DIGITAL EDIFICATION: AN ANALYSIS OF TECHNOLOGY READINESS AND CONCEPT OF ABILITY IN THE SCHOOL DISTRICT OF PALM BEACH COUNTY K-12 SCHOOL LEADERS

by

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This dissertation was prepared under the direction of the candidate's dissertation advisor, Dr. Victor Wang, Department of Educational Leadership and Research Methodology, and has been approved by the members of his supervisory committee. It was submitted to the faculty of the College of Education and was accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

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The purpose of this research study was to determine K-12 school leaders' concepts of ability and technology readiness. The Theories of Intelligence Scale (TIS) was used to analyze concepts of ability and the Technology Readiness Index (TRI) 2.0 was used to analyze the technology readiness of K-12 school leaders. Data from the two instruments were used to determine if there was any relationship between K-12 school leaders' concept of ability and technology readiness. This analysis filled a blank spot in the research contributing to the literature on leadership, Mindset Theory (Dweck, 2006; Dweck, Chiu, & Hong, 1995), and Technology Readiness (Lin & Hsieh, 2012; Parasuraman, 2000). Furthermore it helped to determine the state of K-12 school leaders' status as 21st century leaders.

The sample consisted of the school leaders of School District of Palm Beach County (SDPBC). This included 158 principals from 104 elementary, 31 middle, and 23

high schools. The researcher was a school district employee and therefore had access to the participants.

Each of the four null hypotheses were rejected as SDPBC school leaders scored significantly higher on the TIS ($p<.05$) and TRI 2.0 ($p<.01$), there was a significant ($p<.0125$) positive relationship between TIS and the TRI 2.0, and that relationship was affected ($p<.05$) by gender, race, and experience.

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CHAPTER 1: INTRODUCTION

The purpose of this research study was to determine School District of Palm Beach County (SDPBC) K-12 school leaders' concepts of ability and technology readiness. The Theories of Intelligence Scale (TIS; Dweck, Chiu, & Hong, 1995) was used to analyze concepts of ability, and the Technology Readiness Index (TRI) 2.0 (Parasuraman & Colby, 2015) was used to analyze the technology readiness of K-12 school leaders. Data from the two instruments were used to determine whether or not there is any relationship between K-12 school leaders' concept of ability and technology readiness. The connection between mindset theory (Dweck, 2006) and technology readiness (Parasuraman & Colby, 2001) was tested during the course of this study.

This analysis sought to fill a blank spot in the research contributing to the literature on leadership, Mindset Theory (Dweck, 2006; Dweck et al., 1995), and Technology Readiness (Parasuraman, 2000; Parasuraman & Colby, 2001; Parasuraman & Colby, 2015). It helped to determine the state of K-12 school leaders' status as 21st century leaders and add to the understanding of the 21st century characteristics of K-12 school leaders. There have been few studies elucidating the connection between an incremental concept of ability and technology readiness in K-12 school leaders. Furthermore, this study may positively impact the curriculum of educational leadership programs, school district based certification programs, and professional development programs for educational leaders shaping them to become better 21st century leaders.

Problem Statement

Today's challenging economic climate of global competitiveness, rapid technological advancement, and increasing complexity has had a great influence on the K-12 school system (Litz, 2011). Educators are being called to facilitate learning that will prepare students to be college and career ready, able to compete in the market upon graduation. This preparation requires changes in the K-12 system from the ground up beginning with school leadership. An incremental concept of ability and technology readiness are essential components in the fostering of 21st century skills. An in-depth knowledge of the relationship between K-12 school leaders' concept of ability and technology readiness can provide insight into to their ability to facilitate such change.

Today's teaching workforce is a product of many historical and ideological variables. The progressive ideology, largely espoused by Dewey (1897) and other influential educational philosophers, became an entrenched part of the American educational landscape. This ideology answered the question of why do we educate satisfactorily to many Americans, pointing to the need for students to be prepared for the workforce with relevant job oriented skills. Today's vocational and economic landscape has changed from a product based economy to an information based economy and now demands that students be information literate and competent in 21st century skills (Drucker, 1999). One's ability to collect and manipulate information is quickly becoming one of the most sought after skills within the workforce. Organizations that seek to compete in this economy need to build their collective capacity and information systems. They are finding it difficult to adjust to these new demands at an adequate rate, being left in traditional modes of operation (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2013).

Because of this, pressure is being placed on K-12 education to produce students who are better able to meet these demands and who will subsequently need less training.

Helping traditional educators embrace the pedagogies and curriculum of the digital age is an important endeavor for school leaders. The field of change theory provides a rich framework on how to foster change within an organization. Structural issues of the organization as well as the people within the organization are centers of focus. K-12 school leaders who seek to embrace the digital age need to embrace lifelong learning. As the world changes over time it is difficult for one to remain the same while inspiring the future through education. Lifelong learners are able to adjust their own understandings and embrace the new demands.

Leading others to a place where self-reflection and frame breaking change are possible takes a thorough understanding of what motivates people. Leaders cannot simply give technology to teachers, connect their compensation to how well they integrate it into classrooms, and expect success. Roadblocks such as competing commitments (Kegan & Lahey, 2001), where a person can be committed to multiple things that stand at odds with one another, can get in the way.

One of the fundamental roadblocks that leaders face in the change process, and with great emphasis in the advance of technology, is the Mindset theory of teachers, or their concept of ability (Dweck, 2006; Lawson, 2007). These are synonymous terms describing one's beliefs as to the malleability of their own intelligence. This variable, as measured by the TIS, is a critical variable in the learning process (Dweck et al., 1995). Leaders who are resistant to change can hold a fixed mindset toward their technological intelligence and talent. A fixed mindset can be based on many big assumptions that one

holds. Leaders in today's schools need to dawn an open mindset toward their technological intelligence and talent in order to model 21st century attitudes for their staff. As leadership attitudes influence the culture of the school, change will be actualized.

As noted above people are able to have mixed commitments that battle to find priority (Kegan & Lahey, 2001). Likewise people tend to have mixed feelings about technology. One can, at the same time, have feelings of optimism, innovativeness, discomfort and insecurity toward technology. Parasuraman and Colby (2001) found that the net consideration of these feelings acted as an accurate description of one's technology readiness. School leaders need to be technology ready learners and model such attitudes within their organization.

Leaders need to be able to communicate a vision that leads their organizations if the envisioned change is going to occur (Kotter, 1996). Where the growth of 21st century literate, globally competitive, and technologically fluent students is desired, K-12 leaders need to embrace the mindset and technology readiness that they want to see produced.

Purpose Statement

The purpose of this research study was to determine K-12 school leaders' concepts of ability and technology readiness. The TIS was used to analyze concepts of ability and the TRI 2.0 was used to analyze the technology readiness of K-12 school leaders. Data from the two instruments were used to determine if there is any relationship between K-12 school leaders' concept of ability and technology readiness. This analysis fills in a blank spot in the research contributing to the literature on leadership, Mindset Theory (Dweck, 2006; Dweck et al., 1995), and Technology Readiness (Lin & Hsieh,

2012; Parasuraman, 2000). Furthermore, it helps to determine the state of K-12 school leaders' status as 21st century leaders. This study was needed to add to the understanding of the 21st century characteristics of K-12 school leaders.

Significance of Study

There have been few studies elucidating the connection between concept of ability and technology readiness in K-12 school leaders. This study sought to fill the blank spot. This study contributes to the literature on K-12 leadership, Mindset Theory, and Technology Readiness. Furthermore, this study may impact the curriculum of educational leadership programs, school district based certification programs, and professional development programs promoting 21st century leadership. As McLeod says, in the area of technology "if the leaders do not 'get it' their systems- most importantly their students- surely will not either" (2011, p. 294). Leaders need to be able to espouse the skills and mindset that they want to be envisioned in their system and consequently embodied in their students. Kotter (1996) affirms that the basis of leadership lies in one's ability to create change through visionary direction. As the technological revolution in education lags behind the greater technological revolution in society, studies such as this inform and empower K-12 school leaders to assess themselves and encourage the change process.

The change process requires systematic learning (Fullan, 2010). Lifelong learning goes far beyond acquisition of knowledge throughout life by including the augmentation of the learner as new knowledge changes that learner's understanding of the world (Argyris & Schon, 1974; Habermas, 1971; Leithwood, 1994; Mezirow, 1990). A greater understanding of the concept of ability and technology readiness and their relationship

provides K-12 school leaders with an essential piece of knowledge with which to engage in critical self-reflection. Through such reflection learning and change are possible, first in the individual and then in the organization.

This study will act as a test for both Mindset Theory and Technology Readiness Theory. It can be expected that those who espouse an incremental concept of ability will be more capable of remaining change ready and learning ready and therefore display a higher level of technology readiness. By looking at the relationship between these instruments one will be able to confirm or deny this hypothesis. Furthermore, a greater opportunity for theory building is presented in the prospective relationship that could be found in each of the parts of technology readiness, optimism, innovativeness, discomfort and insecurity, and mindset theory. Through this study and analysis, theory will be able to be generated on what kinds of feelings toward technology are manifested by those with differing mindsets toward learning. Is there ultimately a link between one's personal understanding of learning and technology learning with technology readiness acting as an indicator for one's readiness to accept and learn new technologies?

Conceptual Framework

Bruner (1957) presents "a general view of perception that depends upon the construction of a set of organized categories in terms of which stimulus inputs may be sorted, given identity, and given more elaborated, connotative meaning" (p. 148). As a person moves through life making sense of the world, this process acts as an organizational tool to create a worldview framework. One's ability to connect to perceived reality in Bruner's (1957) view depends on such constructions.

Change and the embracing of new things, is tied to one's perceived construction of reality (Bruner, 1957). Bruner (1957) states, "perceptual readiness refers to the relative accessibility of categories to afferent stimulus inputs" (p. 148). In other words perceptual readiness is a factor determined by the amount of effort it takes for one to fit stimuli into their construction of categories, or make sense of incoming data according to their construction of reality. Perceptual readiness is determined by "the likelihood of occurrences of events learned by the person," and "the requirements of search dictated by need states and the need to carry out habitual enterprises" (p. 148). The first refers to how likely one's incoming data, perception, fits their construction of categories. As one creates a "model of the likelihood of events" (p. 148), and the more closely this model fits with incoming data leading to fewer surprises or conflicts, the greater the perceptual readiness of the individual. The second determinant of perceptual readiness is the limiting factor of need states. Similar to Maslow's (1943) hierarchy of needs, one's ability to sort incoming data into categories is affected by their state of being. If one is in a state of great hunger, then the ability to categorize stimuli for higher level needs may be limited.

When an individual is not perceptually ready for incoming stimuli, as limited by the two determinants, they are forced to deal with the inconsistencies in one of two ways. First, they can engage in the "relearning of categories and expectancies", editing their understanding of the world making it better suited for the additional information, and second, "by constant close inspection of events and objects" (Bruner, 1957, p. 149). Bruner (1957) notes that when one participates in such close inspection, the ability to adjust to the new information is lost. This affect is further hindered by limited capacity, risk and time pressure (Bruner, 1957).

Adult learning seeks to place challenges on one's perceptual readiness through critical self-reflection (Mezirow, 1990), prompting the learner to reexamine their presuppositions. Argyris (1977) refers to these presuppositions as "hidden theories of action" (p. 115). He theorizes that in order for learning, that goes beyond reactionary, to take place it must go beyond single loop learning to a second loop learning. Single loop learning as defined by Argyris (1977) is a process that "enables the organization to carry on its present policies and achieve its objectives" (p. 116). Through this process one operates within a single unchanging frame while learning to react to stimuli within the bounds of that frame. Double loop learning on the other hand engages in "questioning the underlying policies" a "more comprehensive inquiry" (p. 116). Organizations and individuals who operate with a greater perceptual readiness are more able to engage in double loop learning because their underlying assumptions become more inclusive. Interpersonal interaction through this kind of process becomes one of greater understanding as those in the conversation seek to learn from others, while advocating their principals, rather than defending or demanding acceptance of principals and wining the conversation (Argyris, 2002, p. 217).

Why people do or do not embrace technological change, or any other change, can be partially explained by their theory of intelligence (Dweck, 2006; Lawson, 2007; Murphy & Dweck, 2009). According to Dweck (2006) there is a dichotomy of learner mindsets that differentiate people in the world. The first is the fixed mindset. This is described as belonging to those who believe that intelligence, talent, and potential for success are fixed. Lawson (2007) expresses concerns that "learning climates that persuade students that ability is fixed are more likely to result in a higher proportion of

unmotivated students" (p. 42). Dweck's (2006) second learner mindset is the growth mindset. This mindset is the total opposite of the fixed mindset. "Everyone can change and grow through application and experience" (Dweck, 2006, p. 7). Challenges are seen as opportunities to learn and be stretched. Lawson (2007) also asserts that "if climates can be created that encourage students to believe that they are able to improve, rather than believe that they have no control over their ability, students are more likely to adopt a deeper approach to their work" (p. 41). Lawson (2007) describes learner mindset well as an incremental concept of ability noting, "overall an incremental concept of ability is associated with a self-determined motivation, which is most likely to lead to positive achievement behaviors" (p. 39). A positive attitude toward one's own ability to improve is vital to the learning process. Dweck (2009) asserts, about students but certainly applicable to all learners, that a vital first step in fostering 21st century skills in students is to produce in them a growth mindset.

Theory of intelligence, a synonym for mindset, is used by Dweck et al. (1995). They state that,

> An entity theory of intelligence is the belief that intelligence is a fixed trait, a personal quality that cannot be changed. Individuals who subscribe to this theory believe that although people can learn new things, their underlying intelligence remains the same. In contrast, an incremental theory of intelligence conceives of intelligence as cultivatable (i.e., individuals may become more intelligent through their efforts). (pp. 267–168)

Murphy and Dweck (2009) found that an organization's cultural manifestation of a fixed or open mindset shapes its member concurrently. This phenomenon was even

evident in the self-presentations of recruits as they sought to gain employment. People's behaviors were found to be in accordance with the overall cultural mindset of the organization. Furthermore Dweck (2014) found that:

> Employees in a "growth mindset" company are 47% likelier to say that their colleagues are trustworthy, 34% likelier to feel a strong sense of ownership and commitment to the company, 65% likelier to say that the company supports risk taking, and 49% likelier to say that the company fosters innovation. (p. 28)

The far-reaching implications of one's mindset abound as Yeager et al. (2014) notes that a person's entity theory can help to predict their stress, health, and achievement.

Research on the adoption of new technologies has shown that people can hold a paradoxical relationship toward technology (Parasuraman, 2000). Individuals are able to at the same time hold negative and positive feelings toward a new technology. Positive attitudes such as optimism and innovativeness act as motivators while negative attitudes like discomfort and insecurity act as detractors to technology adoption (Parasuraman, 2000). Once balanced these attitudes can be viewed on a continuum to calculate one's technology readiness.

K-12 school leaders who espouse these positive attributes will be more successful in bringing their organizations into the 21st century and producing globally competitive, technologically literate citizenry. Figure 1 presents a theoretical framework for the integration of theories from Argyris and Schon (1974), Bruner (1957), Dweck (2006), and Parasuraman and Colby (2001). The portion of this conceptual framework that is

being tested during this study is the relationship between concept of ability and the technology readiness components.

