The Role of the Minnesota Superintendent As a Technology Leader: A Delphi Study

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Executive Summary

"What is the role of the school superintendent as an effective technology leader?"

Superintendents in the 21st century face a myriad of political, social, and organizational pressures. One of the more recent pressure points to surface is the use of technology solutions throughout the academic and managerial functions in their school districts. The rapid change of technology, the increased accountability for student achievement, and an ongoing state of financial austerity has created a professional environment where superintendents must be adept at change and have the requisite knowledge to effectively lead our schools.

This study was conducted during the 2013-14 school year and sought to identify the knowledge, performances, and the disposition (attitudes) necessary for school superintendents to function effectively as school district technology leaders. The study participants were Minnesota superintendents who had implemented multi-grade 1-to-1 learning environments employing mobile learning devices in their school districts between 2010 and 2013. Fifty-two (52) potential participants were identified as meeting the criteria, and thirty-one (31) superintendents participated and completed the study that used the Delphi Technique to gather data.

The Delphi Technique is a systematic, interactive forecasting method that relies on a panel of experts who are selected because they hold knowledge or an opinion on a specific topic. It is based on the principle that forecasts (or decisions) are more accurate when gathered from a structured group of individuals than from unstructured groups. Completed in three steps, the process gathers data using an open-ended question and through subsequent iterations allows the individual and group to come to consensus.

At the conclusion of the study, the expert panel found consensus on 43 knowledge domain items, 47 performance domain items, and 39 disposition (attitude) domain items. Knowledge domain findings were categorized into four areas: Professional Knowledge, Technology Integration, Managing Technology, and Total Cost of Ownership. The Performance domain also had four categories: Supporting the Human Infrastructure, Technology Related Mentoring, Managing Technology, and Managing with Technology. The Disposition domain had five areas of importance: Accountability, Adequacy of Resources, Staff Knowledge, Community Relationships, and Evidence of Technology Planning.

Effective district technology leaders in the superintendent role ideally possess and express a vision for progress, knowledge of the tools and the new pedagogy in 21st century education, communication skills that not only inform but inspire internal and external stakeholders, and much more as evidenced by the extensive list of results reaching a high level of participant consensus. It is incumbent upon educators and leaders to possess the willingness to see our world through the eyes of the students and imagine the needs of their future. Effective superintendents, as effective district technology leaders, provide the vision, the physical and emotional conditions necessary for change, and the inspiration that move institutions and its people.

Introduction

Current research suggests that superintendents should possess certain leadership traits and practice certain competencies in order to successfully implement technology in their districts (Edwards, 2014; Fullan, 2013; Key & Greenhill, 2013). School districts world-wide have invested significant resources in the purchase of new educational technology tools in the last decade, challenging the traditional 20th century learning and teaching process so familiar to the current leaders of education.

The multi-billion dollar investments in educational technology has dropped the ratio of computers to students in the United States from 120:1 in 1983 to 4:1 in 2002. Approximately 4% of the schools in the United States began 1-to-1 laptop programs in 2003-2004, with that number rising to an estimated 25% by 2006.

The innovations and innovators were not immune from criticism during this period of technology proliferation. Cuban (2010) stated, "that laptop programs have failed to achieve their goals". However, the laptop programs did set the stage for a significant level of educational innovation. The next generation mobile learning device, the iPad, was introduced the following year and it effectively "revolutionized mobile computing since its release in 2010" (eSchool News, 2014).

Apple has sold more than 170 million iPads since its introduction in April 2010 (Speciale, 2014). The number of iPads sold to education customers is at approximately 13 million units (Cavanaugh, 2014) and is purported to consume up to 95% of the tablet market in K-12 education (Norris & Soloway, 2014). "The iPad's invasion of Minnesota's classrooms continues …with no signs of slowing down. In a long history of financial, pedagogical, and philosophical debates, the

iPad is dominating the latest chapter about technology's role in education." (Scharber, 2014). The Chromebook is a relative newcomer to the educational technology world, selling over a million units to schools in the second quarter of 2014 (Forrest, 2014).

"Leadership is the single most important factor affecting the successful integration of technology" (Bryan, 1998). Forward thinking district leaders understand that the impact of technology, the globalization of society, and individual learning needs of students are of primary importance (Mueller, 2009). Students must possess highly developed skills, knowledge and viewpoints to be successful life-long learners, economic contributors, and productive citizens in the global society of the 21st century. Consequently, superintendents face an increasing number of technology related responsibilities (ISTE, 2000). Valdez (2006) observed that the skills needed to lead educational institutions in the 21st century parallel the desired skill set desired for corporate leadership positions.

Educational institutions across the country have made multi-billion dollar investments in educational technology with the goal of more effective instruction and increased student achievement. While there has been a multitude of 1-to-1 laptop programs implemented, in general they have not achieved the anticipated improvement in student achievement results in light of the resources expended (Cuban, 2010). Shortly after Cuban made this statement, the personal technology landscape changed dramatically with the introduction of the iPad tablet computer in April 2010.

Minnesota like other states in the United States has seen the proliferation of mobile learning devices in its public and private school systems. This study's expert panel consisted of Minnesota superintendents that had professional experience leading a technology initiative in multi-grade, 1-to-1 learning environments since the year 2010. A 1-to-1 learning environment was defined as an

initiative taking place in a school setting where all students in a minimum of two grade levels are provided with a personal mobile computing device, such as Chromebook or iPad.

This study asked the overall question "What is the role of the school superintendent as an effective technology leader? The three guiding research questions were:

1. What does a school superintendent need to know about technology to be an effective technology leader?
2. What actions should be performed by a school superintendent to be considered an effective technology leader?
3. What are specific indicators of a school superintendent's disposition as an effective technology leader?

The rapid integration of technology into educational organizations has challenged the traditional 20th-century learning and teaching process so familiar to the current educational institutions. Consequently, Superintendents have had to navigate complex change processes associated with technology integration into their school districts. The following section will discuss change, organizational change, and the leadership of change.

