CHAPTER 2. LITERATURE REVIEW

Chapter Two builds the contextual framework for this study by incorporating relevant research and theory that are key sources for describing education technology leadership, which is the primary topic of this study. The chapter contains three sections. The first section explores the basis for education technology leadership including education technology leadership performance standards. In the second section, three different sources of education technology leadership are described. In the third section, a review of collaborative leadership theory as it relates to education technology leadership is provided. Each section contains an introduction as an advance organizer. The chapter concludes with a summary linking the research with theory to establish this study's framework.

Education Technology Leadership

The Education Technology Leadership section provides a general background and basis for the presence of technology leadership in pre-kindergarten through twelfth grade (P-12) schools today. This section discusses the importance of education technology leadership and provides a review of various education technology leadership standards.

Importance of Education Technology Leadership

There are almost as many definitions of leadership as there are persons who have attempted to define the concept (Stogdill, 1974, p. 259). For the purpose of this study, leadership was considered as a term describing the actions of an individual in relationship to other individuals. Leadership in this context can be described as "the process of persuasion and or example by which an individual (or leadership team) induces a group to pursue objectives held by the leader or shared by the leader and his or her followers"

(Garnder, 1990). Education leadership was the "guidance and direction" of instructional improvement (Elmore, 2000). Education technology leadership has been defined by the efforts to induce the pursuit of education improvement objectives with the support of technology.

The effective integration of technology into education can be throttled by the availability of education technology leadership. Schools have faced six barriers to effectively integrating technology into their curriculum, the biggest one being lack of leadership (Barnett, 2001). The school technology leader has been noted as one of the most important factors affecting the effective integration of education technology (Byrom & Bingham, 2001; Ross, McGraw, & Burdette, 2001). For example, in a quantitative study of factors that facilitate teaching and learning with technology in P-12 classrooms, strong technology leadership was determined to be a variable with high predictive influence (Baylor & Ritchie, 2002). This study found that school leaders who actively promote the use of technology by modeling technology use, planning and articulating a vision, and rewarding teachers as they strive to incorporate technology reinforce technology's importance, thereby influencing its use by teachers and students.

Education technology leaders have worked to create school improvement with the aid of technology (Creighton, 2003). Being an educational technology leader has required the ability to adapt to the quick changing pace of technology and also the ability to apply the technology where appropriate, not necessarily as soon as it emerges. It has required adequate training and understanding of how technology can be used to enrich the learning experience (Earl & Lampe, 2004, p. 22). It has required the technology leaders to be

technologically literate (Wonacott, 2001). Standards have been developed that help describe the framework for effective education technology leadership.

Education Technology Leadership Standards

Margaret Honey from the Education Development Center testified before the U.S. Senate that one can find ample empirical evidence that technology does have a positive impact when the right conditions are in place (Culp et al., 2005). She concluded that, if technologies are to be used to support real gains in educational outcomes, six factors must be in place: leadership, solid educational objectives, professional development, adequate technology resources, time, and evaluation. Norris, Smolka, and Soloway (1999), in a convergent analysis of technology studies, identified a set of five critical conditions for technology use in education: (1) access to technology and time on task, (2) adequate teacher preparation, (3) effective curriculum, (4) supportive school/district administration, and (5) supportive family. Similarly, Eichinger and Lombardo (2006) developed a professional leadership competency wheel that is applicable to education technology leadership, and is based on six leader qualities for success: (1) individual excellence, (2) organizational skills, (3) courage, (4) results, (5) strategic skills, and (6) operating skills. The education competency wheel diagram is shown in Figure 1.

The International Society for Technology in Education (ISTE) is an organization dedicated to promoting appropriate uses of technology to support and improve learning, teaching and administration in PK-12 and teacher education. ISTE is the home for the National Educational Technology Standards (NETS) Project. The primary goal of the ISTE NETS Project was to enable technology stakeholders in P-12 education to develop

Figure 1. Education Competency Wheel

Adapted from: (Eichinger & Lombardo, 2006)

national standards for educational uses of technology that facilitate school improvement in the United States (ISTE, 2006; Twomey et al., 2006).