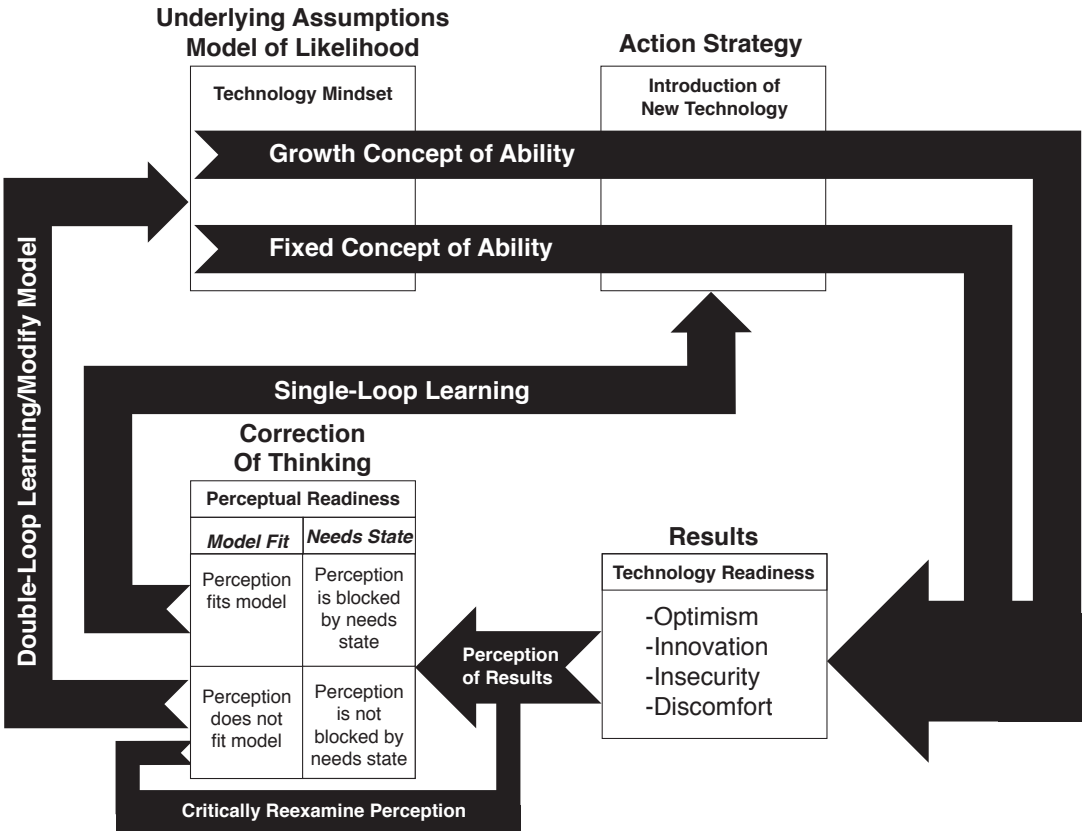

Figure 1. Conceptual framework. Derived from Argyris and Schon (1974), Bruner (1957), Dweck (2006), and Parasuraman and Colby (2001).

Research Questions

The research questions are as follows:

1. What is the technological readiness of SDPBC K-12 school leaders and how does it compare with the norm?

2. What is the concept of ability of SDPBC K-12 school leaders and how does it compare with the norm?

3. What is the relationship between SDPBC K-12 school leaders' concept of ability and their technology readiness?

4. How is the relationship between concept of ability and technology readiness moderated by contextual variables?

Null Hypotheses

The null hypotheses examined are:

$H_0 1$: There is no difference between K-12 school leaders and the norm group in technology readiness.

$H_0 2$: There is no difference between K-12 school leaders and the norm group in concept of ability.

$H_0 3$: There is no relationship between the concept of ability and technology readiness of K-12 school leaders.

$H_0 4$: The relationship between concept of ability and technology readiness is not moderated by contextual variables.

Variables

The dependent variable was technology readiness, as determined by the TRI 2.0. The concept of ability, as determined by the TIS, acted as an independent variable. The following contextual independent variables were also used to assess moderation of the relationship of the K-12 leaders' concept of ability and their technology readiness: age, gender, race, school level (elementary, middle or high), level of education (bachelor's, master's, double-master's, specialist, doctoral), university at which leadership degree was acquired, quality and quantity of online coursework exposure, and years in education.

Definition of Terms

Concept of ability: This term was used by Lawson (2007) to describe a person's belief that their intelligence is either fixed or incremental. It was synonymous to Dweck's (2006) term *mindset.* Concept of ability will be measured by the TIS (Dweck et al., 1995).

Discomfort: This term was defined as "a perceived lack of control over technology and a feeling of being overwhelmed by it" (Parasuraman, 2000, p. 311). Discomfort was operationalized and measured by the TRI 2.0 (Parasuraman & Colby, 2015).

Implicit Theories: "Implicit theories refer to the two different assumptions people may make about the malleability of personal attributes; they may believe that a highly valued personal attribute, such as intelligence or morality, is a *fixed*, nonmalleable trait-like entity (*entity theory*), or they may believe that attribute is a malleable quantity that can be changed and developed (*incremental theory*)" (Dweck et al., 1995, p. 267). Implicit Theories was operationalized, and measured by the TIS (Dweck et al., 1995).

Innovativeness: Innovativeness was defined as "a tendency to be a technologically pioneering and a thought leader" (Parasuraman, 2000, p. 311). Innovativeness was operationalized and measured by the TRI 2.0 (Parasuraman & Colby, 2015).

Insecurity: Insecurity was defined as "distrust of technology and skepticism about its ability to work properly" (Parasuraman, 2000, p. 311) and operationalized and measured by the TRI 2.0 (Parasuraman & Colby, 2015).

Mindset: Mindset was the term used by Dweck (2006) to describe a person's implicit theories. Synonymous to Lawson's (2007) term *concept of ability* and operationalized, and measured by the TIS (Dweck et al., 1995).

Optimism: Optimism was defined as "a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives" (Parasuraman, 2000, p. 311) and operationalized and measured by the TRI 2.0 (Parasuraman & Colby, 2015).

Technology-readiness: "The technology-readiness construct refers to people's propensity to embrace and use new technologies for accomplishing goals in home life and at work. The construct can be viewed as an overall state of mind resulting from a gestalt of mental enablers and inhibitors that collectively determine a person's predisposition to use new technologies" (Parasuraman, 2000, p. 308). Technology readiness was operationalized and measured by the TRI 2.0 (Parasuraman & Colby, 2015).

Role of the Researcher

The researcher has worked in the K-12 system in various roles from instructional to administrative and has assisted and led the inception of two technology based choice programs at two school locations during this time. The researcher engaged with a diverse group of leaders throughout this process and has found that differences in perceived technology readiness as well as concept of ability have had great impact on the way that these programs were envisioned and actualized, eventually leading to different experiences and learning for students. This has led the researcher's interest in the

connection between concepts of ability and technology readiness of K-12 school leadership.

Additionally, the researcher believes that if schools are to provide society with college and career ready workers with 21st century skills then leaders will need to espouse these skills themselves and change their organizations to produce such results. Schools will not produce 21st century competent, globally competitive workers unless leaders also become 21st century, globally competitive leaders.

It is the assumption of the researcher that there will be a tendency for those with high level of technology readiness to have a highly incremental concept of ability because technology readiness may be partially the result of an incremental concept of ability being manifested in a technology rich environment. This is not to say that the inverse, a high level of technology readiness, will lead to a highly incremental concept of ability because as Dweck (2006) has noted people can have a compartmentalized concept of ability toward different concepts.

This research should be continued in different locations with different populations. During the collection and analysis of the data the researcher made every effort to remove any effects of his assumptions and biases.

Delimitations

Only principals employed by one school district in South Florida, the SDPBC, during 2015 were included in the sample. This school district was used because of the researcher's convenience and access. As a result the findings may not be generalizable to all K-12 settings and may be limited to similar school districts. The researcher chose to use email as the medium of the survey instrument, which may have had an effect on the

data as it may skew the results of the technology readiness component. This, though, should be a minimal effect as the SDPBC, and especially its leadership, has been using email as an official mode of communication and considers it to be standard practice. The time of year that the study was conducted was during the slower summer season in order to foster greater participation. Conducting the survey during a less stressful season may also have some effects on the results.

Limitations

Participation in this study was on a voluntary basis and those who participated may have tended toward a specific concept of ability and level of technology readiness. The researcher chose the specific instruments because they have been shown to be reliable and valid through a variety of contexts and uses. Only specific contextual variables were considered during this study: age, gender, subject area, level of education (bachelor's, master's, double master's, specialist, doctoral), university at which leadership degree was acquired, quality and quantity of online coursework exposure, and years in education. Other factors that were not accounted for such as experiences and past employment may have had an effect on the data. There may have been an influence on the data due to social desirability of responses. This influence was compensated for by comparison with the norm groups that would have experienced similar influence. Additionally, due to the researcher's relationship with SDPBC as a support administrator for middle school programs, there may have been an additional desirability for participation by middle school principals.

CHAPTER 2: LITERATURE REVIEW

Today's teaching workforce is a product of many historical and ideological variables. The progressive ideology, largely espoused by Dewey (1897) and other influential educational philosophers, became an engraved part of the American educational landscape. It answered the question of, why do we educate, satisfactorily to many Americans. Students need to be prepared for the workforce with relevant job oriented skills. The vocational and economic landscape has changed from a product-based economy to an information-based economy and now demands that students be information literate and competent in 21st century skills (Drucker, 1993; McLeod, 2011). One's ability to collect and manipulate information is quickly becoming one of the most sought after skills within the workforce.

Organizations that seek to compete in this economy need to build their collective capacity and information systems. They are finding it difficult to adjust to these new demands at an adequate rate, being left in traditional modes of operation (Fitzgerald et al., 2013). Because of this, pressure is being placed on the schools to produce students who are better able to meet the demands and who will need subsequently less training.

In this pursuit, curriculum that gets its cues from this perspective on society is seeking to grow tomorrow's well-equipped work force. These newer curricular foci open up the field of information giving students opportunities to interact with more diverse content rather than cleaving to the official knowledge (Gur & Wiley, 2007). This phenomenon stands in contrast to what has been a trend of curriculum in the preceding

decades and today. Curricular control of subject matter, spurred on largely by the high stakes testing movement and the essentialist reification of knowledge, both of which are still a dominant reality today, have led to a narrowing of content (Gur & Wiley, 2007). Some teachers who were trained and have taught through much of this trend can have difficulty transforming their understanding of education and embracing some of the new demands on the teaching profession. Balancing these paradoxical priorities can be a difficult business.

Helping traditional teachers embrace the pedagogies and curriculum of the digital age is an important endeavor for school leaders. The field of change theory provides a rich framework on how to foster change within an organization (Kotter, 1996). Elements of the organization as well as the people within the organization are centers of focus. Educators who seek to embrace the digital age need to embrace lifelong learning. As the world changes over time it is difficult for one to remain the same while inspiring the future through education. Lifelong learners are able to adjust their own understandings and embrace the new demands (Mezirow, 1990).

Leading teachers to a place where self-reflection and frame breaking change are possible takes a thorough understanding of what motivates people. Leaders cannot simply give technology to teachers, connect their compensation to how well they integrate it into classrooms, and expect success. Some of these roadblocks include learner mindset (Dweck, 2006) and technology readiness (Parasuraman & Colby, 2001). By better understanding these elements a leader can better equip their organization and people to have a change ready perspective.

Knowledge Based Economy

The economy is changing from an economy of goods into an economy of knowledge (Drucker, 1993; McLeod & Richardson, 2011). According to Drucker (1993):

> Every few hundred years in western history there occurs a sharp transformation. We cross... a divide/ within a few short decades society rearranges itself, its worldview; its basic values; its social and political structure; its arts; its key institutions. Fifty years later, there appears a new world... we are currently living through such a transformation. (p. 1)

One of the driving factors behind this phenomenon is the uncertainty of future markets, which leads to a need for greater knowledge. According to Kim and Mauborgne (2005), market dominance is not a sustainable condition. Innovative untapped markets need to be continually sought. This idea is also associated with and illustrated well by the sigmoid curve (Figure 2) used by Handy (1994).

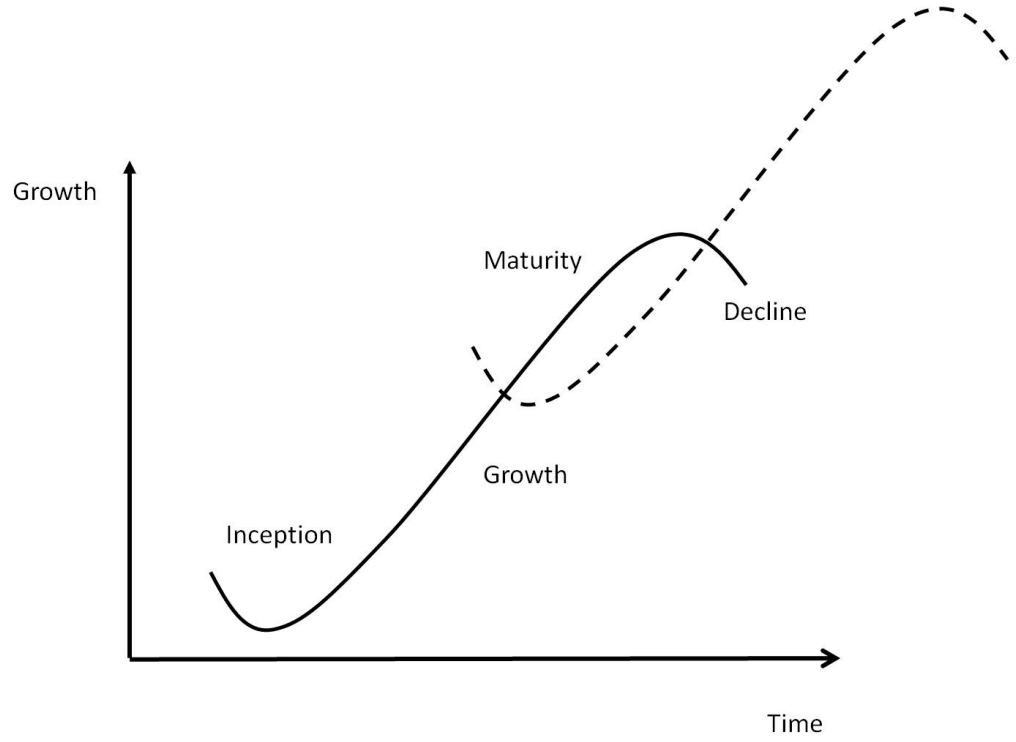

Figure 2. Sigmoid Curve from Handy (1994). Retrieved from http://iangotts.wordpress.com/2013/08/02/entrepreneur-is-not-a-job-description-success-is-not-a-destination-startup-entrepreneur-charleshandy/

Handy (1994) used the sigmoid curve to describe the life cycle of technology, organizations, empires, and so forth. It is a double S curve where a new technology begins the downward, and then upward, journey of an emergent mode braking innovation. Eventually demand wanes and another innovation is necessary to take up the old technology's place and provide market dominance. The acquisition of market prominence, extensive capital, and political influence is unable to guarantee a company's future success. Knowledge becomes the commodity that allows for future success. Bolman and Deal (2003) also attest to the importance organizational knowledge as they analyze organizations through 4 frames. These are the structural, human resource, political and symbolic frames. Noting the structural frame, they found that as organizations become larger and more complex they require more sophisticated organizational structures. They state, "information technology permits flatter, more

flexible, and more decentralized structure" (Bolman & Deal, 2003, p. 59). In essence information technology allows organizations to grown larger and handle complexity.

