do your teachers integrate technology into their classroom practices? How are students using technology in your school?

10. How is technology being used within the school and within each classroom? Is it being used the way you believe it should be used?

11. What are your expectations for technology utilization within a classroom? What do you do to assist teachers in achieving these expectations?