The NETS Project was established in order to set the standards for educational uses of technology that would facilitate school improvement. Those standards have influenced program accreditation, state curriculum, and certification requirements in the United States of America (Twomey et al., 2006). The various NETS standard sets

represent a consensus view and a common sense wisdom about a variety of education technology elements, including education technology leadership. The NETS Project standards served to guide educational leaders in recognizing and addressing the essential conditions for integration of education technology in support of P-12 education. Within the body of NETS Project work are four sets of education technology standards that are related to the topic of education technology leadership: (1) National Education Technology Standards for Students (NETS-S), (2) National Education Technology Standards for Teachers (NETS-T), (3) National Education Technology Standards for Administrators (NETS-A), and (4) Technology Leader (TL) standards.

The NETS-S were published in 1998. They were developed from a synthesis of responses to proposed educational technology standards from many groups and individuals across the nation who participated in conference sessions, technology forum meetings, Internet dialogue, and surveys (ISTE, 2000). The NETS-S project established six standards. These standards provided a framework for all five of the NETS Project standard sets. The NETS-S standards are listed in Table 1.

The NETS-T were developed with a focus on pre-service teacher education. NETS-T defined the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings (ISTE, 2002). NETS-T provided a framework for implementing technology in teaching and learning. The NETS-T work supplied teachers with strategies for integrating technology into their professional preparation and into their classroom by providing a myriad of subject related resources. The NETS-T standard framework is listed in Table 2.

The NETS-A were based on the work of the Consortium for Technology Standards for School Administrators and their Technology Standards for School Administrators (TSSA). The NETS-A standards represented a national consensus

Table 1. NETS-S standards

Standard	Description
NETS-S Standard 1	Basic operations and concepts
NETS-S Standard 2	Social, ethical, and human issues
NETS-S Standard 3	Technology productivity tools
NETS-S Standard 4	Technology communications tools
NETS-S Standard 5	Technology research tools
NETS-S Standard 6	Technology problem-solving and decision-making tools

Table 2. NETS-T standards

Standard	Description
NETS-T Standard 1	Teachers demonstrate a sound understanding of technology operations and concepts.
NETS-T Standard 2	Teachers plan and design effective learning environments and experiences supported by technology.
NETS-T Standard 3	Teachers implement curriculum plans, which include methods and strategies for applying technology to maximize student learning.
NETS-T Standard 4	Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies.
NETS-T Standard 5	Teachers use technology to enhance their productivity and professional practice
NETS-T Standard 6	Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in P-12 schools and apply those principles in practice.

Table 3. NETS-A standards.

Standard	Description
NETS-A Standard 1	Educational leaders inspire a shared vision for comprehensive integration of technology and foster an environment and culture conducive to the realization of that vision.
NETS-A Standard 2	Educational leaders ensure that curricular design, instructional strategies, and learning environments integrate appropriate technologies to maximize learning and teaching.
NETS-A Standard 3	Educational leaders apply technology to enhance their professional practice and to increase their own productivity and that of others.
NETS-A Standard 4	Educational leaders ensure the integration of technology to support productive systems for learning and administration.
NETS-A Standard 5	Educational leaders use technology to plan and implement comprehensive systems of effective assessment and evaluation.
NETS-A Standard 6	Educational leaders understand the social, legal, and ethical issues related to technology and model responsible decision-making related to these issues.

among educational stakeholders of what best indicated effective school leadership for comprehensive and appropriate use of technology in schools (ISTE, 2004). The NETS-A standard framework is listed in Table 3.