Knowledge can be either tacit or explicit (Nonaka, 1991; Nonaka & Konno, 1998; Nonaka & Takeuchi, 1995; Polanyi, 1958). Mezirow (1981) refers to Polanyi's (1958) tacit understanding as "unformulated knowledge" (Mezirow, 1981, p. 16). It represents everything that one knows that has not been manifested. Explicit knowledge on the other hand is externally expressed knowledge. According to Nonaka (1991) a knowledge creating company is one that synthesizes the tacit knowledge of their workforce to gain new insight and create new knowledge. This strategy will broaden the knowledge base of the organization. But, if organizations are to go beyond the knowledge that is internally and externally available, to become globally competitive, then digitally literate workers will be needed.

Drucker (1999) agrees with the centrality of knowledge-based work in the new economy placing it as a higher commodity to that of equipment and hardware assets. He states, "the most valuable assets of the 20th-century company was its production equipment. The most valuable asset of the 21st-century institution (whether business or non-business) will be its knowledge workers and their productivity" (p. 79). If these "knowledge workers" are of such a central role in the future success of organizations, it follows that educational systems that provide these kinds of skills will be acting in their students' best interests. Apple (1986) believes that "our job as educators (and instructional designers) involves skilling, not deskilling" (p. 173). This means that we need to transfer knowledge to students in such a way that will give them the skills that are necessary for their future. In contrast we are also not to deprive them of the knowledge

and skills that are in fact helpful for their future. This qualifies as detrimental or "deskilling." In the 21st century new literacies and skills are necessary for the future success of our students.

Students today need to be able to compete in the global economy (Kotter, 1996; Litz, 2011; McLeod, 2007; McLeod & Richardson, 2011; Pisapia, 2009). McLeod (2007) attaches to the idea of global citizenship the qualification of digital literacy. The term "digital and global citizen" and "21st century citizen" are used similarly by McLeod (2007, p. 1) to describe the desired outcome for future students. In the use of these terms there is a contrast being established. If one is digitally competent and globally minded, then they are one with the times and can be associated with this modern citizenry. If on the other hand, one is digitally illiterate and confined to their own place, speaking in informational terms, then they are a separate, less able, citizenry. He states that "so-called 21st century skills" are needed to make "digital and global citizens" (McLeod, 2007, p. 1). So, according to McLeod (2007, p. 1) "students now must be media and information literate, globally aware and skilled at online collaboration if they are to be successful digital and global citizens." Students who leave school proficient in core subject matter but who are not prepared with technological skills are likely to struggle in a work environment that demands proficiency of these skills.

Kotter (1996) points out that developments in economic and social forces necessitate change. Many companies are in great need of digitally literate workers. In a survey of 1,556 executives and managers Fitzgerald et al. (2013) found that "according to 78 % of respondents, achieving digital transformation will become critical to their organizations within the next two years. However, 68% said the pace of technology

change in their organization is too slow" (p. 2). Students who are able to assist in meeting this need will have a competitive edge and be able to empower companies to reach their digital goals. Accordingly, Bruce (2004) asserts "information literacy is conceivably the foundation for learning in our contemporary environment of technology change" (p. 8). This new literacy found its inception in the early 1970s and is associated strongly with information and communication technology environments (Bruce, 2004, p. 8). It is considered to be "the critical literacy of the twenty-first century" (Bruce, 2004, p. 8). This link points to the understanding that digital literacy does not in and of itself empower students to be globally competitive. It is the link between digital literacy and information literacy that empowers students to compete on the global market. The emphasis must remain on the acquisition of knowledge and not on the vehicle through which that knowledge is gained and manipulated. Technological school leaders must not lose the trees for the sake of the forest. According to some (McLeod, 2007; Pisapia, 2009), technology is only the tool through which information is gained. This information can then be leveraged as a valuable resource (Fowler, 2008). McLeod (2007, p. 8) affirms that, "technology is a means, not an end" while Pisapia (personal communication, November 1, 2013) goes further stating, "technology is short for knowledge. Knowledge is the commodity, technology is the conduit." Digital literacy is closely linked with global competitiveness because digitally literate people are able to gain a greater breadth of information with which they can make informed strategic decisions.

The findings of the study of Autio, Dahlander, and Frederiksen (2013) provide further support. They "suggest that reducing demand uncertainty is a central factor regulating entrepreneurial action" (p. 1348). In other words, Autio et al. (2013) found that

entrepreneurial action is more likely to take place when there is a greater understanding of need. This understanding of need can come from the acquisition of user need information and knowledge generation. In times of complexity and demand uncertainty the exposure of entrepreneurs to information lowers the perceived complexity of the market and allows for "opportunity recognition" wherein, "his/her action of evaluating whether third-person opportunities represent feasible and desirable first-person opportunities for entrepreneurial action" (p. 1348). Information therefore becomes the linchpin for action and future success of an organization.

The effects of globalization as a result of information technology growth are not without unintended consequences. Litz (2011) views the concept of globalization through a deconstructivist lens and concludes that many of the globalizing trends have negative effects on people. The negative outcomes have been identified as "rampant consumerism; feelings of disenfranchisement, inequity, animosity and exclusion; environmental degradation; allegations of imperialism and hegemony; and increasing disparities of wealth and other inequalities between developed and developing nations" (pp. 58–59). In the same way that the interstate highway system in the United States allowed consumers to bypass smaller towns, by allowing them to go more exactly where they wanted, so too has the increase of readily available information and globalization given people access to exactly what they need. If one is able to stay competitive in the larger pool of opportunity then success is possible, but if one is unable to compete then great loss is likely to occur.

Historical Effect of Curriculum Development

Students tend to learn what they are taught (Anderson, 2002; Walker & Schaffarzick, 1974). According to Anderson (2002), "what and how much students are

taught is associated with, and likely influences, what and how much they learn" (p. 255). While any teacher would likely assert that this is common knowledge, 'they learn what I teach,' this is still a statement with vast curricular significance. Standardization of curriculum lowers the variability of student learning while increasing the consistency of specific curricular goals being achieved (Walker & Schaffarzick, 1974). In a period during which curricular autonomy was diminishing, Walker and Schaffarzick (1974) asserted "the creation and use of curriculum materials is generally producing a pattern of academic achievement consistent with the intentions of curriculum developers" (p. 109). That is, as curriculum was developed and implemented, students achieved in accordance with what the curriculum focused. The intent of curriculum makers was successful in producing student learning corresponding to their goals. Walker and Schaffarzick (1974), taking a positive attitude, therefore suggest that a great opportunity is created for educators to shape and develop student learning with direction. They suggest that educators cease to think of curriculum, "as a fixed race course and begin to think of it as a tool, apparently a powerful one, for stimulating and directing the active learning capacities which are ultimately responsible for the achievement we want from schools" (p. 109). Viewing this through a technological lens, it can be seen that if students are exiting the 12th grade with little career relevant, capital enabling, technological literacy, then it follows that the curricular goals of their education were not aligned to produce this outcome in them.

Today, the use of rigidly specific curriculum designed to maximize high-stakes testing achievement and the narrowing of curricular autonomy has yielded negative consequences for education (Au, 2007; Gur & Wiley; 2007; Rolland, 2012) with specific

technological implications. According to Au (2007), “high-stakes testing exerts significant amounts of control over the content, knowledge forms, and pedagogies at the classroom level” (p. 264). This *control* is a narrowing rather than broadening. Rolland (2012) found that “extrinsically focused classroom goal structures [necessitated by the movement toward standardization] have an overall negative effect on academic achievement” (p. 396). When the leadership of the classroom’s content was taken from the teacher the desire for achievement that warranted the demand for extrinsically focused goals was not achieved. This relationship can be viewed as an imbalance of Fowler’s (2008) concepts of order versus expressive individualism. Describing the tendency of the American psyche, Fowler (2008) notes “explicitly or implicitly, the high value that most Americans—including practicing educators—place on orderly schools is always an important influence on education policy” (p. 109). This order is therefore being expressed in the standardization movement. Fowler (2008) continues, “resistance by Americans to policies such as national standards, curriculum, and examinations can be understood as a desire for individualistic rather than group-oriented policies” (p. 109). Americans hold both of these paradoxical values side by side with a great influence on education.

Gur and Wiley (2007) refer to this phenomenon, the standardization of education, as objectification. Specifically pertaining to instruction in reading during the high-stakes testing era they write:

> The reduction of the teachers' role to manager of commercially produced reading materials not only degrades teachers from their professional status, but also reduces and reifies school literacy to the completion of materials and to students'

> scores on standardized reading tests-- in essence, ignoring how students develop critical literacy on their own. (p. 3)

The consequences for this kind of curricular control are both vast and deep. Gur and Wiley (2007) go further stating "one can identify three related political/economical problems with the objectification of education: deskilling, reification, and proletarianization" (p. 6). Students are emerging less skilled and less able to compete in the marketplace, understanding only a narrow *official* knowledge that lacks the breadth of that which is easily available in the information age, and being therefore subjected to downward social mobility for a future with less opportunity. In essence these consequences act as the reversal of the positive possibilities and benefits that information technology promises to students. Students who are information literate are skilled, being able to access vast amounts of data with discernment and efficiency, understand the diversity of information without the need to substantiate one 'official' view, and are more able to compete in the global knowledge economy.

Some researchers (Follett, 1896; 1926; Gur & Wiley, 2007; Rolland, 2012) focus on the relational aspect of organizations. Rolland (2012) suggests a more horizontal relationship, rather than vertical authority, to increase achievement. She found that, "teachers' socioemotional and instructional support… [and] socio-emotional factors including self efficacy, interest in class, and prosocial behaviors and goals" (p. 396) were factors that correlated with higher achievement on norm bases assessments. Much in agreement with Rolland (2012), Gur and Wiley (2007) insist that, "instructional products should be designed and imported as instructional resources which might enhance a caring relationship" (p. 10). The motivation behind Gur and Wiley's (2007) emphasis on

relationship building focuses heavily on a move toward entering into dialogue with students over the complexities of problems. According to Gur and Wiley (2007) "teaching should not only be seen as the production and transmission of instructional materials. The importance of dialogue should be acknowledged" (p. 8). They also present information technology as a tool through which this dialogue can be enriched. According to Gur and Wiley (2007) "[information technology] IT as an art has the potential to disclose things as things, not as standing reserve to be (re) used. Bodies and subjectivities should be affirmed, not seen as an obstacle to learning" (p. 9). Through the use of information technology students can be exposed to variations in opinion, which can be used to facilitate dialogue and deeper understanding. This point is supported by Tamim, Bernard, Botokhovski, Abrami, and Schmid (2011) in their second order meta-analysis on the impact of technology on learning, which included 1,055 individual studies. They found an effect size of .31 in favor of using technology as the direct instructional means over traditional instruction and an effect size of .42 in favor of using technology to support instruction. The incorporation of technology in the classroom therefore had a significantly ($p < .01$) positive influence on student learning.

Despite the supporting literature for technology influence on learning, there is also some literature on the fence of the issue. Russell (2011) found that there was no significant difference in the delivery method and its effect on student learning. This assertion does not counter the positive claims of technology literacy's attributes but rather sits on the fence saying that the use of technology in the delivery of content, or any other delivery method for that matter, does not produce any variation from the mean performance.

In order for technology to have a positive effect on student learning it must be used as a gate rather than a jar. As McLeod (2007) so concisely, stated, "technology is a means, not an end" (p. 8). Technology when used effectively should open the possibilities and bring new information to the student. Much of the time this end is not achieved because educators treat technology as a jar. Educators, who once presented their material and practice using one form, say a cup, now deliver the same comfortable content with a new mode or in a new vessel, the jar. The technology has been used, but the only extra learning that students received was to understand that there are alternative modes of delivery for the same reified content (Gur & Wiley, 2007, p. 6). The move from lecturing from behind a lectern and writing textual notes on the board, to lecturing from behind a computer while displaying textual notes on an electronic presentation exemplifies this. This practice does little to foster the information literacy advocated by McLeod (2007). Melneck (2002) presents a parallel to the need for new pedagogical practice with the incorporation of technology. He attests to the need for new strategies and frameworks for useful application of the web. He states, "as groups began to understand the web as a distinct medium, they realized that it required new ways of thinking about design, layout, content, and user interactions" (p. 86). The common practice of simply posting mountainous quantities of text onto the web as if it were print proved to be cumbersome to access and use. In much the same way technology can create an evolution of pedagogical practice or be a new means for delivering the same content. This practice therefore does not provide the information literacy and 21st century skills that students need.

Discernment and creativity are therefore required for technology to make its greatest impact. McLeod (2007) in his paper on technology leadership insists that we ask kinds of questions that will lead to this end. Some of these questions include:

- When and why do we use digital technology in our classrooms?
- How does our usage of digital technologies align with our curricula and instructional goals?
- How do we know whether technology is being used effectively in the classroom?
- What positive results are we seeing from our use of digital instructional technologies?
- What are the barriers to effective technology usage by students and teachers?
- How can technology better facilitate student learning? (p. 8)

When educators start answering these questions it is expected by McLeod (2007) that there will be a greater impact in the classroom for the acquisition of 21st century skills.

Lifelong Learning

According to McLeod (2011) "we can't firmly believe in 'lifelong learning' and simultaneously not be clued in to the largest transformation in learning that ever has occurred in human history" (p. 4). Under McLeod's (2011) reasoning, personal growth in technological skill that mirrors the growth of technological advancement must be a vital part of any lifelong learners' pursuit in the 21st century. If educators are ultimately about the business of student learning and if educators believe technologically rich pedagogy to be a powerful tool for reaching them and empowering their learning, then it follows that

educators who claim to be lifelong learners would be excited about and embrace technologically rich pedagogy with open arms.

This has not been the reality for many educators. There are internal roadblocks for some that hinder them from embracing technology (Ertmer, 2005; Li & Choi, 2010; Wang & Torrisi-Steele, 2015). According to Ertmer (2005) the study of teachers' pedagogical beliefs about instruction in technology needs to be conducted as a "vital first step" in understanding its role in assimilating technologically rich pedagogy (p. 25). This is vital because, as Ertmer (2005) asserts, teachers are unlikely to use technological skills "unless they fit with teachers' existing pedagogical beliefs" (p. 37). It is suggested therefore that educators focus not only on the imparting of technological skills to teachers but also focus on teachers' pedagogical beliefs. Li and Choi (2010) found that "social capital plays a pivotal role in leveraging change in schools and has a direct effect on teachers' use of technology in their professional practice" (p. 2). According to their study, of social capital's influence on technology infusion, social capital was more influential than professional development and had a "direct influence on teachers' receptivity toward technology use and their perceived effectiveness of CPD [continuous professional development]" (p. 14). Teachers' pedagogical beliefs about technology and social capital should therefore be understood as important aspects of any technological initiative in a school. The fostering of a culture that embraces technologically rich pedagogy should be a priority for a school leader. In a culture where technologically rich pedagogy is esteemed highly, there is likely to be more social acceptance of such practices and therefore a greater influence of social capital behind the initiative.