Background Information

Change is the substitution, modification, or the transformation of an object, product, paper, job activity, or process. Organizational change is often initiated as a response to a perceived need to increase efficiency, effectiveness, or worker satisfaction. To be successful the purpose for the change must be understood and the process managed.

Change management at the organizational level is a systematic methodology for planning, monitoring, adapting, controlling, and producing desired change (Sullivan, 2009). Organizational change can also be expressed as a modification to employee thinking, expectations, and skills (Robertson, Roberts, & Porras, 1993; Schalk et al., 1998). The literature concerning organizational change falls into one of two main categories: one that emphasizes organizational efficiency, and the other emphasizing social change (Sullivan, 2009, p. 70).

John Kotter is arguably the world's foremost scholar of how organizations can change old habits and develop new ways of thinking. In "Benefits of Change", Kotter (1996) expanded the understanding of how organizations change by shifting the focus from the group to the participant's role in initiating and sustaining successful change. He found that change can be managed successfully, but the process inevitably leads to some angst and frustration. 'The Heart of Change' (Kotter & Cohen, 2002) identified eight steps to guide change in an organization. They are:

1. Establishing a Sense of Urgency
2. Creating the Guiding Coalition
3. Developing a Change Vision
4. Communicating the Vision for Buy-in
5. Empowering Broad-based Action
6. Generating Short-term Wins
7. Never Letting Up
8. Incorporating Change into the Culture

Michael Fullan's exploration of leadership and organizational change stands out due to his groundbreaking work and lasting impact. His work in the early 1990s focused on the complexity and uncertainly of school change, where the stages of change identified the stages of change, factors that affect the process, the variability of situations, processes, and individuals participating, and the realization that change is ongoing and not a static event.

In 1991 Fullan and Steigelbauer identified four broad actions or conditions that impact the change process: initiation, implementation, continuation, and outcomes. Two conceptual themes were added to the list after further research. First, that schools should be considered 'living systems' in an organizational sense, and secondly that teachers need to understand and support the end product from the beginning of the process (Fullan, 1999).

In Fullan's book, "The Complexity of the Change Process" (1993), he shared five key components to effective change management: (a) moral purpose, (b) understanding the change process, (c) relationship building, (d) knowledge creation and sharing, and (e) coherence making. Later he added the concept of "initiation" to that list.

Griffith and O'Neil (n.d.) used Fullan's components of successful and unsuccessful change processes, and found that unsuccessful processes were likely to include the following characteristics:

- Processes were not scaled in terms of the size and nature of the intended change,
- The change being too big or vague,
- The terms of change were too narrow and prescriptive,
- The processes change associated with the lacking follow through support,
- The change was externally imposed without teacher support,
- The change was entirely school-based without adequate resources and other supports.

Diffusion of Innovations Theory

Ryan and Gross (1943) coined “diffusion of innovations” to describe their research that focused on the diffusion of hybrid seed corn in Iowa. The diffusion of innovations theory has since been used to study innovation in settings ranging from American agriculture to the implementation of educational technology in schools

Everett Rogers (1995) defined diffusion as "the process by which an innovation is communicated through certain channels over time by members of a social system." Roger’s theory states that an innovation has specific characteristics that determine its rate of adoption:

(1) Relative advantage is the degree to which an innovation is perceived as being better than the idea or innovation that it supersedes

(2) Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences and the needs of potential adopters

(3) Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use

(4) Trialability is the degree to which an innovation may be experimented with on a limited basis

(5) Observability is the degree to which the results of an innovation are visible to others

(6) “Re-invention” is how an innovation can change during the process of adoption or implementation

Impetus for Change in Education

A Nation at Risk was released in 1983 and called for major reform of public education and teacher training. Calls for reform in the United States public education system have become more

frequent as a result of the perceived decline of student academic performance as compared to other industrialized nations of the world The decade of the 1990s gave rise to the Outcome Based Education [OBE] reform movement. The new millennium ushered in the standards movement that culminated in the No Child Left Behind [NCLB] Act of 2002. The No Child Left Behind Act of 2002 (NCLB) was enacted as a direct response to relatively poor student achievement of American students on standardized assessments both at the national and international levels

The common core standards project is the most recent large-scale educational reform in the United States. The academic standards initiative began in 2009 and was sponsored by the National Governors Association and the Council of Chief State School Officers. The Common Core Standards were developed to be "relevant to the real world, reflecting the knowledge and skills that…young people need for success in college and careers" (www.corestandards.org). The Common Core incorporates district level minimum technology requirements for security and allowable testing devices.

In Stratospheres (2013), Michael Fullan makes the case that technology, pedagogy, and change knowledge have sought a synergy for the past forty years. He states "…these three forces have now developed to the point that powerful synergy with fantastic results for learning are in the offing" (p. 1). Technology and pedagogy are common vernacular in education but 'change knowledge' is new to the discussion. Fullan (2013) defined 'Change knowledge' as "…implementation, which is putting something new into practice" (p. 65). He stated that educational reforms based only on technology and pedagogy will fail if not properly implemented using 'change knowledge'. [transition needed]

Superintendent as a technology innovator.

Superintendents must be aware of national and state educational requirements relating to the implementation of technology at the local district level (Colandrea, 2012). The No Child Left Behind Act [NCLB] (2002) and Race to the Top, otherwise known as the American Recovery and Reinvestment Act (2009), both required changes to school curriculum in exchange for additional district funding. In both cases, computer technology must be incorporated into the school curriculum in order to qualify for funding (ISTE, 2002).

As superintendents look to the future impact of technology, the globalization of our society, and individual learning, the needs of students must be of primary importance (Mueller, 2009) because students must possess highly developed skills, knowledge and viewpoints to be successful as life-long learners, economic contributors, and productive citizens in the global society of the 21st century (Ilies, Judge, & Wagner, 2006). These skills are often referred to as 21st century Skills (ISTE, 2000). "Technological literacy is fundamentally important to all students" (ITEA, 2006; p. 1).