The TL Standards were aligned with the six National Educational Technology Standards for Teachers (NETS-T), but extended the performance expectations of each NETS-T standard. The work was spurred by recognition that teachers and administrators have the potential and the shared responsibility to integrate technology into teaching and learning. The TL Standards addressed the need for a set of performance standards for educators responsible for supporting the integration of technology into teaching and

learning. “Technology leaders work as ambassadors among policy, technology, and pedagogy” (ISTE, 2002; Twomey et al., 2006, p. 17). The TL Standards serve to guide those leaders as they coordinated efforts of technical personnel, administrators, and classroom teachers. The TL Standards are listed in Table 4.

The education technology standards developed by the NETS Project were designed to identify the essential education technology skills, including education technology leadership skills. The NETS Project also produced information in support of assessing attainment of the standard skill sets. Assessments in the form of rubrics were published in the NETS Project body of work. The rubrics served to assess the various NETS standards across a performance continuum. This approach to assessing attainment of the standards suggests that proficiency in education technology leadership exists across a range as opposed to an “exist/not exist” criteria.

Another aspect of education technology leadership supported by the rubric approach to assessment was that there was the potential for complex inter-relationships and inter-dependencies, both between the various standard sets, and also within a standard set. These inter-relationships could be considered to be common threads running through the standards and the standard indicators. These underlying features, when viewed collectively, could be used to generate themes to help create a picture of technology leadership (Twomey et al., 2006). For example, themes mentioned by Twomey for the TL Standards included Evaluation, Professional Development, Design, and Implementation (p. 69). In the NETS Project, the TL Standards represented the essential skill sets of education technology leaders, with the opportunity for correlation between various TL Standard skill set indicators. In comparison, the TL Standard themes

Table 4. Technology Leadership (TL) standards

Standard	Description
Technology Leadership Standard 1	Technology Operations and Concepts. Educational technology leaders demonstrate an in-depth understanding of technology operations and concepts.
Technology Leadership Standard 2	Planning and Designing Learning Environments and Experiences. Educational technology leaders plan, design, and model effective learning environments and multiple experiences supported by technology.
Technology Leadership Standard 3	Teaching, Learning, and Curriculum. Educational technology leaders apply and implement curriculum plans that include methods and strategies for applying technology to maximize student learning.
Technology Leadership Standard 4	Assessment and Evaluation. Educational technology leaders communicate research on the use of technology to implement effective assessment and evaluation strategies.
Technology Leadership Standard 5	Productivity and Professional Practice. Educational technology leaders design, develop, evaluate and model products created using technology resources to improve and enhance their productivity and professional practice.
Technology Leadership Standard 6	Social, Ethical, Legal, and Human Issues. Educational technology leaders understand the social, ethical, legal, and human issues surrounding the use of technology in P-12 schools and develop programs facilitating application of that understanding in practice throughout their district/region/state.
Technology Leadership Standard 7	Procedures, Policies, Planning, and Budgeting for Technology Environments. Educational technology leaders coordinate development and direct implementation of technology infrastructure procedures, policies, plans, and budget for P-12 schools.
Technology Leadership Standard 8	Leadership and Vision. Educational technology leaders will facilitate development of a shared vision for comprehensive integration of technology and foster an environment and culture conducive to the realization of the vision.

represented the essential skill areas, where each skill area would have limited correlation with the other skill areas. The concept of essential skill sets lends itself to initiatives designed to develop education technology leadership, where the concept of essential skill areas lends itself to the assessment of education technology leadership.

The NETS Project supported efforts related to the development of education technology leadership, including education technology leadership skills sets and skill areas. The NETS Project standards provide a framework for assessing education technology achievements of various education stakeholders. The education technology leadership standards that emerged from the NETS Project appear to be well suited to support research designed to explore the assessment of education technology leadership.

Sources of Education Technology Leadership

Included with the evidence found in the literature supporting the importance of education technology leadership related to educational objectives was evidence of multiple sources of education technology leadership. In this section, three different sources of technology leadership are described. The sources are (1) Administrator, (2) Teacher, and (3) Chief Technology Officer (CTO).