An analysis of Adult Learning Theory helps one to understand some of the challenges in facilitating a change culture to an adult population (Brookfield, 1986, 2013; Cranton, 1994; Habermas, 1971; Knowles, 1975; Mezirow, 1990). According to Knowles (1990) the "foundation stones of modern adult learning theory [are]":

- Adults are motivated to learn as they experience needs and interests that learning will satisfy; therefore, these are appropriate starting points for organizing adult learning activities.
- Adults' orientation to learning is life-centered; therefore, the appropriate units for organizing adult learning are life situations, not subjects.
- Experience is the richest resource for adults' learning; therefore, the core methodology of adult education is the analysis of experience.
- Adults have a deep need to be self-directed; therefore, the role of the teacher is to engage in a process of mutual inquiry with them rather than to transmit his or her knowledge to them and then evaluate their conformity to it.
- Individual differences among people increase with age; therefore, adult education must make optimal provision for differences in style, time, place, and pace of learning. (p. 31)

Learning, therefore, in an adult, must be motivationally derived from within rather than without. It requires self-direction. Knowles' (1975) definition of self-directed learning is when learns "take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating

learning outcomes" (p. 18). Creating an environment where this kind of personal learning takes place is vital to a technological leader. The establishment of need in the individual is the starting place, and a culture of change is necessary if a learner's perceived need is to mirror the constant growth in technology. Even back in 1975, Knowles asserted that "the half-life of many facts (and skills) may be ten years or less, half of what a person has acquired at the age of twenty may be obsolete by the time that person is thirty" (p. 15). This phenomenon has only been accelerated through the rapid advance in technological advancement. Moore's Law (Moore, 1965) is evidence of this rapid advancement as it points to the tendency for computing speed to double every year, creating an even shorter half-life for much technological knowledge.

With the rapid change tendency of technology, the curriculum of technology literacy is not the simple transmission of knowledge about current technology. Rather,

> The main purpose of education must now be to develop the skills of inquiry. When a person leaves schooling he or she must not only have a foundation of knowledge acquired in the course of learning to inquire but, more importantly, also have the ability to go on acquiring new knowledge easily and skillfully the rest of his or her life. (Knowles, 1975, pp. 15–16)

The proactive self-directed learner not only provides a greater ability to stay current but also tends to achieve deeper learning. According to Knowles (1975), "there is convincing evidence that people who take the initiative in learning (pro-active learners) learn more things, and learn better, than do people who sit at the feet of teachers passively waiting to be taught (reactive learners)" (p. 14). The idea is that instructors and leaders of adult

learning need to focus on changing the learner, and therefore their behavior, rather than adding information to an unchanged receptacle.

Critical thinking therefore is an essential component of adult learning. Brookfield (1987) points out that,

> Identifying and challenging the assumptions by which we live is central to thinking critically. It is also difficult and complex. Admitting that these assumptions might be distorted, wrong, or contextually relative is often profoundly threatening, for it implies that the fabric of our personal existence might rest upon faulty foundations. (p. 89)

Thinking critically means questioning our big assumptions, a practice acclaimed by many proponents of learning theory (Bowe, Lahey, Armstrong, & Kegan, 2003a; Brookfield, 1986; Dweck, 2006; Lawson, 2007). Through this process the learners challenge their norm-based assumptions and emerge with a greater diversity of understanding. Brookfield (1987) developed nine critical thinking themes.

1. Critical thinking is a productive and positive activity.
2. Critical thinking is a process, not an outcome.
3. Manifestations of critical thinking vary according to the contexts in which it occurs.
4. Critical thinking is triggered by positive as well as negative events.
5. Critical thinking is emotive as well as rational.
6. Identifying and challenging assumptions is central to critical thinking.
7. Challenging the importance of context is crucial to critical thinking.
8. Critical thinkers try to imagine and explore alternatives.

9. Imagining and exploring alternatives leads to reflective skepticism. (pp. 5–9)

Items 6, 8, and 9 all point to the connection between critical thinking and paradigm shift. Item 9 brings the connection of critical thinking and reflection to the forefront.

According to Brookfield (1995):

> Reflection becomes critical when it has two distinctive purposes. The first is to understand how considerations of power undergird, frame and distort so many educational processes and interactions. The second is to question assumptions and practices that seem to make our teaching lives easier but that actually end up working against our own best long-term interests. (p. 8)

With students these processes are best conducted in a group setting where peers assist one another and act as "critical mirrors shedding light on assumptions" (Brookfield, 2013, p. 10).

Mezirow (1990) also emphasizes the power of reflection in adult learning in his concept of transformational learning. Transformative learning is defined by Mezirow (1990) as "the process of learning through critical self-reflection, which results in the reformulation of a meaning perspective to allow a more inclusive, discriminating, and integrative understanding of one's experience. Learning includes acting on these insights" (p. xvi).

Mezirow (1990) outlines three distortions in meaning perspective. These include epistemic distortions, which pertains to "the nature and use of knowledge," sociocultural distortions, that "involve taking for granted belief systems that pertain to power and

social relationships," and psychic distortions, which result from "presuppositions generating unwarranted anxiety that impedes taking action" (pp. 15–16).

Leading an environment that encourages critical self-reflection must be done with care. By entering into dialogue and modeling the challenging of assumptions, one can lead another in the process to achieve this emancipatory learning and education (Habermas, 1971; Mezirow, 1990). Mezirow (1990) asserts that,

> Because critical reflection is a process of testing the justification or validity of taken-for-granted premises, the role of dialogue becomes salient. It is through dialogue that we attempt to understand - to learn- what is valid in the assertions made by others and attempt to achieve consensual validation for our own assertions. (p. 354)

Though critical self-reflection is an internal process it can be encouraged and lead through others. Cranton (1994) provides three aspects of promoting this learning. "[First] fostering learner empowerment or setting the stage for the critical self-reflection, [second] stimulating transformative learning, including consciousness-raising and challenging learners, and [third] supporting the process [by] providing on-going encouragement and assistance as an educator and through the learning group" (p. 121). Under this model a community of learners can be encouraged through the right environment to engage in reflection, that encourages change.

Wang and Cranton (2012) argue that transformational learning is best facilitated through a self-directed learning model and view the two as "intertwined" (p. 16). They argue that the West lags behind the East in the implementation of self-directed learning. Following a similar line of thought in the context of technological education Wang and

Cranton (2013) find that technology is an appropriate tool for facilitating, rather than causing, such critical self-reflection. They write, "technology cannot, in itself, transform adult learners. Rather, it is the learners themselves who transform themselves by using technology as a tool to enhance learning" (p. 35). Technology is a tool with which to encourage learning, reflection and change. Three themes of the power of technology as recorded by Wang and Cranton (2013) include "learners research technology as technology represents a core body of knowledge, learners learn from technology as technology complements and supplements learners' existing knowledge base [and] learners learn with technology as technology represents one access point to knowledge" (p. 27). As technology encourages the knowledge generation, that knowledge when used in critical self-reflection can lead to change.

Competing Commitments

According to Heifetz, Grushow, and Linsky (2009) "any social system (including an organization or a country or a family) is the way it is because the people in that system (at least those individuals and factions with the most leverage) want it that way" (p. 17). Similarly "there is no such thing as a dysfunctional organization, because every organization is perfectly aligned to achieve the results it currently gets" (p. 17). How can this be, if there are so many systems that fail to achieve their expressed goals? The answer, at least in part, may be because people are complexly motivated and are capable of juggling several commitments at one time (Bowe et al., 2003a; & Bowe, Lahey, Kegan, & Armstrong, 2003b; Kegan & Lahey, 2001). Kegan and Lahey (2001) identified that people who are resistant to change often have competing commitments, which hinder them from accomplishing their goals. These competing commitments are based in big

assumptions that the person holds that are a manifestation of their worldview. They suggest that change can really occur once people's big assumptions are tested and in many cases replaced. According to Bowe et al. (2003a) “the approach, first and foremost, seeks to unearth longstanding, deep seated and systematic mechanisms undermining substantive change” (p. 717). This process must be done with care as those who find their big assumptions questioned will often respond with defensiveness and even manifest a “counterproductive mindset” (Bowe et al., 2003a, p.721).

Bowe et al. (2003a) outline five strategic steps to encourage people in the questioning of their big assumptions. These steps are as follows:

Step 1: Translating gripes into personal commitments.

Step 2: Identifying behaviors that keep the primary commitment from being realized.

Step 3: Identifying the competing commitments.

Step 4: Exposing the ‘big assumptions.’

Step 5: Testing the ‘big assumptions.’ (pp. 717–720)

In helping people to expose their own personal commitments and then helping them to translate those commitments into their big assumptions people are allowed to discover their underlying motivations through self-discovery rather than accusation. The process becomes more palatable.

According to Bowe et al. (2003a) the existence of a competing commitment does not mean that one is not committed to an initiative. Just as one who is motivated by higher motivators on a hierarchy of needs, say love, will still have to succumb to more elemental needs of food and safety (Maslow, 1943). To express this in other language,

one's commitment to the maintenance of love does not nullify one's commitment to food and safety. Competition arises when two or more commitments require contradictory action in order to be maintained. Because of this commitment conundrum one will often prioritize, consciously or otherwise, choosing which commitment to support in a given situation, thus the hierarchical structure of needs models in motivational theory. Bowe et al. (2003a) actually refer to this process as "personal defense systems [that exist in order to] avoid anticipated consequences that the reforms threaten to carry with them" (pp. 715–716).

Resistance to change in the form of competing commitments is not restricted to the individuals that form an organization. Resistance can become cultural within an organization and institutionalize. According to Bowe et al. (2003b), "left unaddressed, institutional resistance to change can undercut and minimize the impact of the most well-intentioned curriculum reforms" (p. 724). These curriculum reforms can include such things as technology initiatives. This makes the assessment of an organization's competing commitments a vital step in the process of changing technology culture. The technology leader should understand that people's resistance is not out of a dislike for change in and of itself but rather out of a fear of what the change will cost them or what they will lose as a result of the change. As Heifetz et al. (2009) pointedly note, "what people resist is not change per se, but loss" (p. 22).

Motivation Theory

There is a rich literature base for motivational theory that can be applied to the motivation of people to embrace technological pedagogy (Herzberg, 1974; Maslow, 1943; McClelland, 1961; McGregor, 1960). Maslow (1943) set up his theory of

motivation into a hierarchy of needs. This hierarchy includes five ascending levels: physiological, safety, love, esteem, and finally self-actualization. As one progresses up the hierarchy and has one's more basic, lower level, needs met, one is then freed to pursue higher levels of the hierarchy. Motivation is thus influenced by a person's position on the hierarchy. For example if one is trying to motivate a veteran teacher to incorporate technology into their classroom through the prospect of being the best teacher that they can be, self-actualization, but the teacher feels that the esteem of their peers is at stake by admitting that growth is needed, then it is likely that the technique of motivation will be unsuccessful. The appeal to the teacher's need for self-actualization could be undercut by the more basic need for esteem. McClelland's (1961) theory on the motivations of an achieving society share many similarities with Maslow (1943). He theorized that people are motivated by three main needs, achievement, power and identification.

McGregor's (1960) contribution to motivational theory sets a contrast in beliefs between the old and new theory that reveals a shift in understanding of human nature. According to McGregor (1960) the old theory views management's role as forcing the hand of the employee as a farmer drives a mule. The farmer must provide all of the needs of the mule to keep the mule healthy and able and then motivate the mule to do its labor. The mule is seen as sluggardly, unmotivated, passive, and sometimes resistant to the needs of the farmer. It is the farmer's role to bring about the potential for work within the mule that would not be actualized by the mule if left to its own devices. McGregor (1960) labeled this understanding of motivation as Theory X. At its core Theory X takes a negative view of human nature and by implication bolsters top down authoritarian relationships.

McGregor (1960) contrasts the old theory by presenting a different way of looking at employees. This view is beautifully typified by the organizational structure of Disney Pixar's creative studies. At Pixar employees are given an almost shocking amount of freedom. They can ride around the office on scooters, stop for a latte, relax in any of the numerous green spaces, or play a mid-morning game of basketball. They allow and encourage almost anything in order to keep the creative juices flowing. So, what is the result of all of this autonomy and trust? They are extremely successful and have happy hard working employees. The responsibility of managers in this environment is to provide the needs of the workers and then give them the freedom to do their best. McGregor (1960) summarizes the contrasting theories well stating, "Theory X places exclusive reliance upon external control of human behavior, whereas Theory Y relies heavily on self-control and self-direction" (p. 12).

Herzberg's (1974) theory of motivation breaks working conditions into either hygiene factors or motivational factors. He referred to his theory as motivation-hygiene theory. According to Herzberg (1974), people's level of unhappiness with their work depends on how well they are treated. The factors that affect the treatment of the individual are therefore described as *dissatisfiers* because of their ability to foster dissatisfaction if lacking. As a result Herzberg (1974) coined these dissatisfier treatment factors as hygiene factors. They are the prerequisites for moving an employee from dissatisfaction to a more neutral position where the employee is not dissatisfied. To bridge the next gap between a state of non-dissatisfaction and non-motivation to satisfaction and motivation, Herzberg's (1974) satisfiers must be present. Satisfiers are factors that lead to greater satisfaction and motivation. Herzberg would theorize that if

people's hygiene factors were taken care of, then people could be motivated to grow in their technological pedagogy through the application of satisfiers.

Mindset Theory

One's understanding of their own growth potential matters (Adams, 2009; Dweck, 2006; Galton, 1895; Lawson, 2007). Sir Francis Galton, a younger half cousin of Charles Darwin, coined the popular phrase "nature and nurture" and laid the foundation for a debate that has captivated educators and popular culture alike ever since (1895, p. 9). Galton wrote:

> The phrase "nature and nurture" is a convenient jingle of words, for it separates under two distinct heads the innumerable elements of which personality is composed. Nature is all that a man brings with himself into the world; nurture is every influence from without that affects him after his birth. (p. 9)

Notice the difference of the phrase "nature and nurture" from the more popular modern phrase of *nature versus nurture*. Commonly today the phrase is a debate rather than the *two distinct heads* or categories with which to organize the elements of personality. Stated differently Galton did not see nature and nurture as mutually exclusive. He instead found that:

> The distinction is clear: the one [nature] produces the infant such as it actually is, including its latent faculties of growth of body and mind, the other [nurture] affords the environment amid which the growth takes place, by which natural tendencies may be strengthened or thwarted, or wholly new ones implemented. (p. 9)

The person therefore, according to Galton, is not singularly the result of genetics, nor the result of the influences of their environment and experiences, but rather the summation of both where one is given capacity at birth that can then be built upon through experience.

A connection can be drawn between the nature versus nurture debate and the Mindset theories of Carol Dweck. She has now researched the effects of learner mindset for over 30 years with her scholarly work leading to her Mindset Theory. According to her 2006 book *Mindset*, "the view you adopt for yourself profoundly affects the way you lead your life" (p. 6). Dweck's (2006) first mindset, the fixed mindset, can be associated with those who attribute personality as being singularly or even to some extent primarily a result of nature, while Dweck's (2006) second mindset, the growth mindset, can be paralleled with a greater emphasis on nurture. Dweck (2006) defines the fixed mindset, as follows:

> Believing that your qualities are carved in stone-the fixed mindset-creates an urgency to prove yourself over and over. If you have only a certain amount of intelligence, a certain personality, and a certain moral character-well, then you'd better prove that you have a healthy dose of them. It simply wouldn't do to look or feel deficient in these most basic characteristics. (p. 6)

Another popular term used for this theory of intelligence in an entity theory. According to an earlier work, by Dweck et al. (1995),

> An entity theory of intelligence is the belief that intelligence is a fixed trait, a personal quality that cannot be changed. Individuals who subscribe to this theory believe that although people can learn new things, their underlying intelligence remains the same. (Dweck et al., 1995, p. 267)

So, those with a fixed mindset do not believe in their or others ability to grow in talent or intelligence. A typical example of this is evidenced by people who struggled with math in school and say that they are not a *math person*, inferring that they do not have the ability to grow in mathematical ability.