The most effective technology leaders provide educational programming that combining 21st century skills and academic content standards (Dede, 2007). When considering all the roles that the school leader must exhibit to be successful, technology leadership appears to be the most global (Fullan, 2001a). Valdez (2006) observed that the skills needed to lead educational institutions in the 21st century parallel the desired skill set desired for corporate leadership positions. Transformational leadership is often associated with successful technology use and integration in an organization.

Transformational leadership.

Transformational leaders exemplify a style that results in a positive transformation or symbiotic relationship for the leader and those that were led, as opposed to transactional relationships that result in some type of reward in exchange for worker compliance. Bernard Bass (1985) studied transformational leadership within educational organizations. In this context, transformational leadership can be defined as the encouragement of employees beyond their self-interests, generating benefits for the organization and highlighting the mission and goals of the organization to maintain awareness and acceptance among its members. Transformational leadership recognizes and exploits existing needs or demands of followers by looking for their potential motives, seeks to satisfy these higher needs, and engages the abilities of the followers.

Transformational leadership style is effective in a high tech educational environment. The literature provides the following examples:

- organizations that employed leaders that possessed transformational leadership skills had an increased level of technology embedded within their educational and managerial functions Tan (2010)
- Transformational leaders engage in more in networking within the organization and seeks consensus when making decisions (Lambert et al., 2002), and value systems thinking an imagination of the organization as a whole (Dyer, Kale & Singh, 2001; Valdez, 2006).
- Leaders that build strong relationships with employees create a participatory leadership culture (Fullan, 2002) exemplified by open and genuine communication processes (Farson, 1996) that result in strong school cultures (Lashway et al., 1995; Valdez, 2006).
- West (2010) found that transformational leadership improves the decision making of individual members of the organization.

Transformational leaders gather and process information from a large network and from several viewpoints allowing them to address "novel, ill-defined, and complex organizational problems" (Zaccaro, 2001, p. 17).

- "Transformational leadership practices also aim to stimulate organizational members to think reflectively and critically about their own practices, and to provide appropriate models of the practices and values considered central to the organization" (Leithwood et al., 2004, p. 249).
- Hughes and Zachariah (2001) studied school personnel in Ohio and found the knowledge, skills, and dispositions associated with transformational leadership had a positive effect on technology integration.
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Superintendent Technology Knowledge, Performances, and Dispositions

There have been several national organizations that have sought to identify the personal and professional knowledge, skills, and dispositions needed by educational leaders be effective technology leaders. The National Educational Technology Standards for Administrators (NETS-A) was developed by the International Society of Technology Education and represent a national consensus of skills needed to be effective technology leaders (ISTE, 2002). Personal technology skills are a strong predictor of effective leadership and successful technology integration processes (Anderson & Dexter, 2005).

Mirra (2004) used the Delphi research technique in a nation-wide study to identify the leadership traits and characteristics that, when present, enhance a school superintendent's professional growth as a technology leader. He categorized the most desirable characteristics in a

superintendent/leader into three categories: Knowledge, Performances, and Dispositions. For purposes of this section of the literature review, Mira's organizational structure regarding superintendent domains were used to organize the relevant literature review.

Knowledge.

Knowledge is defined as an understanding of an innovation and how it works (Rogers, 2003). Professional knowledge, technology integration, technical skills, and technology specific management skills are most associated with this domain (Mirra, 2004). Financial Knowledge emerged as a fifth domain in this category.

Professional Knowledge. Superintendents, as effective technology leaders, must be aware of emerging local, national, and global trends (American Recovery and Reinvestment Act, 2009; Avolio, Walumba, & Weber, 2009; Colandrea, 2012; Flanagan & Jacobsen, 2003; Gibson, 2001; NCLB, 2002; Ritchie, 1996; Synder, Acker-Hocevar, and Synder, 2000). Attendance at professional conferences (Brown, 2012), remaining current on emerging technologies (Mirra, 2004) and large-scale one-to-one technology implementations are noted as indicators in this area.

In order to stay current it is important for superintendents to continually seek the most up-to-date information regarding technology and its applications in education (Colandrea, 2012; Marzano et al., 2005), and use that knowledge to transform their district (Kay & Greenhill, 2013). Edwards (2014) urges leaders to rethink the educational process in order to transform the learning and teaching process for students.

Technology Integration Knowledge. It is important that leaders understand that using technology in any classroom is a means to an end (Brown, 2012; Mirra, 2004). Student technology skills training must be embedded in courses (Brown, 2012) and curriculum goals must be aligned

(Kay & Greenhill, 2013) with a continual focus on student achievement data (Edwards, 2014). Educational technology, when implemented with fidelity, can significantly raise student achievement (Greaves, 2012).

Technical Skills Knowledge. District technology leaders must utilize personal productivity software (Brown, 2012) and demonstrate those skills for faculty and staff (Kay & Greenhill, 2013). Organizational support for changing technologies is enhanced when effective leaders incorporate best practices (West, 2010).

Effective technology leaders use their skills to demonstrate the relationship between the district's technology plan to that of the strategic plan (Brown, 2012; Kay & Greenhill, 2013; Mirra, 2004). An understanding of the relationship between technology and business efficiency (Brown, 2012), and the ability to identify the unintended consequences of adding new technologies (Edwards, 2014) were also identified as necessary skills.

Financial Knowledge. Superintendents are responsible for the financial operation of the school district in addition to being an educational leader. Greaves (2012) found that properly implemented educational technology can be revenue positive at the local level. The study identified several skills or tasks important to understanding the total cost of ownership of technology in a school district:

1. The skill to conduct and oversee a technology lease/purchase.
2. Recognition that technology must be replaced on a cyclical basis.
3. The cost of human infrastructure costs associated with technology purchases (engineering support, training, vendor support, and other employee costs such as overtime).

Uninformed school leaders are a detriment to educational effectiveness (Flanagan & Jacobsen, 2003; Gibson, 2001; Ritchie, 1996). Superintendents lacking the knowledge of

technology effectiveness are more likely to avoid technology implementation in their organization. School leaders who successfully integrate technology demonstrate a coordination of strategies and techniques in order to fully implement the innovation in the organization (Colendrea, 2012; Edwards, 2014; Mueller, 2009).