The School Administrator as Technology Leader

In the majority of the literature reviewed, the school technology leader was the assumed role of the school administrator in the form of Principal or Superintendent. There was support found that both Superintendents and Principals were effective education technology leaders (Battle, 2004; Hudanich, 2002; Mirra, 2004). These effective leaders often shared common tendencies. A supportive administrator took staff input into consideration when developing school schedules or organizing school

activities; engendered a high level of communication, encouragement and support that was felt by individuals; devoted resources needed to replicate successful programs; developed and supported partnerships between school and universities and corporations to stimulate the use of technology; empowered their staff; was flexible regarding the placement of technology yet insured that technology was uniformly accessible to teachers and students; had a commitment to professional development; had a respect for students as individual learners (Demetriadis et al., 2003; P. E. Holland, 2001; Kozma, 2005). In contrast, a lack of administrative support was found to limit professional growth and reinforced a hierarchical structure (Demetriadis et al., 2003).

A survey of elementary school principals revealed that while all the Principals agreed that technology was an important aspect of learning, the schools that had the highest technology-use rating shared one characteristic: strong, enthusiastic principal technology leadership (Stegall, 1998). Principals who exhibited education technology leadership were instrumental in modeling the use of technology in classrooms. They understood how it could support best practices in instruction and assessment, and they provided teachers with guidance for its use. Principals also participated actively in professional development activities related to education technology and provided teachers with opportunities to learn how to use those resources (Culp et al., 2005; National Center for Education Statistics, 2006).

When administrators supported teachers using technology with staff development and on-going dialogue about technology integration in the context of teaching and learning, their teachers exhibited sustained technology integration in the curriculum (Sandholtz et al., 1997; Stegall, 1998). Wilsmore and Betz (2000) stated that “technology

will only be successfully implemented in schools if the principal actively supports it, learns as well, provides adequate professional development and supports his/her staff in the process of change" (p. 15). Granger et al. (2002) found that "supportive relationships among teachers, a commitment to pedagogically sound implementation of new technologies, and principals who encourage teachers to engage in their own learning" (p. 2) were factors that led to innovative and effective teaching in the classroom.

While literature was found that identifies the school principal as a key factor in bringing about successful change in schools (Fullan, 2001a, 2001b; Hall & Hord, 2001), Schiller (2002) claimed there is very little research on the relationship between education leadership and technology. Additional research in the area of leadership and the implementation of instructional technology was found to be needed (Wilsmore & Betz, 2000; Yee, 1998).

The School Teacher as Technology Leader

There was information found in the literature concerning the use of education technology by teachers to support education reform and student achievement improvement. In a meta-analysis of the value and use of education technology in K–12 education (Valdez, 2000), the North Central Regional Laboratory found a very strong connection between appropriate teacher use of education technology and increased student achievement:

> Education technology offers opportunities for learner-control, increased motivation, connections to the real world, and data-driven assessments tied to content standards that, when implemented systematically, enhance student

achievement as measured in a variety of ways, including but not limited to standardized achievement tests (p. iii).

Technology was reported to be increasingly available in a variety of forms for use by teachers (Culp et al., 2005). As technology became more available to teachers, the issue was not whether, but how teachers contend with it (Fullan, 2001b). As education technology became more powerful, good teachers became more indispensable. While technology could generate a glut of information it had no particular pedagogical wisdom regarding new breakthroughs in cognitive science about how learners must construct their own meaning for deep understanding to occur (Earle, 2002).