Dissimilarly those with a growth mindset tend to view their intelligence as being in a constant transitional state of ascending skill and ability. Dweck (2006) describes the growth mindset as being:

> Based on the belief that your basic qualities are things you can cultivate through your efforts. Although people may differ in every which way-in their initial talents and aptitudes, interests, or temperaments-everyone can change and grow through application and experience. (p. 7)

Just as a fixed mindset is also referred to as an entity theory, so too a growth mindset is spoken of as an incremental theory (Dweck et al., 1995) or an incremental concept of ability (Lawson, 2007). In 1995 Dweck et al. wrote that "an incremental theory of intelligence conceives of intelligence as cultivatable (i.e., individuals may become more intelligent through their efforts)" (pp. 267–268). Lawson's (2007) term, incremental concept of ability, is perhaps the most useful as it is most understandable at face value.

The debate on nature versus nurture has evolved to include the effects of one's view. One who holds a behaviorist view of human personality, one that emphasizes the role of nature, will tend to view intelligence as a fixed construct. Likewise one who views personality as being primarily or additionally influenced by nurture, all that one experiences through life, would see intelligence as being a more malleable aspect of

personality. This second view has a greater potential as a growth model, which is important in a fast changing technological world.

According to Dweck et al. (1995) one's mindset is a core assumption of their worldview. This core assumption shapes the way that individuals view, react to, and envision realty. It does not determine behavior but rather creates a lens through which people react to the world. Neither mindset assumption is considered to be "correct" though both have great implications for how an individual will perceive the worthiness of their actions. Many such implications are outlined by Dweck (2006). She finds that in sports those with a growth mindset strive and practice while those with a fixed mindset rely on their current talent. Growth business leaders work more collaboratively and invest in growing collective capacity in their organizations while fixed business leaders are more authoritarian and elitist. Even relationships are affected by mindset as growth minded individuals are more willing to work at a relationship, giving themselves and others time to grow while fixed mindset people are more likely to compete. When it comes to parents and teachers, mindset can set the tone for motivating or stifling growth (Dweck, 2006, 2008). Mindset has been shown to be independent of age, sex, political affiliation, religion, cognitive ability, confidence in intellectual ability, self-esteem, "optimism or confidence in other people and the world," social-political attitudes, and political conservatism or liberalism (Dweck et al., 1995, pp. 272–273).

Adams (2009), a researcher with a similar mindset theory to Dweck (2006), emphasizes the result of each mindset. His theory states that people either hold a learner mindset that is open and optimistic, or the mindset of a judge, one that is pessimistic and critical. Those who have a learner mindset are open to multiple possibilities while the

judge mindset believes in one best answer and therefore limited possibilities. The judger asks questions like "Who's to blame? How do I protect my turf? [and] How could I lose?", while the learner asks "What am I responsible for? What are my choices? [and] What's possible?" (Adams, 2009, p. 121). Dweck's (2006, 2008) fixed mindset and Adams' (2009) judger mindset are similar concepts, and it can be seen how one with a fixed mindset could display judgmental attitudes that are in accordance with the judger mindset. This is further emphasized in the research as leaders with a fixed understanding of attributes tend to hold to a judgmental stance with authoritarian, elitist attitudes (Dweck et al., 1995; Dweck, 2006).

These attitudes can permeate through schools affecting teaching and learning. Lawson expresses concern (2007) that "learning climates that persuade students that ability is fixed are more likely to result in a higher proportion of amotivated students" (p. 42). Conversely an incremental assumption can lead to greater persistence during difficulty (Dweck et al., 1995). Those with a growth mindset can perceive challenges as opportunities to learn and be stretched and view their students as moving at different paces up a continuum of skill. There are some quick studies in the group and there are some who need to work harder to reach the same ends, but ultimately each has the ability to better themselves and grow. Lawson (2007) agrees asserting that "if climates can be created that encourage students to believe that they are able to improve, rather than believe that they have no control over their ability, students are more likely to adopt a deeper approach to their work" (p. 41).

The implications for how teachers treat students and what they communicate about failure and success are of great importance (Dweck, 2008). Dweck (2008)

describes the debilitating effects of praising a student's intelligence or ability rather than their hard work and perseverance. How teachers communicate praise to students will teach them one of the two mindsets. It is her suggestion that teachers focus on praising a student's work ethic rather than ability. Praising a high achieving student who puts little effort forward to succeed will tell them that they have met the mark and do not need to work very hard to improve. Conversely teachers who fail to praise low achieving students who strive diligently to improve communicate to the struggling learner that unless they hit a certain achievement level, one that may not be a reality for that student, then they are unsuccessful no matter how hard they try. This kind of communication steals the potential growth from both students. If a teacher communicates from a growth mindset they can empower the high achieving student to move to greater levels and the low achieving student to reach proficiency and beyond. Though this research focuses specifically on teacher student communication many lessons can be gleaned when applied to the context of leadership within a school.

Lawson (2007) describes how an incremental concept of ability affects a learning environment noting,

> Overall an incremental concept of ability is associated with a self-determined motivation, which is most likely to lead to positive achievement behaviors. This needs to be of note to educators who recognize the importance of creating an intrinsic environment for learners. Identifying students who do not have a high concept of ability, and who may be at risk of being less intrinsically motivated early in a module, would allow opportunities for lecturers to work with these

> students, reinforcing that fact that it is possible for all students to develop within a subject. (p. 39)

A positive attitude toward one's own ability to improve is vital to the learning process. When a person fails it is an opportunity to teach them that they are either a failure and that they shouldn't have bothered with trying, or the failure can be turned on its head and used as an opportunity to show how much they can grow.

According to Lawson (2007) the key to developing an open mindset is to engage learners in the content. By having students "engage with content in order to develop their understanding, and in doing so change their conceptions of the material, they will also develop a concept of ability that sees it as possible to improve in a subject" (p. 42). Bringing the conversation back to technological skill growth it is seen that technology learners need to get their hands on the technology and play with it. One does not instruct a non-swimmer of the sensation of the water, the need for upward buoyancy, and the graceful motion required for propulsion outside of the context of the pool. One must be wet in order to learn to swim. Likewise the most impactful learning that a technology learner can experience will come in the actual use of technology. Lawson (2007) therefore places the responsibility of creating learning environments that encourage a growth mindset on the shoulders of the instructors. Lawson (2007) insists that this is especially important because today's learners, specifically undergraduate students, though certainly still applicable to school leaders and teachers, are time poor and strategic in their learning. Learners will tend to walk the straight line between two points in learning traveling the shortest distance, without taking time to learn the terrain in a wide and deep manor. It is the job of the guide to encourage the learner to travel the unbeaten

path, seeking new expanses. The nurturing of a culture where teachers and students embrace an open mindset on technological growth is the responsibility of the school leader.

The American Association of School Librarians created a set of standards for 21st century learners in 2007. Dweck (2009) suggests that the key to becoming 21st century learners who manifesting these standards, skills, dispositions, responsibilities, and self-assessment strategies is a growth mindset. Dweck (2009) asserts, about students but certainly applicable to all learners, that a vital first step in fostering 21st century skills is to facilitate a growth mindset. According to Dweck (2009) "the twenty-first century will belong to the passionate and resilient learners. Let us foster the growth mindset in our students" (p. 9). McLeod (2008a) has made the assertion that the greatest component of a leader's ability to foster 21st century skills in their school and community is their mindset. He states that if leaders have a mindset that supports the growth of technology and views technology literacy as a vital piece of educating America's children then all the specifics of policy implementation and infrastructure will work themselves out, while a pessimistic mindset can have the alternate outcome. He finds that "if a district is determined to treat technology from a fearful or wary standpoint, its policies will reflect that position as well" (p. 8). McLeod (2008a) shows the positive growth attitude of his understanding of leader mindset by describing those who possess it as follows, "their first reaction is not 'keep this out' but rather 'how can we make this work?'" (p. 8). It is therefore suggested that educators look to those with this mindset for leadership. These leaders can provide insight in navigating the typical roadblocks in technology initiatives. Pisapia (personal communication, November 1, 2013) agrees that attitude is a central

aspect of leading change asserting that "societally, we are moving from controlled change to accelerated change nearly beyond control. Both attitude and behavior must be the target of transformational leaders."

Individuals are not the only entity affected by an espoused mindset. Organizations take on a concept of ability within their cultures, which have a great influence on their policies and operations. Murphy and Dweck (2009) found that an organization's cultural manifestation of mindset has a great affect on the individuals within. In their study, people's behaviors were found to be in accordance with the overall cultural mindset of their organization. This phenomenon was so pervasive that it was even evident in the self-presentations of recruits as they sought to gain employment. Further evidence of the organizational mindset was found by Dweck (2014), where:

> Employees in a 'growth mindset' company are 47% likelier to say that their colleagues are trustworthy, 34% likelier to feel a strong sense of ownership and commitment to the company, 65% likelier to say that the company supports risk taking, and 49% likelier to say that the company fosters innovation. (p. 28)

Growth mindset organizations are better suited to achieve and serve their stakeholders within the 21st century. Trust, commitment, risk taking, and innovation are all vital to the change process and need to be encouraged by leaders.

Why people do or do not embrace technological change, or any other change, can be partially explained by their theory of intelligence (Dweck, 2006; Lawson, 2007; Murphy & Dweck, 2009). The far reaching implications of one's mindset abound as Yeager et al. (2014) notes that a person's entity theory can help to predict their stress, health and achievement. In the 21st century learners need to be able to persist and engage

in constant change in order meet the needs of the globally competitive economy. A learner mindset is an asset in achieving these ends.

Technology Learners: Millennial and Non-Millennial

In current times it has been suggested that the new generation of millennial learners are dissimilar to learners of the past (Prensky, 2001; Rosen, 2010). This idea is mirrored by popular culture with a prime example coming from the recent film, *Ender's Game*, which was based on the seminal science fiction novel by the same name (Card, 1985). One of the main premises of the film is that children will be the battle strategists of the future because of their greater ability to multitask and assimilate large quantities of information quickly. Prensky (2001) claims that digital natives learn in significantly different ways from past generations and suggests that education reform be used to meet their specific needs. Because of the influence that digital technology has had on people born into the technological era, Prensky (2001) has created a distinction between them and those who are of the eras predating it. According to Prensky (2001), a digital native is one who has grown up with digital technologies while a digital immigrant is one who has grown up without digital technologies. Rosen (2010) refers to the digital natives as the iGeneration. He claims that these students are a "creative multimedia generation," that multitasks and "thrives on social interactions" (pp. 20–21). Furthermore, Rosen (2010) insists, "we can no longer ask our children to live in a world where they are immersed in technology in all parts of their lives except when they go to school" (p. 4). Like Prensky (2001), Rosen (2010) calls for educational reform in supporting these new learners. McLeod (2011) takes a different tone than Prensky (2001) and Rosen (2010) but stresses the same end. He describes the influence that globalization and free mass publication

over the net, a factor also noted by Hargittai and Walejko (2008), has had on the spread of knowledge and affirms that this knowledge could be gleaned by students, if only they are taught to do so. McLeod (2011) speaks of the opportunity that educators, especially educational leaders, have to provide this type of learning environment to students but contends that schools lag behind, missing out on what could be an impacting strategy. This void between student's digital lifestyles and the traditional teaching methods of educators has created a cultural gap between students and those entrusted to educate them (Williams, 2008). According to McLeod (2008b) "as districts look at the millennials in their classrooms and plan for the most effective educational strategies to reach them, it is clear that technology can enable learning in ways that never before have been possible" (p. 1).

It is helpful to note that there is much contention in the literature over the simplistic demarcation of Prensky's (2001) digital native and digital immigrant. This point of contention can also be found in Rosen's (2010) denotation of the new group of learners as being the iGeneration. There are some (Bennett, Maton, & Kervin, 2008; Thompson, 2012) who say that age or inclusion into a specific birth era is not enough to include or exclude you from a learning movement.

Bennett et al. (2008) critique Prensky's notion of digital natives and digital immigrants, pointing out several shortcomings of the many of the claims about digital natives. The authors seek to encourage a more sober understanding of the new society in which we live. They claim that the digital native movement is an educational moral panic where sensationalist language is used to portray the youth culture in a way that threatens social norms and values. Or stated another way, the proponents of the digital revolution

in schools try to use rhetoric that fosters positive action toward their goal. The idea is to stir up popular and political support for the cause by using language that makes the problem out to be much more serious than it is.

Thompson (2012) also critiqued the popular press assertions about digital natives showing how many of Prensky's (2001) Ten Characteristics of the Games Generation were speculative. She insists that technology use is not bound by age, may be restricted in its application by various groups, and that "students may have limited desire for technology integration in the classroom" (p. 21). The point being made is that the universal understandings of technology's influence on people are not accurate understandings. Just like in most other phenomena, variability is to be expected.

Thompson (2012) found that digital natives "use a narrow range of technologies" (p. 105), that they tend to use the web with "speed and efficiency rather than [for] deep learning" (p. 107), and "do not demand constant entertainment" (p. 109) as is commonly believed. Thompson (2012) connected the concept of Internet use and productivity finding that there is a "complex relationship between technology use, digital characteristics and productive learning habits" (p. 110). Some types of digital technology use showed a correlation with lower average productive learning habits as compared with books while others showed the converse. Thompson (2012) found that the extent of different technologies had different relationships with digital characteristics and productive learning habits. Specifically, "frequent use of Rapid Communication Technology (i.e., texting, Facebook, and instant messaging) in particular does appear to have some association with less productive learning behaviors, including a difficulty in controlling multitasking" (p. 114). This connection was not lost by the participants within

Thompson's (2012) study. Participants found a need to manage their own technology use, expressing a discernment over some of the potential negative aspects of technology's saturation in theirs and future generations' lives.

The Second Digital Divide

There is a body of research that studies the separation of people from technology. The term used to describe this separation is the digital divide. The digital divide is broken into two categories. The first is the digital divide, which describes a person's access to technology, and the second digital divide describes a person's use of technology. For the sake of this paper the second digital divide will be discussed.

According to Hargittai (2002) much of the research on the digital divide focuses singularly on participants' access to the Internet as their inclusion exclusion criteria. These data therefore are limited in their ability to elucidate people's ability with the Internet as a viable informational tool. One may have access to the Internet but have no desire or ability to use it in a productive way. Hargittai (2002) surmised that one's ability to complete online tasks in an efficient time-appropriate manor was a better indication of one's Internet skill. She found that age is negatively correlated, experience in technology use is positively correlated, and gender is neutrally correlated with Internet skill. That is not to say, pertaining to age's negative correlation, that all older people have less skill than those that are younger, only that there is a greater density of young people skilled in Internet use. This phenomenon, the differences in people's ability to use technology, has been coined by Hargittai (2002) as the second-level digital divide. Several studies have been conducted that help to vivify the second-level digital divide (Hargittai, 2010; Hargittai & Hinnant, 2008; Hargittai & Walejko, 2008) since 2002. It has been found that

one's creation of digital content, that is subsequently posted to the Internet, is positively correlated with socioeconomic status (Hargittai & Walejko, 2008), that within those ages 18-26, level of education is correlated positively with the use of "capital enhancing online activities" (Hargittai & Hinnant, 2008, p. 618), and that those from more privileged backgrounds, such as those with high parental education, who are male, and white or Asian, use the Internet with greater diversity and strategy (Hargittai, 2010). Because of the consistent correlation of parental education and socioeconomic status, as being the highest indicator of the quality of Internet use, the second-level digital divide has come to be most associated with these factors. In their call for researchers to go beyond studies of technology tool usage in educational leadership McLeod, Bathon, and Richardson (2011) noted "when they [more affluent student populations] use learning technologies, they often use them in very different ways than their less-affluent student peers (the so-called 'second digital divide')" (p. 293). Inferred by the context of this article is that the *very different ways* with which less-affluent students use the Internet are inferior, less helpful, and less skillful ways. According to McLeod (2008a) educators who leave these students to become digital, global citizens on their own are "relegate[ing]" them to "second-class status in the new economy" (p. 8).