Performances

Mirra (2004) defines 'skills' as data driven decision-making, human infrastructure support, technology related mentoring, technology management, and management with technology as the skills most associated with this leadership domain.

Data Driven Decision-Making. Technology leaders employ data driven decision-making processes utilizing technology applications (Edwards, 2014). Brown (2012) stated that the terms data and decision-making were becoming synonymous for leaders. Effective district technology leaders:

- identify an assessment plan for implementation processes (ISTE, 2012)
- define student outcomes (Kay & Greenhill, 2013), and
- implement data-driven personalized instruction (Edwards, 2014).

Human Infrastructure Support. Superintendent behavior and support for members of the organization affect the success of technology implementation (Baggozzi, 2007). Educational leaders create a supportive technology culture by providing adequate financial resources (Anderson & Dexter, 2005; Brown, 2012; Edwards, 2014), and recognizing the training and support needs of faculty and staff across the organization (Davies, 2010; Butler & Sellbom, 2002; Greaves, 2012, Mirra, 2004). Kay and Greenhill (2013) emphasize the need for high quality professional development around technology integration and suggest support using the professional learning community model for collaborative staff work (Brown, 2012; Kay & Greenhill 2013).

Technology Related Mentoring. During the process of integrating technology the critical factors of personal knowledge regarding the innovation and anticipating the reactions from members of the organization often determine the success or failure (Baggozzi, 2007; Van der Merwe, Pretorius, & Cloete, 2004). Effective technology leaders foster technology leadership among staff (Edwards, 2014; Kay & Greenhill 2013) and encourage their staff and faculty to make decisions employing technology tools to manipulate and analyze student achievement data (Brown, 2012).

Managing Technology. District technology leaders employ several strategies to manage technology within their organizations. Effective leaders communicate their vision of the new technology to all stakeholders (Brown, 2012; Greaves, 2012; Mirra, 2004). Prior to any initiative it is imperative that superintendents closely examine the existing conditions and available resources (Guthrie, 2011). He also provided evidence that school cultures that use technology are more receptive to additional technology initiatives (Guthrie, 2011). Edwards (2014) notes the following management considerations for successful management of technology in an school organization:

(1) conduct pilot programs to ensure success;

(2) roll out new programs while old systems are still functioning

(3) ensure support from vendors post-rollout, especially in the implementation of complex systems;

(4) conducting post rollout support for all stakeholders in case of continuing problems with the technology.

Leaders must maintain contact with members of the organization after implementation (Colandrea, 2012), and following implementation the superintendent must ensure ongoing technical support (Butler & Sellbom, 2002).

Management with Technology. Mirra (2004) found that effective leaders model technology usage by performing traditional management functions for their staff and faculty. Leadership should align technology resources to support business and strategic goals (Edwards, 2014). West (2010) found the experiences of leaders allow recognition and acknowledgement of the transformative effects leadership actions impart on financial and technology implementation decisions.

Disposition

Disposition is the superintendent's proclivity to move the organization in one direction or another (Perkins, 1995). Indicators include attitudes that make a superintendent an effective technology leader. Accountability, adequacy of resources, staff knowledge, community relationships, evidence of technology planning, vision and innovation, and technology visibility are found within this domain (Mirra, 2004).

Accountability. Accountability, as defined in this domain, refers to actions that effective leaders perform to monitor technology implementation throughout the organization. Feedback solicited from school and community based technology committees and periodic staff surveys are considered effective practices (Brown, 2012; Mirra, 2004).

Adequacy of Resources. Technology initiatives must be allocated sufficient resources (Colandrea, 2012; Mirra, 2004). Superintendents are accountable for the establishment of goals (Rielly, 2005) and to collect evidence that allows stakeholders to evaluate effectiveness of a technology initiative (Colandrea, 2012) in comparison to the investment of time and resources (Bagozzi, 2007).

Staff Knowledge. Effective communication of decisions by the superintendent to staff contributes to the direction and success of the initiative (Henry & Reidy, 2007; Mueller, 2009; Patterson, Koenigs, Mohn, & Rassmussen, 2006; Uchida, Cetron, & McKenzie, 1996). Technology leaders should facilitate discussion among district stakeholders (Edwards, 2014; Greaves, 2012; Kay & Greenhill, 2013) to change staff beliefs (Davies, 2010) and "displace cherished misconceptions" regarding their practice (Dede, 1993, p. 24).

Shared planning of an initiative by the leader and members of the organization increases loyalty to the plan (Colandrea, 2012). Superintendents who communicate clear educational goals that effectively frame technology initiative can drive progress (Ke & Wei, 2006; Mueller, 2009; Rico, 2006; Walters & Marzano, 2006).

Technology leaders understand the best process for sharing effective technology practices throughout the district, support creative and innovative practices in the classroom, and build a teaching and learning community consensus regarding technology integration into the curriculum (Brown, 2012, Kay & Greenhill, 2013; Mirra, 2004).

In innovative school communities, teachers are provided opportunities to experiment with technology integration in the classroom without the fear of repercussion (Kay & Greenhill, 2013). Effective technology leaders "reward experiments, and treat failures as learning and innovation

opportunities" (Kay & Greenhill, 2013, p. 93). Successful schools provide meaningful feedback to teachers in order to inform and improve their practices in the classroom (Kay & Greenhill, 2013). All of these beliefs or attitudes serve the shared goal of improved student achievement.

Once committed to an initiative, superintendents must model enthusiasm (Valdez, 2006), practice effective communication to empower the members of the organization with purpose and responsibility, and create a sense of personal accountability for all stakeholders (Guthrie, 2011). Overbay, Mollete and Vasu (2011) recommend superintendents place a high value on relationships during a technology initiative rather than focusing on the effort itself. Fullan supports this belief in his book 'The Six Secrets of Change (2008). He encourages leaders to care deeply for their employees, create connection points for employees, create systems to build internal capacity, make learning the work of the organization, promote transparency within the system, and allow the system to grow and learn in a unified manner.