The real power of education technology lied in the way its use caused teachers to develop different perspectives through rethinking teaching and learning (Riedl, Smith, Ware, Wark, & Yount, 1998). Teaching with technology has caused teachers to confront their established beliefs about instruction and their traditional roles as classroom teachers. This has meant that teachers must become experts in pedagogical design. It also has meant that teachers must use the powers of technology, both in the classroom and in sharing with other teachers what they are learning. Working in an appropriately designed technology-rich environment had the potential of producing a variety of positive outcomes (Tiene & Luft, 2001): improved patterns of social interaction, changes in teaching styles, more effective teaching, increased student (and perhaps, teacher) motivation, and enhanced student learning. Achieving this potential, however, was the challenge, and it required the correct vision of technology and its integration. The attainment of this learning potential required the leadership of teachers.

Teachers exercise leadership in the form of guidance and direction of instructional improvement. According to Elmore (2000), most of the knowledge required for this improvement resides in teachers who deliver instruction, not in the administrators who manage them. All teachers have leadership potential (Barth, 1999). It is important for teachers to exercise this leadership potential. The key to technology integration is having teachers take hold of best practice teaching strategies and implement them in their classroom. When they do this and they have ample access to technology the technology will be integrated as a tool to create student centered, active learning environments (ACOT, 1995).

The Chief Technology Officer as Technology Leader

In school districts, the responsibilities of locating, evaluating and selecting technologies, managing networked computer systems, and facilitating their effective use in classrooms fall mainly upon the shoulders of staff members variously titled "Technology Director", "Technology Coordinator", "Chief Information Officer", or "Chief Technology Officer". This study will use the term Chief Technology Officer (CTO) as the descriptor for this type of education technology leadership source in a school organization.

Education technology has been considered a strategic resource in elementary and secondary education (CoSN, 2006). No longer restricted to a few content areas or located in certain rooms, computers and networks are part of the fabric of educational practice. In an era of rising technology expenditures and greater accountability, school districts have faced daunting challenges in their efforts to implement technology resources that provide students with the quality learning experiences they deserve. For these reasons school

districts must ensure the technology support they need to succeed. It has been the CTO's role to provide the school organization this support.

The CTO technology leadership role in P-12 education required the political and interpersonal skills that supplement technical and educational skills and abilities (Rust, 2006). "Education technology is often complex, but working through the political environment and the myriad entrenched processes is equally challenging" (p. 1). The CTO may be a technology expert and have experience in the instructional area, but the CTO also needed to understand how decisions are affected by internal political forces. According to Rust, "CTOs who are unaware of such alliances will unwittingly antagonize one party or the other and find themselves on the wrong end of a well-orchestrated move to shelve the next (education technology) proposal to hit the table" (p. 2).

The school CTO must be a skilled manager, a knowledgeable educator, an effective communicator, and a technologically-savvy individual who can work with all district staff at all levels within the organization. Leadership from the CTO in education requires competencies in multiple, contrasting areas. The Consortium for School Networking (CoSN) defined ten skill sets for school CTOs (CoSN, 2006; CoSN K-12 CTO Council, 2006): (1) Leadership and Vision, (2) Planning and Budgeting, (3) Team Building and Staffing, (4) Systems Management, (5) Information Management, (6) Business Leadership, (8) Education and Training, (9) Ethics and Policies, and (10) Communication Systems.

In comparison, Hurley (2002) defined CTO skills in terms of "soft" skills and "hard" skills. Soft skills included abilities related to vision, communication, human relations, and political savvy. Hard skills encompassed business knowledge and technical

proficiency. These soft and hard skill sets should be framed by an understanding of the CTO of the unique nature of an educational institution and its mission. Successful school organizations have CTO leaders who "offer visionary solutions, a passion for the educational mission, the ability to implement short and long term solutions that address the goals of the organization while pushing the envelope, and the ability to gain the support of significant educational stakeholders" (p. 2).

The CTO position holds an important role in relation to school organization governance. The CTO position will often report directly to the superintendent of schools, and when this is the case, the CTO can impart education technology leadership independently across the organization, to areas of greatest need and of greatest organizational benefit (Keller & Rust, 2001). "When the CTO is not a recognized player at the highest level of the organization, "turf wars" and political end runs of standards persist, and strong arguments for mutually beneficial policies and resources are weakened" (p. 2).