McLeod (2008b) expresses the importance of teaching technology skills to what seems to be a technologically literate generation. He insightfully notes:

> While students use technology almost intuitively, they lack the wisdom to understand how to leverage that facility into the ability to find information and turn it into knowledge. That is where schools can help. An education leader knows that his or her staff must be prepared to help students be prepared for life

> and work in an uncertain future. Thus the goal of technology integration is to use the best tools for each job seamlessly so that the technology itself becomes transparent and supports teaching and learning. Leadership must drive this. (p. 2)

Meaningful technology instruction and implementation are therefore the bridge between students and digital citizenry. This will be true or the converse will be. If students do not receive meaningful technology instruction then they will likely not learn the discernment to capitalize on technology-derived knowledge.

An example of such instruction, which counteracts the results of the second digital divide, is reported by Reynolds and Chiu (2013). They found that student participation in Globaloria, an e-learning technology intervention, "wipes out parent education effects in home computer engagement, a measure of transfer of learned skills to the out-of-school-context" (p. 6), therefore overcoming some known effects of the digital divide. Similar results have been reported by Chandra and Lloyd (2008), who found that through an electronic learning intervention, overall student performance was increased. The findings were inconsistent according to achievement and sex, as high achieving females tended to decrease while low achieving boys tended to increase. Pointed instruction that is technologically relevant can powerfully combat the second digital divide and empower less privileged populations.

The effects of the second digital divide act much like illiteracy. If children are to grow up to be able to participate in the global economy in an equitable way education is their best hope. It will allow Freire's (1970) notion of education, that it should allow the oppressed to regain a sense of humanity, to be applied to the have-nots in the technological world.

Technology Leadership

The more leaders are exposed to technology and use technology the more they are able to provide technology leadership (Dawson & Rakes, 2003; Stuart, Mills, & Remus, 2009). Dawson and Rakes (2003) show that the types and amounts of technological training principals received influence the integration of technology in schools. Speaking of experience they note "the more sustained the principal's training experiences and the more those experiences are tied to the school's curriculum and to the principal's needs, the more progress the school is likely to make toward technology integration" (p. 45). This shows the importance of technology leadership training being specifically relevant in order to be effective. Dawson and Rakes (2003) also note that there is "no statistical significance for years of administrative experience or sex" for their influence on technology integration in schools (p. 37). Stuart et al. (2009) also attest to the importance of experiential learning being specific to the individual leader as they affirm, "school leaders need to be more practically involved in the ICT projects in their school and in ICT management" (p. 740). This, the authors say, will allow them the opportunity to be authentic role models in the technological role. Taking a step back to view the research base on the relationship between professional development and technology integration into the classroom, Lawless and Pellegrino (2007) found the body of research to be disappointing as it lacked rigor and was in need of clear theoretically driven research methods.

Compounding evidence of this blank spot, Wagner (1993), there are those who assert that an appropriate body of technology leadership research is also lacking (McLeod, 2011; McLeod et al., 2011; McLeod & Richardson, 2011; Wagner, 1993).

According to McLeod and Richardson (2011), in their appropriately titled article *The Dearth of Technology Leadership Coverage*, "modern digital technologies have united the fields of school leadership and educational technology to create a new field of study; school technology leadership" (p. 218). Of this new field of study "we simply cannot say that we know what effective technology leadership practices look like in elementary and secondary schools. We simply do not have enough high-quality research to inform best practice" (p. 236).

Some of this void is the result of a lack of appropriate technology leadership coursework within higher education (McLeod, 2011; Schrum, Galizio, & Ledesma, 2011). McLeod (2011) describes the research as "nearly nonexistent" asserting, "only a handful of the nearly 600 educational leadership programs in America are even attempting to provide meaningful, substantive preparation of technology-knowledgeable school leaders" (p. 4). Schrum et al. (2011) agree stating "overall, most states and institutions do not require any formal preparation in understanding or implementing technology for instructional purposes, and likely their graduates are not prepared to implement technology systemically in their school" (p. 241). As a result of the lack of formalized technology training being offered to educational leaders and the growing need to implement change within their schools, Schrum et al. (2011) found that leaders need to be self-motivated and seek personal technological growth outside of academia. They write encouragingly, "administrators do learn on their own, have a dedication to these changes, and promote their staff members' implementation through professional development, by modeling its use, and purposefully setting goals for their schools" (p. 241).

In Thapa, Cohen, Guffey, and Higgins-D'Alessandro's (2013) comprehensive review of school climate research there was absolutely no mention of technological climate, leader mindset or 21st century skills. These factors were not, to any significant degree, a part of the last 20 years of research on school climate. This shows that the link between school climate and technology leadership is limited within the research.

School technology leadership is more important than other technological factors within a school (Anderson & Dexter, 2005; McLeod et al., 2011). McLeod et al. (2011) categorized the research on the use of technology in educational leadership into three areas. They were: "using digital technologies to teach traditional educational leadership content, training school administrators to better use digital technologies, and preparing school administrators to be better technology leaders" (p. 296). Of the three categories the third has the most potential to bring about change, but has the least research with which to inform educational leaders. Because of this, the authors believe that "new administrators… are woefully unprepared to be effective leaders in the area of technology, even though we know that if the leaders do not 'get it,' their systems—most importantly their students—surely will not either" (p. 294). Their suggestion is that we begin to look at our educational leadership programs through a "technological lens" that will empower educational leaders to break from the status quo and create new paradigms. Anderson and Dexter (2005) concur noting, "that although technology infrastructure is important, for educational technology to become an integral part of a school, technology leadership is even more necessary" (p. 74). Furthermore, their "results suggest that a school's technology efforts are seriously threatened unless key administrators become active technology leaders in a school" (Anderson & Dexter, 2005, p. 74).

While there is a lack of research on technology leadership there are still technology leadership standards with which to inform practice. According to the National Educational Technology Standards for Administrators (International Society for Technology in Education [ISTE], 2012) from the International Society for Technology in Education administrators need to:

- Inspire and lead development and implementation of a shared vision for comprehensive integration of technology to promote excellence and support transformation throughout the organization.
- Create, promote, and sustain a dynamic, digital-age learning culture that provides a rigorous, relevant, and engaging education for all students.
- Provide digital age leadership and management to continuously improve the organization through the effective use of information and technology resources.
- Promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources.
- Model and facilitate understanding of social, ethical and legal issues and responsibilities related to an evolving digital culture. (pp. 1–2)

Each of the standards shows strong relationship with change theory, as they were created with the intention of assisting school leaders in the implementation of technology leadership. Because of the constant change in the field of technology and technology related industries and the need for students to be kept abreast of these changes, school

technology leaders need to be change agents who promote a forward looking vision. According to McLeod (2008b):

> Leaders must be change agents who help others think beyond what is happening in schools today to what could or should be happening. They lead the district in developing a shared vision and big-picture perspective on the district's goals and they lead staff, students, parents, and administrators to implement meaningful and effective uses of technology. (p. 2)

In order to provide this kind of learning environment McLeod (2008b) suggests that:

> Technology leaders must have insight about ways in which the world is changing, the new tools that are available for teaching and learning, and cutting-edge technologies. They must have an understanding of the technologically-rich information society for which students must be prepared intellectually and the media-rich environment in which students are comfortable. (p. 2)

Technology leaders are not only within the schools. According to McLeod (2008a) "the vision for the district flows down from the top" (p. 8). Technological vision needs to be embraced and modeled at each descending tier of the organization if it is to impact the students.

Franciosi (2012) suggests that transformational leadership theory is an effective leadership perspective in fostering technological change. He states "there are empirical studies suggesting the importance of technology leadership in education, and the efficacy of a transformational leadership style" (p. 241). It was argued by Franciosi (2012) that the influence of the digital culture on education makes it dynamic and fast-changing field, so rigid traditional models of leadership that emphasize the delegation of routines should be

discarded for more fluid leadership frameworks that refocus on communication and human relationships (p. 244).

Knippenberg and Sitkin (2013) in their assessment of charismatic and transformational leadership concluded that charismatic and transformational leadership labels should be abandoned for a more clearly defined form of leadership theory. If this is true then much of the emphasis in educational leadership theory needs to be refocused in favor of a system that can appropriately account for the growing complexity within leadership. Many researchers have noted the need for leaders to call upon a diverse arsenal of leadership methods suited for the distinct situational needs of their organizations (Nutt & Backoff, 1993; Pisapia, 2009). Even Machiavelli (1992), though writing almost 500 years ago in 1513, exemplified this need through his political strategies during periods of change.

Pisapia (2009) suggests that the future of executive leadership rests in the postmodern intersection between old and new technologies as illustrated by Handy's (1994) sigmoid curve. This theoretical view places emphasis and the importance of leadership action within the highly complex and uncertain transitions of an organization. This claim comes within the context of Lawrence, Lenk, and Quinn's (2009) finding that there was a lack of research elucidating the conceptual complexity, and behavioral complexity models within leadership.

Understanding the gap in the theory and the complexity of leadership action required for successful navigation of the postmodern condition Pisapia (2009) describes the process that a leader should use to discern which method to choose, from their tool-box of leadership behavior, as artistry. Pisapia (2009) likens the choices of a leader to

that of an artist making creative decisions that are both based on the diversity of their skill and their environmental understanding of their historical context. He also claims "artistry is the key distinguisher between strategic leadership and traditional leadership" (Pisapia, 2009, p. 42).

Knowing what to do and when to do it is a key component not only in Pisapia (2009) but also in Nutt and Backoff (1993). These researchers emphasize that the leader must have two bags of tricks for different organizational seasons. For times on consistency and technological *exploitatio*n (March, 1991), a bag that emphasizes strategic management. For times of change and technological *exploration* (March, 1991), a bag that holds the skills of strategic leadership. By wielding the choicest tool for the job rather than groping in the limited bag of old tricks leaders can effectively transition through each cycle of uncertainty and carry their organization through the global world.

Eisenman (2013) describes the need for aesthetic innovation at different points on the lifeline of a technology. "When producers of technology engage in aesthetic innovation, they do so with the expectation that users will value the sensory stimulations and second-order meanings their products offer" (pp. 348–349). Eisenman (2013) theorized that the need for aesthetic innovation is most at the beginning and end of a technology's market-life forming a U-shaped relationship. During the onset of a technology's market-life, aesthetic innovation is needed primarily to explain the new technology and secondly to excite and extend sales. Similarly aesthetic innovation is needed at the end of a technology's market-life primarily to excite and extend sales and secondarily to explain the product. During the middle of a product's market-life, a common mode and function are dominant and little profit is gained from aesthetic

innovation. Eisenman's (2013) theory is similar to Pisapia's (2009) in its description of the initiation of a new technology. The initiation takes a higher level of effort to establish itself, but then once it is established, Pisapia (2009) would suggest that leaders seek to find a new initiative rather than invest effort in the end of the product's market life. Expend resources in the creation of frame breaking change rather than sustaining the product that is past its prime. Applying these theories to the implementation of a technological initiative in a school, it can be seen that additional work is required at the onset of the initiative in order for the initiative to take.

Adaptive Leadership

Maslin-Ostrowski and Drago-Severson (2014) have found that "even with the astonishing help of technology, we've learned that leadership challenges are becoming increasingly complex" (p. 651). Technology is not the solution to our leadership problems. Leadership frameworks that are appropriate for the digital age are needed to meet such challenges.

According to Heifetz et al. (2009) the idea of a system, such as an organization, being broken is a myth. The authors assert "the reality is that any social system is the way it is because the people in that system want it that way" (p. 17). The greater question therefore becomes how do individuals identify the differences between the system that we have and the system that we would prefer? The concepts of problem identification, clarification, leading and group learning become very important in this perspective.

In describing their theories of adaptive leadership Heifetz et al. (2009) draw on an illustration from evolutionary theory to describe the kind of situations that require their leadership. Problems can be broken up into either technical or adaptive problems.

Technical problems have a fixed requirement on knowledge and are able to be solved within the regular functioning of the system. Adaptive problems on the other hand require knowledge that the system may not contain, and require the system to adapt and change in order to successfully move toward a solution to the adaptive problem.

Because of this dichotomy of problems, it is crucial to ask the correct questions in order to identify which kind of problem a system faces. Adaptive leadership is used once an adaptive problem is found which needs to be resolved. This process of adaptation in an organization is one of give and take for stakeholders and must be done with care because the people in the organization will need to change in order to bring about the desired effect. This is no easy task, as people can seem resistant to change. Heifetz et al. (2009) prefer that people are not resistant to change but rather fear anticipated loss that could come with change. They note "when change involves real or potential loss, people hold on to what they have and resist the change" (p. 22). Because of this the important questions become "of all that we care about, what must be given up to survive and thrive going forward?" and "of all that we care about, what elements are essential and must be preserved into the future, or we will lose precious values, core competencies, and lose who we are?" (p. 23).

Questioning is central to Heifetz et al.'s (2009) concept of leadership. The authors distinguish adaptive leadership from authority. Those in authority use their formal and informal power to accomplish their expected tasks while adaptive leaders question what is expected of them and move beyond their formal and informal authority to push their organizations past expectations to take risks.

According to Heifetz et al. (2009), the term leader is derived from an Indo-European root world *leit*. The leit was the flag bearer at the front of an army who would be sacrificed to show his comrades where danger lay ahead. In very much the same way, adaptive leaders are trying to ask questions that take the organization into dangerous territory.

So, if leadership means taking the organization into dangerous territory and people are fearful of loss, then a "disequilibrium" (Heifetz et al., 2009, p. 29) will be established. Heifetz et al. (2009) find that there are two helpful skills necessary for surviving in this environment. These include, "manage yourself in that environment and help people tolerate the discomfort they are experiencing" (p. 29).

Technological School Culture

There is a collective mind within an organization (Prahalad & Bettis, 1986; Schein, 1990). The concept of school culture is one of the qualitative ways that people explain the differences in schools. According to Schein (1990) "one needs concepts that permit one to differentiate between organizations within a society, especially in relation to different levels of effectiveness, and the concept of organizational culture has served this purpose well" (p. 110). Schein (1990) notes that there are three manifestations of culture that can be examined and analyzed. These are "observable artifacts, values and basic assumptions" (p. 111). By looking that these three the observer can begin to grasp the kind of culture that an organization holds.

Another popular qualitative aspect of an organization is its climate. Schein (1990) notes "climate is only a surface manifestation of culture, and thus research on climate has not enabled us to delve into the deeper causal aspects of how organizations function" (p.