School culture as developed by a superintendent plays a significant role in the implementation process. School culture may be defined as the "deep foundation or base that governs many other aspects of the schools operation" (Eller & Eller, 2009). An important facet of the relationship between school culture and school change is the active support of staff members (Griffiths & O'Neill, n.d.). Organizational culture, as nurtured by an organizational leader, has tremendous impact on innovation and change (Barber, 2011).

Community Relationships. There is clear evidence that effective community relationships support technology and innovation in school districts (Brown, 2012; Davies, 2010). Patterson et al. (2006) stressed the importance of district leaders being responsive to their constituents, and for district and community leaders to work together to capitalize and build on mutual assets.

Evidence of Technology Planning, Vision, and Innovation. Walters and Marzano (2006) found that effective district leadership in [illegible]

planning for technology initiatives by the superintendent is crucial and must focus on the end result of improved student achievement (Edwards, 2014).

Collins (2001) theorized that successful superintendents utilize different thought processes when considering technology implementation. Blin and Munro (2007) state "educational leader must have clarity of vision for the future and the competence to adapt to change for the world's consumers of education" (pp. 188-189). Superintendents must build a shared vision in order to transform their organizations. Nanus (1992) defined vision as a realistic, credible, attractive future for an organization. Harari (1994) stated that:

> Vision should describe a set of ideals and priorities, a picture of the future, a sense of what makes the company special and unique, a core set of principles that the company stands for, and a broad set of compelling criteria that will help define organizational success. (pp. 29-31)

The concept of a vision is often tied to organizational strategic planning (Fullan, 2002; Lashway et al., 1995; Zaccaro, 2001). Wheatley (1999) found that leaders who can develop a clear vision of the future help their organization retain focus on the goal.

Leaders who use vision to inform their decision making on a regular basis have a higher level of success during the change process (Drucker, 1955; Senge, 1990) and are better able to understand and overcome resistance to change (Valdez, 2006). Organizational leaders who collaborate with school personnel in the vision creation process and its implementation create "school districts that are viable and thriving learning communities for students, staff, and community members" (Valdez, 2006, p. 5).

Vision enables superintendents to reform their schools using technology (Hope & Stakenas, 1999). That vision when enacted becomes part of the shared mission of the organization (Edwards, 2014; Flanagan & Jacobson, 2003; Greaves, 2012; Kay & Greenhill, 2013) and creates a supportive

Technology Visibility, Effective leaders assure that technology is used seamlessly throughout the district whether in the classroom, a media center, a business office, or any location in which access to information and productivity tools is necessary (Brown, 2012; Mirra, 2004).

Research Question One

Research Question One addressed the technological knowledge that a superintendent should ideally possess. Research Question One was: "What does a school superintendent need to know about technology to be an effective technology leader?" Knowledge was defined as "specific information that should be known by a school superintendent to be an effective leader in the area of technology" (Mirra, 2004).

Educational leaders must understand and articulate that using technology in any classroom is a means to an end (Brown, 2012; Mirra, 2004). Data from the study indicate that a true world-class 21st century education is a combination of great instruction and guidance from the teacher, an engaged and active student learner, and tools (content, curriculum, technology) that enhance and accelerate student achievement. The results of the study showed technology's role in the classroom encompasses four distinct sets of knowledge competencies:

1. Instructional best practice in the technology-enabled classroom creates an environment where high levels of student achievement can take place. The high achievement is a result of the content, teacher skill and knowledge, and student engagement enhanced by technology.
2. Understanding that technology in and of itself is not the single catalyst for increased student achievement. Technology hardware and software cannot be central anywhere in the classroom, but must be supportive in engaging the student and teacher in

3. The pedagogy of the 21st century includes emerging trends such as constructivism or project-based learning, use of technology to support student skills and competencies, and personalized learning plans for each student.
4. Using technology applications to support higher-level authentic assessment and evaluation raises student achievement.

Survey items reaching the highest level of consensus in research question one survey are presented in Table 23 below.

Table 23

Research Question One: Survey Items with Highest Consensus

#	*Item*	*N*	*M*[a]	*SD*	*%*[b]
15	Have a vision for technology in the district that aligns with district goals	31	4.81	0.47	100%
11	The process of systemic change	31	4.61	0.49	100%
28	How technology can improve student achievement	31	4.58	0.61	100%
26	How to maintain and sustain the technology initiative	31	4.48	0.50	100%
8	That learning occurs between content, teacher skill and knowledge, and student engagement	31	4.45	0.71	100%
40	Understanding the huge staff development	31	4.45	0.84	97%
25	An understanding of the role/purpose of technology	31	4.45	0.55	100%
16	How to win the support of staff for technology innovation	31	4.35	0.65	100%
9	How digital tools and resources impact and can personalize learning	31	4.35	0.65	100%
10	Knowledge of 21st Century Skills	31	4.35	0.65	100%

 # – Delphi II Item Number *N – Sample Size*
M –Mean or Average Rating *SD – Standard Deviation*
[a] *Rating scale:1=not important, 2=slightly important, 3=important, 4=very important, 5=extremely important.*
[b] *Percentage of Responses in the three most favorable categories of the rating scale (important, very important, or extremely important.*

Knowing how to develop and implement a vision for technology in an organization was an extremely important and prevalent theme in this research question. This finding aligns with

previous research that found effective leaders rethink the educational process in order to transform the learning and teaching process for students (Edwards, 2014, Flanagan & Jacobsen, 2003; Gibson, 2001; Kay & Greenhill, 2013; Ritchie, 1996).

The expert panel placed a strong emphasis on the need to understand the change process as well as how change is initiated in an organization in order to create and sustain staff and community support of for the technology initiative (Fullen, 2008; Kotter, 2007). Previous research demonstrated that school leaders who successfully integrate technology employ a coordination of strategies and techniques in order to fully implement the innovation in the organization (Colandrea, 2012; Edwards, 2014; Heifetz, 1994; Mueller, 2009).