Collaborative Education Technology Leadership

This section provides a general review of collaborative leadership theory and ties education technology leadership to collaborative leadership theory. The association of collaborative leadership with education technology leadership supports this study's premise that education technology leadership can effectively exist at various levels in the school organization and come from various sources.

Collaborative Leadership Theory

Increased school reform and accountability demands, coupled with a shift away from the Industrial Age to a technological and global economy, have fostered calls for a

move away from a hierarchical model of leadership to a collaborative one (Pounder, 1998). Although Principal leadership is an essential element in school success, research indicated that the complexities of schools required a new focus on collaborative leadership and the creation of a sense of community in which leadership is shared (Retallick & Fink, 2002). While there was no consensus on the precise definition of collaborative leadership (Fishbaugh, 1997), Elmore (2000) laid out specific principles that, for the purposes of this study, provided the foundation for a model of collaborative leadership:

> The purpose of leadership is the improvement of instructional practice and performance, regardless of the role. Leaders must ensure the creation of settings for learning focused on clear expectations for instruction (p. 20).

According to Elmore, instructional improvement required continuous learning as both an individual and social activity. The roles and activities of collaborative leadership flowed from the expertise required for learning and improvement, not from the formal dictates of the institution. Leaders must understand that learning grew out of differences in expertise rather than differences in formal authority. Leaders must create environments in which individuals expected to have their practice and ideas scrutinized by colleagues. Leaders must model the values and behavior that represented the common good.

In collaborative leadership settings, schools were viewed not as an organization or institution but as a community of individuals who work together for the good of the whole (Barth, 1999). Leadership that was collaborative was potentially more than the sum of the involved individuals' practice (Spillane et al., 2001). Collaborative leadership relied on multiple sources of guidance and direction. The role of the administrative leader

in a collaborative leadership system was primarily to "enhance the skills and knowledge of the people in the organization, create a common culture of expectations around the use of the skills and knowledge, hold the various pieces of the organization together in a productive relationship with each other, and hold individuals accountable for their contributions to the collective result" (Elmore, 2000, p. 15).

Barth (1999) reported that the exercise of authority required reciprocity of accountability and capacity. Leaders derived their authority from their ability to create the environment necessary to carry out the requirement. Principals who were most successful as leaders in a collaborative leadership environment were able to enlist teachers in providing leadership for the entire school. This concept of collaborative practice considered school leadership as being "stretched over" the school's social and situational contexts (Spillane et al., 2001, p. 1).

In considering the availability of leadership to school improvement situations, including those with elements of education technology, it is useful to consider the leadership capacity of the organization. Leadership capacity is "an organizational concept meaning broad-based, skillful participation in the work of leadership that leads to lasting school improvement" (Lambert, 1998, 2003). High leadership capacity schools are learning communities that amplify leadership. These schools have developed a fabric of structures (e.g. teams, communities, study groups) and processes (reflection, inquiry, dialogue) that form a more lasting and buoyant web of interrelated actions. The Principal is only one of the leaders in the school community and models collaboration, listening, and engagement. Each participant shares the vision, understands how the school is moving toward the vision, and understands how he or she contributes to that journey.

The development of collaborative leadership was often used as a strategy to help organizations build leadership capacity in support of adaption to change. In theory, for a school to sustain any improvement or innovation the school's leadership must move away from role-based conceptions and be distributed across roles in the organization (Elmore, 2000). A system building leadership capacity via collaborative leadership saw the creation, sorting, and sharing of knowledge throughout the system. Knowledge flowed freely through the system at all levels (Fullan, 2001a; Wheatley, 1999).