109). Climate is important to technological implementation as well as the implementation of any other initiative. According to Thapa et al. (2013), "School climate matters. Sustained positive school climate is associated with positive child and youth development, effective risk prevention and health promotion efforts, student learning and academic achievement, increased student graduation rates, and teacher retention" (p. 369). Climate research can be categorized into five areas of focus. These include:

> (a) Safety (e.g., rules and norms, physical safety, social-emotional safety),
>
> (b) Relationships (e.g., respect for diversity, school connectedness/engagement, social support, leadership, and students' race/ethnicity and their perceptions of school climate),
>
> (c) Teaching and Learning (e.g., social, emotional, ethical, and civic learning; service learning; support for academic learning; support for professional relationships; teachers' and students' perceptions of school climate),
>
> (d) Institutional Environment (e.g., physical surrounding, resources, supplies), and
>
> (e) The School Improvement Process. (Thapa et al., 2013, p. 358)

The cultural values and basic assumptions of an organization can also be described as what Prahalad and Bettis (1986) refer to as the dominant logic of an organization. They assert that the dominant logic of schools is set by three factors: The characteristics of the core business, critical tasks for success, and the top management's mindset repertoire of tools. Anyone who has observed a murmuration, or cloudlike flock of birds, will understand the idea of dominant logic. The birds stay together and maintain the group for safety. As with organizations, there are always a few wayward birds who may detach themselves and reattach themselves to the mass but generally the whole

moves together. It is the school leader's ability to influence the direction of the murmuration that holds the most of the leader's influence on students. Leithwood, Louis, Anderson, and Wahlstorm (2004) assert that second only to the influence of the teacher, the influence of the school leader has the highest impact on student success. More precisely, when taking into consideration both the direct and indirect effect that leadership action has on what students learn leadership accounts for roughly a fourth of the school's influence. The three leadership actions that most impact student success, indirectly and in descending order of impact, are setting direction, developing people, and redesigning the organization (Leithwood et al., 2004, pp. 8–9). The setting of direction speaks directly to the establishment of cultural direction. According to Leithwood et al. (2004), this leadership action is typified by leadership practices such as "identifying and articulating a vision, fostering the acceptance of group goals and creating high performance expectations" (p. 8).

Speaking of a CEO's ability to foster and manipulate a firm's dominant logic, Kor and Mesko (2013) proposed that a leader's management of human capital, social capital, and cognition all played a key role in the establishment of dominant logic. Furthermore, it is the leader's capacity to balance the leadership team's abilities and create a positive environment within the team that will establish dominant logic over time. According to Kor and Mesko (2013):

> The CEO's dynamic managerial capabilities in concerto with senior executive dynamic managerial capabilities will shape their collective ability to recognize the need for revitalization of the firm's dominant logic. Management teams with a

> strong team absorptive capacity will have a better rate of success in revising the dominant logic to achieve evolutionary fit. (p. 241)

This evolutionary fit allows for the dominant logic of the organization to flex with the demand for change. By doing so the firm is able to better meet needs in a changing atmosphere.

Speaking with the creative director of a local design and marketing firm on the needs of his company, he explained the disparity between what was needed in the business and what was being provided. The students in the local college, where many of his employees had been educated, were not provided a coursework suitable to the economic needs of their post-school marketplace. He explained how the bulk of business had moved from the printing side of design, to the web development side and had been this way for some time. Clients were now paying much more for the creation and maintenance of cutting edge web sites rather than flyers and brochures, but despite this the applicants to new positions knew very little about web design. Important coursework covering concepts to web design, such as user experience and user interface, were simply not provided. This problem typifies the need for a flexible dominant logic, which can allow for changes with fluidity.

Technology Readiness

"Technology readiness refers to people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (Parasuraman & Colby, 2001, p. 18). Technology readiness can be considered to be directly linked to one's level of acceptance of technology. High levels of technology readiness are connected with receptivity to technology while low levels of technology readiness are connected with

resistance to technology (Parasuraman & Colby, 2001, pp. 31–32). Technology readiness varies among individuals, is multifaceted and predicts/explains one's response to new technologies (Parasuraman & Colby, 2001, p. 18).

Research on the adoption of new technologies has shown that people can hold paradoxical attitudes toward technology (Parasuraman, 2000; Parasuraman & Colby, 2001; Elliott, Meng, & Hall, 2008). According to the creators of the TRI, Parasuraman and Colby (2001), individuals are able to, at the same time, hold negative and positive attitudes toward a new technology. According to the authors technology readiness is a composite score of four attitudinal measures of technology. The four measures, as defined by Parasuraman and Colby (2001) include optimism, "a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives" (p. 34), innovativeness, "a tendency to be a technology pioneer and thought leader" (p. 38), discomfort, "a perceived lack of control over technology and a feeling of being overwhelmed by it" (p. 41), and insecurity, "distrust of technology and skepticism about its ability to work properly (p. 44).

These attitudinal measures are balanced as positive, optimism and innovativeness, acting as motivators for technology readiness, and negative, discomfort and insecurity, acting as detractors from technology readiness. Once measured, with negative scoring for the detractors, these attitudes can be combined the calculate technology readiness (Parasuraman & Colby, 2001).

Parasuraman and Colby note "it is important to recognize that these four dimensions are independent, such that an individual can possess any combination of motivations or inhibitions" (2001, p. 58). Similarly, studies have found that the

technology readiness indicators are relatively independent of one another (Elliott et al., 2008) and can be possessed in any variety by an individual (Massey, Khatri, & Ramesh, 2005).

Through a cluster analysis of data collected with the TRI instrument Parasuraman and Colby (2001) found that the relationship between each of the measures of the TRI, optimism, innovativeness, discomfort and insecurity, group into 5 clusters. These segments act as the types that each person of a population can be categorized into. These segments are outlined in Table 1, from Colby and Parasuraman (2003).

Table 1

Description of Five Technology Segments

Technology segment (in descending order of techno-readiness)	Technology belief dimension			
	Contributors		Inhibitors	
	Optimism	Innovativeness	Discomfort	Insecurity
Explorers	High	High	Low	Low
Pioneers	High	High	High	High
Skeptics	Low	Low	Low	Low
Paranoids	High	Low	High	High
Laggards	Low	Low	High	High

Note. Areas shaded in dark gray are associated with a high degree of techno-readiness, while areas shaded in light gray are associated with a low degree of techno-readiness. Adapted from "Technology Still Matters," by C. L. Colby and A. Parasuraman, 2003, *Marketing Management, 12*, p. 31.

Explorers possess the highest level of technology readiness and are highly optimistic and innovative while minimally experiencing discomfort and insecurity. They have the highest education (40% have college degrees) and the highest income (44% have annual household incomes of at least $50,000), are the youngest (median age 36 years, 58% under age 40), and are more likely to be a student, male (62%), and be in a technology profession (45%) (Parasuraman & Colby, 2001, p. 72). Pioneers differ from

Explorers in that while they are highly optimistic and innovative, they are more paradoxical as they also experience high levels of discomfort and insecurity. They have average education (21% have college degrees), average income (25% have annual household income of at least $50,000), are relatively young (median age 39 years, 51% under age 40), are balanced in gender (54% male), and are more likely to be in a technology profession (24%) (Parasuraman & Colby, 2001, p. 76). The third and middle categorized population segment are the Skeptics who are neither optimistic nor innovative despite feeling little discomfort and insecurity. Skeptics have average education (22% have college degrees), average income (33% have annual household incomes of at least $50,000), are average age (median age 40 years), balanced in gender (52% male), and less likely to be in a technology profession (12%) (Parasuraman & Colby, 2001, p. 78). The final two segments, Paranoids and Laggards, are both minimally innovative, and experience discomfort and insecurity. They differ in that Paranoids are still highly optimistic despite their other detracting factors while Laggards are not optimistic and are the least technology ready of the segments. Paranoids have less education (12 % have college degrees), below average income (16% have annual household incomes of at least $50,000), are older (median age 45 years, 41% at least age 50), and mostly female (63%) (Parasuraman & Colby, 2001, p. 81). Laggards, the last people to accept new technology, have less education (17% have college degrees), below average income (18% have annual household incomes of at least $50,000), are older (median age 56 years, 57% at least age 50), mostly female (67%), and are mostly comprised of the retired or those not working full-time (58%). These findings were

closely mirrored by other researchers using the TRI (Caison, Bulman, Pai, & Neville, 2008; Victorino, Karniouchina, & Verma, 2009).

The technology segments are not evenly distributed in the population. According to Parasuraman and Colby (2001, p. 60) Explorers comprise 16% of the adult population in the United States, Pioneers 27%, Skeptics 21%, Paranoids 20%, and Laggards 14%.

The technology segments also engage in new technologies as one would expect, with those of higher technology readiness achieving higher levels of market penetration for new technologies before those with lower technology readiness (Parasuraman & Colby, 2001). There are interesting parallels between Colby and Parasuraman's (2001, 2003) segments and Rogers' (2003) adoption categories. Rogers (2003) describes innovativeness as "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system" (p. 280). His five adopter categories and their descriptions are innovators-venturesome, early adopters-respect, early majority-deliberate, late majority-skeptical, and laggards-traditional. One's placement within these categories (Figure 3) is determined by their placement in the regular distribution of the mean adoption time of an innovation (Rogers, 2003, p. 281).

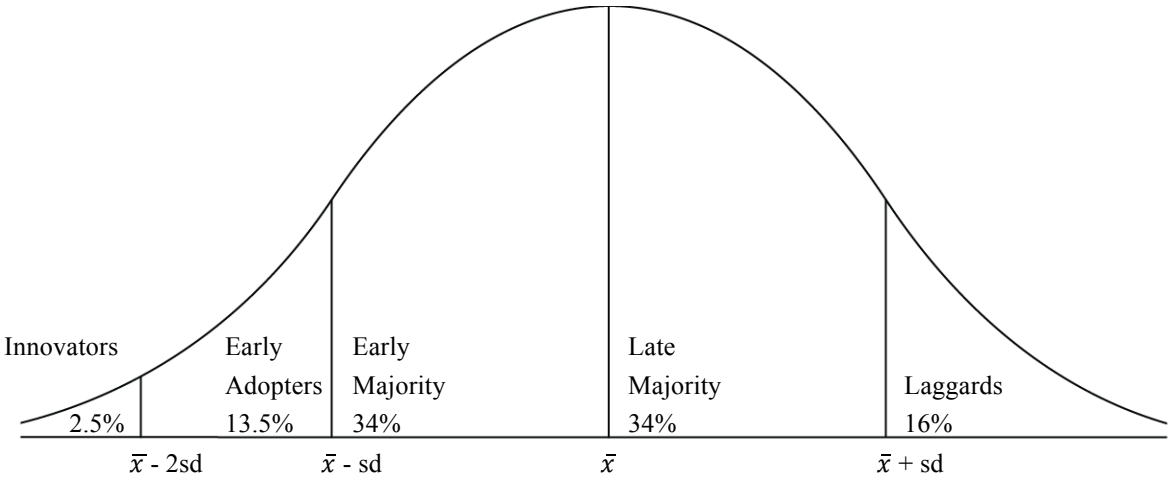

Figure 3. Adopter categorization on the basis of innovativeness. Adapted from *Diffusion of Innovation* by E. M. Rogers, 2003, p. 281.

The innovators take up the portion of a normal distribution of adoption two standard deviations to the left of the mean (2.5%). Early adopters are between one and two standard deviations to the left (13.5% of the population). Early majority are between the mean and one standard deviation from the mean (34% of the population). Late majority are between the mean and one standard deviation to the right (34% of the population), with laggards occupying the population right of one standard deviation from the mean (16%). Table 2 outlines the dominant segment for each stage of development and the subsequent market themes and suggested strategies that are comparable to Roger's (2003) adopter categorization.

Table 2

The Shifting Focus of a Technology-Based Product or Service

Dominant segment	Stage of development	Market themes	Strategy
Explorer	Early adoption	Innovations	Target Innovators, make products future-ready, and build a market base
Pioneer	Accelerating growth	Discomfort and insecurity	Focus on usability and reassurance
Skeptic	Peak growth	Low optimism	Promote product benefits
Paranoid	Peak growth	Discomfort and insecurity	Increase focus on usability and reassurance
Laggard	Declining growth	Market maturity and resistance by "hold-outs"	Focus on retention and innovations

Note. Adapted from *Techno-Ready Marketing: How and Why your customers Adopt Technology* by A. Parasuraman and C. L. Colby, 2001, p. 65.

The items of the TRI have undergone many duplication and validation studies to check for its usefulness in broader contexts (Borrero, Yousafzai, Javed, & Page, 2014; Lin & Hsieh, 2012; Meng, Elliott, & Hall, 2010) and have generally followed a pattern of decreasing the number of items similar to Parasuraman and Colby's (2015) instrument.

For example Lin and Hsieh's (2012) revised edition of the instrument uses 16 of the original 36 items used by Parasuraman (2000) and Parasuraman and Colby (2001) in order to broaden the contextual appropriateness of the tool. Meng et al. (2010) showed in the invariability of the instrument between the contexts of American and Chinese settings allowing for the valid comparison of the two groups. This trend has been followed by Parasuraman and Colby in their 2015 TRI 2.0, which allows for both a 16- and 10-item instrument.

The greater breadth of contextual appropriateness that the TRI 2.0 garners is beneficial to this study because the instrument was originally designed for external use in market research. Parasuraman (2000) does state that the original instrument could be applied internally by organizations. This justifies its use in an internal educational setting.

An example of such use was conducted by Summak, Baglibel, and Samancioglu (2010) in their study of primary school teachers' technology readiness in Gaziantep, Turkey. This study found that this population of teachers had a moderate mean TRI score of 2.96, which was only affected significantly by gender, to the exclusion of age, or subject area taught.

Another contextual use of the TRI worth mentioning comes from Caison et al. (2008) in their study of nursing and medical students. They suggest that additional technological support be given to students who are from rural areas, female, or returning to education later in age.

According to Colby and Parasuraman (2003) "E-services need to be designed so that even the least techno-ready customer can comfortably use them" (p. 33). Borrowing the implications of this statement to apply them to an educational professional development and leadership context, it places the emphasis on meeting educators where they are and providing them with the support that they need to grow. More specifically, the authors suggest meeting customers at their current skill level, providing responsive customer support, and a reassuring design. Each encourages the technology learners to grow.

CHAPTER 3: METHODOLOGY

The purpose of this research study was to determine K-12 school leaders' concepts of ability and technology readiness. The TIS (Dweck et al., 1995) was used to measure concepts of ability and the TRI 2.0 (Parasuraman & Colby, 2015) was used to measure the technology readiness of K-12 school leaders. Data from the two instruments were used to determine if there is any relationship between K-12 school leaders' concept of ability and technology readiness (Appendix A, B). This analysis fills a blank spot in the research contributing to the literature on leadership, Mindset Theory (Dweck, 2006; Dweck et al., 1995), and Technology Readiness (Parasuraman, 2000; Parasuraman & Colby, 2001, 2015). Furthermore it helps to determine the state of K-12 school leaders' status as 21st century leaders, and adds to the understanding of the 21st century characteristics of K-12 school leaders.

Research Questions

The research questions were as follows:

1. What is the technological readiness of SDPBC K-12 school leaders and how does it compare with the norm?
2. What is the concept of ability of SDPBC K-12 school leaders and how does it compare with the norm?
3. What is the relationship between SDPBC K-12 school leaders' concept of ability and their technology readiness?

4. How is the relationship between concept of ability and technology readiness moderated by contextual variables?

The dependent variables were technology readiness, as determined by the TRI 2.0 and the concept of ability, determined by the TIS. The following independent variables were used to determine if the results of the research were moderated at any level in the relationship of the K-12 leaders' concept of ability and their technology readiness: age, gender, school level (elementary, middle or high), level of education (bachelor's, master's, double-master's, specialist, doctoral), university at which leadership degree was acquired, quality and quantity of online coursework exposure, and years in education.