Effective school district superintendents must prepare their institutions for the future, understand the impact of technology, recognize the globalization of society, and meet the emerging expectations of individualized learning plans in order to be effective (Colandrea, 2012; Marzano et al., 2005; Mueller, 2009). The superintendents in this study strongly indicated that district technology leaders must understand why technology is important to student success in in a competitive global economy. This finding is consistent with previous research that found superintendents, as effective technology leaders, must be aware of emerging local, national, and global trends (American Recovery and Reinvestment Act, 2009; Avolio et al., 2009; Colandrea, 2012; Flanagan & Jacobsen, 2003; Gibson, 2001; NCLB, 2002; Ritchie, 1996; Synder et al., 2000). The results also expressed, in a related subject, that leaders remain current on the legal and financial aspects of the technology program in the school setting (Flanagan & Jacobsen, 2003; Gibson, 2001; Ritchie, 1996).

Managing the impact of technology upon the day-to-day operations of the school district was found to very important in this study. District leadership should align technology resources

to support business and strategic goals (Edwards, 2014). The expert panel data indicated that business and managerial functions supported by trained employees have a profound effect upon the overall efficiency of an organization. The most common business applications are found in the business services, human resources, facilities, security, and student information system departments.

Interestingly, the data collected in this study indicated personal technology knowledge was less important as other facets of technology leadership knowledge. Table 24 presents the survey items achieving the lowest levels of consensus in Research Question One.

Table 24

Research Question One: Survey Items with Lowest Consensus

#	*Item*	*N*	*M*[a]	*SD*	*%*[b]
31	How to do basic functions with the hardware, i.e., connect to projection apparatus, etc.	31	3.06	0.76	90%
35	Equipment selection	31	3.19	0.64	90%
42	Technology inter-action (what things won't work well together)	31	3.26	0.67	90%
34	An understanding of infrastructure for networks	31	3.29	0.68	84%
32	The superintendent should be familiar with the SAMR scale.	31	3.45	1.01	97%

 # – Delphi II Item Number *N – Sample Size*
M –Mean or Average Rating *SD – Standard Deviation*
[a] *Rating scale:1=not important, 2=slightly important, 3=important, 4=very important, 5=extremely important.*
[b] *Percentage of Responses in the three most favorable categories of the rating scale (important, very important, or extremely important.*

Mirra (2004) found that the ability to use technology for their personal use as well as having the knowledge to assist in equipment selection was very important to that expert panel. While still found to be valuable to leaders, personal technology skills and the knowledge needed to select equipment and create networks became secondary to providing vision and leadership for a technology initiative in the results of this study.

Research Question Two

Research question two sought to determine the performances or skills needed by a technology leader. Research question two was: "To be an effective school technology leader, a superintendent should perform the following…" Performance was defined for the panelists as "actions that should be taken by a school superintendent to be considered an effective leader in the area of technology". Table 25 presents the 10 survey items that reached the highest level of consensus by the expert panel as related to performances for an effective district technology leader.

Table 25

Research Question Two: Performance Survey Items with Highest Consensus

#	*Item*	*N*	*M*[a]	*SD*	*%*[b]
12	Gain support for the vision from the school board	31	4.77	0.49	100%
4	The superintendent should objectively measure the impact of technology on student achievement	31	4.52	0.56	100%
32	Communicate often that the goal is transformational thinking and learning, not devices	31	4.52	0.56	100%
22	Provide sound vision for technology use for school board members, staff, students, and community members	31	4.48	0.56	100%
17	Have high expectations for users of technology software upgrades	31	4.45	0.50	100%
46	The superintendent needs to ensure that the infrastructure is in place in order for the hardware and software to be useful	31	4.45	0.66	100%
23	Always work with and through a talented group that understand and are willing to carry out and support the vision	31	4.42	0.55	100%
7	Ensure the hiring of people with appropriate technology skills and/or those with the propensity to be able to learn such skills	31	4.39	0.55	100%
24	The superintendent should celebrate and protect technology innovators	31	4.39	0.66	100%
6	Develop and support teacher leaders for implementation and training	31	4.35	0.48	100%

 # – Delphi II Item Number *N – Sample Size*
M –Mean or Average Rating *SD – Standard Deviation*
[a] *Rating scale:1=not important, 2=slightly important, 3=important, 4=very important, 5=extremely important.*
[b] *Percentage of Responses in the three most favorable categories of the rating scale (important, very important, or extremely important.*

The results of this research question may be represented in the following themes: supporting the human infrastructure, technology related mentoring, managing technology, and managing with technology. These representative themes are in alignment with Hadjithoma-Garstka (2011) whose study found that a leader's emphasis on relationships, creation of supportive environments, and quality communication led organizations to a high level of technology integration.

Leithwood et al. (2004) found that an effective leader helps set direction using "… specific leadership practices such as identifying and articulating a vision, fostering the acceptance of group goals and creating high performance expectations" (p. 10). The highest level of expert panel agreement found in this domain centered on providing vision, support for the human infrastructure, and holding high expectations for technology users during the innovation.

Effective leaders communicate their vision of the new technology to all stakeholders (Brown, 2012; Greaves, 2012; Mirra, 2004). The study results indicated that garnering support from the school board, staff, and community was vital in the opinion of the panelists. The key to organizational support is the creation of an action plan by the leader that aligns with the district's strategic plan. "Management . . . can keep a complicated system of people and technology running smoothly," while leadership "creates organizations in the first place or adapts them to significantly changing circumstances" (Kotter, 1996; p. 25).

The results indicated that educational leaders can create a supportive technology culture by providing adequate financial resources (Anderson & Dexter, 2005; Brown, 2012; Edwards, 2014), and by recognizing the training and support needs of faculty and staff across the organization (Butler & Sellbom, 2002; Davies, 2010; Greaves, 2012; Mirra, 2004). Three distinct types of support were noted in the result of this study:

- Provide in-district support for technology integration…such as technology integration specialists.
- Develop and support teacher leaders for implementation and training.
- Creating a culture that promotes learning environments in which students feel comfortable.