This knowledge flow was fostered through the continual development of relationships within the system. Consider the idea of "leadership for many" (Fullan, 2001a, p. 136). Fullan's theory was that if leaders lead well then the organization will outgrow them. In this "culture of complexity", the chief role of leadership was to mobilize the collective capacity to challenge difficult circumstances. The key to success was that many individuals working in concert can become as complex as the society they live in. As Wheatley (1999, p. 36) explains, "systems influence individuals and individuals call forth systems." Organizations were living systems; possessing the same capacity to adapt and grow that is common to all life. Leading needed to be done both from the front and the back of the pack, sometimes showing the vision, sometimes pulling people along, and sometimes pushing from behind.

School improvement initiatives in schools with high leadership capacity hold great promise, but no guarantees, of sustainability (Lambert, 2005). Schools that include everyone within collaborative patterns of participation are able to develop greater levels of leadership skillfulness. This achievement can move a school closer to lasting school improvement than would otherwise be possible.

Education Technology Leadership and Collaborative Theory

There was support found in the literature that education technology leadership was well suited for consideration using a collaborative leadership theoretical viewpoint. Technology leadership was an area that administrators are often willing to share (Mehlinger & Powers, 2001; Schmeltzer, 2001). This willingness frequently was based on their own personal lack of technological expertise. For example, Ertmer et al. (2002) examined changes in administrators' ideas about technology integration and technology leadership as they participated in a semester long online professional development course. The researchers gathered quantitative and qualitative data and used the data to identify the administrators' beliefs that technology leadership is a style of leadership that is participatory and a shared responsibility. The researchers found administrators often identified the technology coordinator or technology-using teachers as the individuals with whom they shared this responsibility. One participant stated that he was not so much the leader as the "cheerleader". Administrators agreed that it was "important to hire the right people, acquire the best resources, and be able to recognize what good technology integration looked like" (p. 16).

Ian Jukes (1996) has built onto this concept of shared leadership:

> If technological initiatives are to be truly successful, responsibility for leadership must be spread around so a broad constituency of leaders develops, rather than have a single champion who must carry the entire burden of making things happen. The goal is to ensure that the plan is still viable after the leadership has moved on. The success or failure of the plan hinges on this critical step (p. 10).

Hughes and Zachariah (2001) investigated the relationship between effective administrative leadership styles and the use of technology. They surveyed public school teachers in Ohio in order to determine their attitudes and perceptions regarding leadership as it affected the school culture. They found that the facilitative leadership qualities in leaders who exhibited a collaborative leadership style proved to be more effective in the implementation of new programs or innovative instructional practices which involved technology.

There are reports that provide strong assertions that technology can catalyze school improvement (CEO Forum, 2000; U.S. Department of Commerce, 2002). Studies showed that new technologies have aided the transformation of classrooms for P–12 students and teachers (GLEF, 2001). "Around the nation teachers are using technology to create exciting and creative learning environments where students teach and learn from each other, solve problems, and collaborate on projects that put learning in a real-world context" (p. 1). Technology innovations were increasing the demand for reforms in teaching and learning approaches that, in turn, were "having a significant impact on technology use expectations" (Valdez, 2000, p. iii). Not only were technology initiatives integrating technology into teaching and learning, they were offering opportunities for organizations to build education technology leadership capacity in support of the technology initiative.

Summary

A review of the literature for this study found evidence that education technology leadership was an important element in the effort to integrate technology into learning. While many researchers examined education technology leadership by studying the

education technology leadership of school administrators, there was also research that examined other sources of education technology leadership, including the leadership of teachers and of chief technology officers. Because education technology leadership was shown to effectively emerge from a variety of sources it appeared that education technology projects would lend themselves well to education leaders who were pursuing a collaborative approach to school leadership. Collaborative leadership was reported to be an effective strategy in building leadership capacity, which in turn provided support for sustained organizational change.

The nature of technology as a change agent was reported. School technology projects were often implemented in support of school change. When the leadership for these projects emerged from multiple sources in a collaborative fashion, the technology projects not only helped schools to achieve sustained improvement, but also helped the schools build leadership capacity.