District technology leaders must take an active role at all levels to support technology innovations. Acting as a role model for effective technology use encourages other members of the organization. As was noted earlier, the data from this study did not support the existing research regarding the relative importance of personal technology skills and participation of the leader in professional development. However, creating and implementing a vision aligned to a plan, communicating and implementing that vision, and monitoring its impact upon the organization all parallel the existing literature.

Superintendents are accountable to collect evidence that allows stakeholders to evaluate effectiveness of a technology initiative (Colandrea, 2012) in comparison to the investment of time and resources (Bagozzi, 2007). Data indicated that leadership in communicating and setting the direction for future teaching and learning strategies has the potential to illustrate that technology can be an enhancement and accelerant of student achievement. The increased visibility and use of technology solutions in school districts may increase accountability regarding the cost and effectiveness of the technology innovation.

Effective technology leaders encouraged their staff and faculty to make decisions employing technology tools to manipulate and analyze student achievement data (Brown, 2012). The data indicated that respondents found high agreement that there in the obligation to objectively measure on an ongoing basis the impact of technology on student achievement and

District leadership should align technology resources to support business and strategic goals (Edwards, 2014). The data indicated that district level leaders interested in efficiencies should encourage the use of the latest technology solutions in transportation, food service, facilities management, and all other support functions.

The Mirra (2004) expert panel showed strong support for a district level technology committee that provided support to an initiative or innovation. Table 26 presents the results from research question survey items that received the lowest consensus rankings. Note that building and district level technology committees were not found by the expert panel to be as necessary as in the Mirra study.

Table 26

Research Question Two: Performance Survey Items with Lowest Consensus

#	*Item*	*N*	*M*[a]	*SD*	*%*[b]
38	Encourage the use of the latest technologies in transportation, place in order for the software and hardware to be useful and meaningful.	31	3.35	0.74	97%
9	Complete a needs inventory of the staff and students	31	3.37	0.91	100%
47	Speak to students at all levels to determine their perspective	31	3.45	0.94	94%
35	Active in staff development opportunities	31	3.48	0.76	97%
27	Creation of technology committee(s) at the building and district level	31	3.68	1.00	94%

 # – Delphi II Item Number *N – Sample Size*
M –Mean or Average Rating *SD – Standard Deviation*
[a] *Rating scale:1=not important, 2=slightly important, 3=important, 4=very important, 5=extremely important.*
[b] *Percentage of Responses in the three most favorable categories of the rating scale (important, very important, or extremely important.*

This study's expert panel placed less emphasis (relatively) on the committee concept than that of Mirra or from the literature reviewed. This is in contrast to the finding that feedback

solicited from school and community based technology committees and periodic staff surveys are considered effective practices (Brown, 2012; Mirra, 2004).

Research Question Three

Disposition is the superintendent's proclivity to move the organization in one direction or another (Perkins, 1995). Research question three was: What are specific indicators of a school superintendent's disposition as an effective technology leader? Dispositions or attitudes that make a superintendent an effective technology leader, such as including accountability, resource availability, staff knowledge, community relationships, evidence of technology planning (Mirra, 2004). Vision, innovation, and technology visibility were identified within the results of this research question. Table 27 presents the ten survey items that garnered the highest level of consensus from the expert panel.

Table 27

Research Question Three: Disposition Survey Items with Highest Consensus

#	*Item*	*N*	*M*[a]	*SD*	*%*[b]
36	Understands that technology is a forever changing paradigm	31	4.81	0.40	100%
22	Superintendent credits staff with all successes	31	4.71	0.45	100%
12	Belief in teachers and principals to carry out a vision	31	468	0.47	100%
16	Visionary	31	4.61	0.61	100%
25	Willing to look at the institution of public education in new ways	31	4.61	0.61	100%
39	Resilience	30	4.60	0.49	100%
15	True belief in the strategic plan new technologies	31	4.58	0.66	100%
32	A willingness to see the world through the eyes of the students and what their futures may might look like	31	4.55	0.50	100%
29	The superintendent is keenly aware and supportive of the innovations taking place in the district	31	4.52	0.50	100%
30	Interested in innovation and redesign	31	4.52	0.50	100%

 # – Delphi II Item Number *N – Sample Size*
M –Mean or Average Rating *SD – Standard Deviation*
[a] *Rating scale:1=not important, 2=slightly important, 3=important, 4=very important, 5=extremely important.*
[b] *Percentage of Responses in the three most favorable categories of the rating scale (important, very important, or extremely important.*

The concept of the leader having a vision for learning outcomes and opportunities that prepare students for their future emerged as extremely important in this domain. Leaders who use vision to inform their decision making on a regular basis have a higher level of success during the change process (Drucker, 1955; Senge, 1990) and are better able to understand and overcome resistance to change (Valdez, 2006). In this context, the vision is conceptual understanding that students must be prepared to live and work in a world that is yet to be fully described.

The expert panel found an extremely high level of agreement around the survey item, "Resilence–things will go wrong. An effective superintendent needs to be able to bounce back." The process of innovation is inevitably fraught with challenges. The capability to meet and react to adversity in a positive, problem-solving manner and then move forward with a plan defines the attitude of an effective leader. Patterson and Kelleher (2005) describe resilience as, "…the coping factors needed to survive an array of risk factors and using energy productively to emerge from adversity stronger than ever" (p. 3).

Collins (2001) developed a continuum of leadership characteristics that culminated with what he called "Level 5 Leaders". The expert panel found high consensus in two survey items; celebrating individual, school, and community accomplishments, and always crediting staff with all successes as a result of implementing technology as innovation. Both are characteristics of effective technology leadership in the Collins "Level 5" leadership context.

Trust is inevitably associated with accountability in an organization. The superintendents in the expert panel indicated that it was important that district technology leaders be willing to trust staff and students. In order to build this high level working relationship, it is incumbent

upon the leader to be aware and supportive of the innovations taking place in the district and to focus on product quality, operational excellence, and building strong relationships (Leithwood et al., 2004).

The expert panel indicated that technology leaders must also avoid policy that overly restricts use and stifles creativity and innovation. A review of the literature on the subject indicates that policies can restrict the use and therefore reduce the educational value of technology in a classroom (Cuban, 2001). In order to build a high level working relationship, it is incumbent upon the leader to remove barriers to innovation, be supportive of the innovations taking place in the district, and focus on product quality, operational excellence, and building strong relationships.

Providing adequate resources for the technology innovation was another theme included in results of the three research questions. The emphasis on adequate resources parallels the existing literature in that technology initiatives must be allocated sufficient resources to be successful (Anderson & Dexter, 2005; Brown, 2012; Colandrea, 2012; Edwards, 2014; Mirra, 2004),

Effective communication of decisions by the superintendent to staff contributed to the direction and success of the initiative (Henry & Reidy, 2007; Mueller, 2009; Patterson et al., 2006; Uchida et al., 1996). The expert panel found it important that effective technology leaders have a comfort level and the confidence to communicate the need for implementing change and to involve stakeholders in the decision making process.

Effective technology leaders foster technology leadership among staff (Edwards 2014, Kay & Greenhill 2013). The expert panel in this study believed that effective technology leaders

have high expectations for technology use by members of the organization. Other leadership strategies to strengthen the knowledge base and overall use of technology in school organizations included in the results were:

- Provide opportunities to showcase the use of technology as an instructional tool acknowledging the work being done by the teaching staff and the students. Effective technology leaders "reward experiments, and treat failures as learning and innovation opportunities" (Kay & Greenhill, 2013, p. 93). Successful schools provide meaningful feedback to teachers in order to inform and improve their practices in the classroom (Kay & Greenhill, 2013).
- Provide opportunities for staff to get together to share with each other how they are using technology in their classrooms. Technology leaders understand the best process for sharing effective technology practices throughout the district support creative and innovative practices in the classroom, and build a teaching and learning community consensus regarding technology integration into the curriculum (Brown, 2012; Kay & Greenhill, 2013; Mirra, 2004).
- Encourage staff to explore methods of using technology as an instructional tool. In innovative school communities, teachers are provided opportunities to experiment with technology integration in the classroom without the fear of repercussion (Kay & Greenhill, 2013).

Blin and Munro (2007) found that an "educational leader must have clarity of vision for the future and the competence to adapt to change for the world's consumers of education" (pp. 188-189). The respondents believed it important that technology leaders understand that

technology is a constantly changing paradigm in education and the global society, therefore being flexible and open to rapid changes in the technology world are desirable traits. In order to move educational pedagogy and practice into the 21st century, effective technology leaders must be willing to look at the institution of public education in new and different ways.

The concept of a vision is often tied to organizational strategic planning (Fullan, 2002; Lashway et al., 1995; Zaccaro, 2001). According to the results of this study, superintendents must believe in the strategic plan and promote it throughout the organization.

Fidelity in the facilitation and implementation of a technology initiative systemizes successful technology engagement by students and staff across the organization. Effective leaders assure that technology is used seamlessly throughout the district whether in the classroom, a media center, a business office, or any location in which access to information and productivity tools is necessary (Brown, 2012; Mirra, 2004).

Table 28

Research Question Three: Disposition Survey Items with Highest Consensus

#	*Item*	*N*	*M*[a]	*SD*	*%*[b]
2	Use technology innovation as a marker in evaluations	31	3.52	0.84	90%
14	Work collaboratively with neighboring districts and experiences	31	3.61	0.94	90%
13	Utilize tech committee in budget process	31	3.71	0.77	94%
35	Grounding in an equity framework	31	3.90	0.82	97%
37	Use pilots and small programs to gain interest and building strong relationships with constituents	31	3.94	0.84	94%

 # – Delphi II Item Number *N – Sample Size*
M –Mean or Average Rating *SD – Standard Deviation*
[a] *Rating scale:1=not important, 2=slightly important, 3=important, 4=very important, 5=extremely important.*
[b] *Percentage of Responses in the three most favorable categories of the rating scale (important, very important, or extremely important.*

Recommendations for the Field

The results of this study have documented the critical knowledge, performances, and disposition of effective technology leaders. The following are recommendations for the field:

- The Minnesota Board of School Administrators (BOSA) should explore the addition of core leadership strategies and practices that specifically support technology innovation into the licensure requirements for administrative licensure.
- Professional organizations that support educational administrators should create and offer opportunities for innovative leaders to collaborate and support other innovators across the state.
- The Minnesota School Boards Association (MSBA) would be well served to provide information and training for its membership on policies and practices that support innovative district level technology leadership in their resident districts.
- Institutions of higher learning engaged and authorized to grant administrative degrees and licensure are highly encouraged to review their course offerings and core learning items to include knowledge and performances associated with effective technology leadership.

Conclusion

The field of education is in the midst of a historic period of change and reform. There is an increasing concentration of mobile learning devices in classrooms, a rapidly emerging educational technology pedagogy expectation for teachers, and changing expectations of district leadership in our educational institutions.

The results of this study show definitive movement taking transformational leadership skills to a new level by innovative Minnesota superintendents …what Fullan (2013) calls the "stratosphere" where knowledge, pedagogy, and technology meet to create a synergy for change. Effective district technology leaders in the superintendent role must possess and express a vision for progress, knowledge of the tools and the new pedagogy in 21st century education, communication skills that not only inform but inspire internal and external stakeholders, and much more as evidenced by the extensive list of results reaching a high level of consensus. It is incumbent upon educators and leaders to possess willingness to see the world through the eyes of the students and imagine the needs of their future. Effective superintendents in the role of effective district technology leaders provide the vision, the physical and emotional conditions necessary for change, and the inspiration that moves institutions and its people to a place of instructional practice and student achievement that are crucial for success in our diverse and ever-changing world.

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