Research Setting

This study was conducted in the School District of Palm Beach County (SDPBC). The SDPBC is the fifth largest school district in Florida and the eleventh largest in continental United States. The SDPBC has 185 schools, 181,205 students, 12,898 teachers, and 21,449 total employees. It has over 250 Choice Programs and Career Academies including STEM (Science/Technology/Engineering/Mathematics) programs, and technology based academies. Within the schools, the district has 69,311 computers and 6,500 iPads. The SDPBC serves a diverse population including 35,314 Exceptional Student Education (ESE) students, 9,050 of which are in gifted education program, 25,746 students in English for Speakers of Other Languages (ESOL) classes, providing instruction in many languages including Chinese, French, Italian, Latin, Spanish, and American Sign Language (Palm Beach County Schools, 2013). This Florida school district can be viewed as a model for national trends as its current demographics very

nearly represent the anticipated demographic growth for the rest of the nation (U.S. Census Bureau, 2015).

Research Sample and Data Sources

Both the unit of analysis and the sample consisted of the principals of SDPBC. This included 158 principals from 104 elementary, 31 middle, and 23 high schools. Only regular K-12 schools were included. The researcher was a school district employee and therefore had access to the participants. The participants represented a diverse group according to all contextual variables. School leaders within SDPBC are required to have 5 years of teaching experience as well as a master's degree in educational leadership and administration before participating in a 1-year in-house leadership academy and then entering the assistant principal pool. Once leaders have been an assistant principal for 2 years, they are able to join a 2-year in-house leadership academy to enter into the principal pool. Most principals surveyed in this study will have gone through this process of education and professional development. Exceptions to this come from old policies that only required 3 years of teaching experience before entering the assistant principal leadership academy or participants who came to the district and had achieved a leadership role through a different organization. For example, charter schools are known to promote teachers to become assistant principals with less than 3 years of experience. Once assistant principals are in a charter school, these leaders could apply and become assistant principals or other level administrators in SDPBC.

Instrumentation

In this section, the two instruments, the TIS and the TRI 2.0 were analyzed to establish trustworthiness (Appendix A).

Theories of Intelligence Scale (TIS).

The second instrument, the TIS, is a very short 3-item instrument developed by Dweck et al. (1995). This instrument is a 6-point Likert-type scale with 1 = *strongly agree* and 6 = *strongly disagree*. The items are included in Table 3.

Table 3

Items in the Theories of Intelligence Scale (TIS)

Item no.	Item
1	You have a certain amount of intelligence and you really can't do much to change it.
2	Your intelligence is something about you that you can't change very much.
3	You can learn new things, but you can't really change your basic intelligence.

Note. Adapted from "Implicit Theories and Their Role in Judgments and Reactions: A World from Two Perspectives," by C. S. Dweck, C. Chiu, and Y. Hong, 1995, *Psychological Inquiry, 6*(4), p. 269.

According to Dweck et al. (1995) the implicit theory of intelligence portion of the instrument garners strong reliability and validity. The three items had a strong internal reliability garnering an α of .94 to .97. Over a 2-week period the test-retest reliability was .80. See Table 4 for a breakdown of the six pilot studies and their reliability statistics as well as study sample size (*N* ranging from 32 to 184), range of responses (1-6), $\bar{x}$ (mean score ranging from 3.57 to 3.97), and standard deviation (ranging from 1.13-1.49).

Table 4

Summary Statistics and Reliability of the Theories of Intelligence Scale (TIS)

Study no.	*N*	$\bar{x}$	SD	Internal reliability
1	69	3.96	1.34	.96
2	184	3.80	1.32	.94
3	139	3.79	1.28	.94
4	121	3.97	1.13	.96
5	93	3.73	1.40	.96
6	32	3.57	1.49	.97

Note. Adapted from "Implicit Theories and Their Role in Judgments and Reactions: A World from Two Perspectives," by C. S. Dweck, C. Chiu, and Y. Hong, 1995, *Psychological Inquiry, 6*(4), p. 270.

The norm score for the TIS, which was used for this study, was computed by combining the mean, standard deviation, and sample size for the six pilot studies. This was accomplished by combining the scores, weighting appropriately for the sample size of each.

The TIS is made up of three entity theory statements where a response of agreement indicates an entity theory and a response of disagreement shows an incremental theory. This is done because there tends to be agreeability with incremental statements. People see the incremental statements as more desirable, so such statements are excluded from the instrument (Dweck et al., 1995). The TIS measures three implicit theory components. Each of the implicit theory components (intelligence, morality, world theory) measured by Dweck et al. (1995) are individual from one another, showing little overlap through factor analysis and can be used separately. Each of the implicit theory components is not "confounded with self-presentation concerns" (p. 271). Therefore, for this study, only the component measuring theory of intelligence, consisting of three items

(Table 3), was used. Dweck et al.'s (1995) instrument is valid and reliable and can be used with confidence.

To score the instrument, responses, ranging from 1 (*strongly agree*) to 6 (*strongly disagree*), were averaged to find an overall mindset theory score. This score will range from 1 (highly entity) to 6 (highly incremental). Respondents can then be categorized as having either a fixed mindset (score of 3 or below) or open mindset (score of 4 or above). Respondents who score between 3 and 4 have no clear implicit theory of intelligence and generally account for 15% of participants (Dweck et al., 1995).

Technology Readiness Index (TRI) 2.0.

The TRI 2.0 by Parasuraman and Colby (2015) was published in its original form by Parasuraman in 2000 and has been widely used to date. Parasuraman and Colby's (2015) updated and streamlined edition of the instrument uses 16 items, 11 of which come from the original 36 items used by Parasuraman (2000). The purpose of creating the TRI 2.0 was to broaden the contextual appropriateness of the tool. This is beneficial to this study because the instrument was originally designed for external use in market research. Parasuraman (2000) does state that the instrument could be applied internally by organizations. This justifies its use in an internal educational setting.

The 16 items from the updated instrument measure four components, which include technological optimism (4 items), technological innovativeness (4 items), technological discomfort (4 items), and technological insecurity (4 items). The two positive measures of technology readiness, optimism and innovativeness, are weighed against the two negative measures discomfort and insecurity to measure a participant's overall technological readiness. The instrument's 5-point Likert-type questions are

answered by indicating a score from 1 = *strongly disagree* to 5 = *strongly agree*. Table 5 outlines the items along with their item codes and numbers.

Table 5

Technology Readiness Index (TRI) 2.0 Items

Item #	Item code	Item
1	OPT1	New technologies contribute to a better quality of life.
2	OPT2	Technology gives me more freedom of mobility.
3	OPT3	Technology gives people more control over their daily lives.
4	OPT4	Technology makes me more productive in my personal life.
5	INN1	Other people come to me for advice on new technologies.
6	INN2	In general, I am among the first in my circle of friends to acquire new technology when it appears.
7	INN3	I can usually figure out new high-tech products and services without help from others.
8	INN4	I keep up with the latest technological developments in my areas of interest.
9	DIS1	When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.
10	DIS2	Technical support lines are not helpful because they don't explain things in terms I understand.
11	DIS3	Sometimes, I think that technology systems are not designed for use by ordinary people.
12	DIS4	There is no such thing as a manual for a high-tech product or service that's written in plain language.
13	INS1	People are too dependent on technology to do things for them.
14	INS2	Too much technology distracts people to a point that is harmful.
15	INS3	Technology lowers the quality of relationships by reducing personal interaction.
16	INS4	I do not feel confident doing business with a place that can only be reached online.

Note. Adapted from "An Updated and Streamlined Technology Readiness Index: TR2.0," by A. Parasuraman and C. L. Colby, 2015, *Journal of Service Research, 18*(1), p. 64.

The TRI 2.0 is an appropriately valid and reliable instrument. Table 6 outlines reliability, and goodness-of-fit statistics. The TRI 2.0's four dimensions range in reliability from .70 for discomfort to .83 for innovativeness in Cronbach α (optimism .80,

innovativeness .83, discomfort .70, insecurity .71). Additionally, goodness-of-fit measures indicate an appropriate fit. Confirmatory factor analysis revealed: goodness-of-fit index = .953; nonnormal fit index = .920; comparative fit index = .942; root mean square residual = .065. Additional summary statistics on the TRI 2.0 are included in Table 7.

Table 6

Factor Analysis of the Technology Readiness Index (TRI) 2.0 Measures

Factor	Technology readiness dimensions			
	Optimism	Innovativeness	Discomfort	Insecurity
Cronbach's α	.80	.83	.70	.71
Composite reliability	.81	.84	.71	.72
Average variance extracted	.51	.56	.38	.40
Maximum shared variance	.42	.42	.38	.38
Average shared variance	.20	.20	.19	.22

Note. Confirmatory factor analysis: goodness-of-fit index = .953; nonnormal fit index = .920; comparative fit index = .942; root mean square residual = .065. All factor loadings have been multiplied by 100. Adapted from "An Updated and Streamlined Technology Readiness Index: TR2.0," by A. Parasuraman and C. L. Colby, 2015, *Journal of Service Research, 18*(1), p. 68.

The four dimensions' range in mean score, using data from the 2012 National Technology Readiness Survey, from 3.02 to 3.75 with an overall TRI score of 3.02. Their standard deviation ranges from .8 to 1.02 in the four dimensions while measuring .61 in the overall TRI. The sample size for the 2012 NTRS is 878. The data from the 2012 NTRS acted as the norm group for comparative analysis. These data can be seen on Table 7.

Table 7

Summary Statistics for Technology Readiness Index (TRI) 2.0 and Its Components

TR components	M		SD	Skewness	Kurtosis	Correlation coefficients*			
	1999 NTRS (TRI 1.0)	2012 NTRS (TRI 2.0)				OPT	INN	DIS	INS
Optimism (OPT)	3.84	3.75	.80	-.55	.10	1.00	.52	-.32	-.28
Innovativeness (INN)	3.18	3.02	1.02	-.02	-.76	.54	1.00	-.40	-.30
Discomfort (DIS)	3.46	3.09	.84	-.11	-.35	-.14	-.20	1.00	.56
Insecurity (INS)	4.03	3.58	.83	-.44	-.20	-.29	-.26	.44	1.00
Overall TRI	2.88	3.02	.61	.19	.29	.70	.75	-.62	-.70

Note. All mean values are on a 5-point scale. The overall TRI score for each respondent was the average score on the four dimensions (after reverse coding the scores on discomfort and insecurity). Adapted from "An Updated and Streamlined Technology Readiness Index: TR2.0," by A. Parasuraman and C. L. Colby, 2015, *Journal of Service Research, 18*(1), p. 70.
*All coefficients are significant at $p < .01$; coefficients in the upper triangle are from the 1999 National Technology Readiness Survey (NTRS) study.

The data from the 16-item TRI 2.0 was used to determine the scores of each of the subsets (optimism, innovation, discomfort and insecurity) of Technology Readiness. Parasuraman and Colby (2015) suggest that surveys missing more than three items be thrown out and that a score of 3 be used for missing items where respondents are missing three or fewer items. Instead of using this method, the mean for all responding to each item was used to replace the missing scores. The score for each of the four dimensions was calculated by averaging their related item responses. An overall Technology Readiness score can be found through the use of the following formula: TRI 2.0= (Innovative + Optimism + (6-Insecurity) + (6-Discomfort))/4. Through this formula a Technology Readiness score between 1 and 5 was computed with a higher score signifying a higher Technology Readiness. The participants' scores on the dimensions of

Technology Readiness, optimism, innovation, insecurity and insecurity were used for analysis.

Moderating variables.

Additional questions collecting data on the contextual variables preceded the two published instruments including questions on age, gender, school level (elementary, middle or high), level of education (bachelor's, master's, double-master's, specialist, doctoral), university at which leadership degree was acquired, quality and quantity of online coursework exposure, and years in education. The complete instrument contained 29 items and took 5-7 minutes to complete (Appendix A).

After data collection was completed two of the moderating variables were thrown out because of missing data. These included quality and quantity of online coursework exposure.

Data Collection Methods

The data were collected during the end of the 2014-2015 school year when principals had a greater opportunity to fill out the survey as opposed to during the busier testing season. The items from both instruments, the TIS and the TRI 2.0, and contextual variables items were combined into a single instrument through Survey Monkey, taking only 5-7 minutes to complete. This instrument attached to an introductory email protocol, explaining the purpose of the study, encouraging participation from novices to experts in technology, and assuring the confidentiality of responses, was sent requesting volunteers to participate in the study (Appendix C).

Additionally, an item was added to the instrument allowing participants to mark their data with a unique 5-digit identifier. Upon completion of the study, a spreadsheet

indicating the Theories of Intelligence score and the Technology Readiness score for each unique identifier was presented to the participants. These data allowed participants to view the results of their survey while remaining anonymous. An executive summary of the findings was also offered as an encouragement to participate.

Data Analysis Methods

The description of data analysis is demarked by the research questions.

1. What is the technological readiness of K-12 school leaders and how does it compare with the norm?

Once the technology readiness scores for the sample were determined, a comparison was computed in Statistical Package for the Social Sciences (SPSS) using the *n*, standard deviation, and the mean of the sample and the norm group. The norm group was 2012 NTRS data.

2. What is the concept of ability of K-12 school leaders and how does it compare with the norm?

Similarly to Research Question 1, Question #2 was answered by first calculating the concept of ability of each respondent. Once concept of ability for the sample was determined a comparison was computed in SPSS using the *n*, standard deviation, and the mean of the sample and the norm group. The norm group was determined by combining data from the six studies from Dweck et al. (1995) while weighting appropriately for each study's sample size (*N*).

3. What is the relationship between K-12 school leaders' concept of ability and their technology readiness?

Determining the relationship between the sample's concept of ability and technology readiness was calculated by analyzing correlations between concept of ability and each one of the technology readiness subsets, optimism, innovation, discomfort, and insecurity.

4. How is the relationship between concept of ability and technology readiness moderated by contextual variables?

Each of the relationships derived by the analysis of Research Question 3 was analyzed through a regression in order to find the effect of the moderating variables on said relationships.

Anticipated Outcomes

It was anticipated that K-12 school leaders would score higher in technology readiness, its positive subsets, optimism and innovation, and concept of ability, indicating an incremental concept of ability, than the norms for both instruments. Additionally, it was expected that there would be a positive correlation between high total technology readiness, as well as high positive technology readiness subsets, optimism and innovation, and an incremental concept of ability in K-12 school leaders.

CHAPTER 4: DATA ANALYSIS AND FINDINGS

In this chapter the data acquired from the survey instrument, TIS, TRI 2.0, and demographic questions, was analyzed in order to address the research questions and null hypotheses. The chapter restates the research questions and null hypotheses, describes the demographics data, and analyzes each null hypothesis in turn. The purpose of the study was to determine the concept of ability and technology readiness of K-12 school leaders in SDPBC. SPSS 23 was used to compute each of the statistical tests.

Research Questions

The research questions are as follows:

1. What is the technological readiness of SDPBC K-12 school leaders and how does it compare with the norm?
2. What is the concept of ability of SDPBC K-12 school leaders and how does it compare with the norm?
3. What is the relationship between SDPBC K-12 school leaders' concept of ability and their technology readiness?
4. How is the relationship between concept of ability and technology readiness moderated by contextual variables?

Null Hypotheses

The null hypotheses examined are:

$H_0 1$: There is no difference between K-12 school leaders and the norm group in technology readiness.

$H_0 2$: There is no difference between K-12 school leaders and the norm group in concept of ability.

$H_0 3$: There is no relationship between the concept of ability and technology readiness of K-12 school leaders.

$H_0 4$: The relationship between concept of ability and technology readiness is not moderated by contextual variables.

Descriptive Statistics

Table 8 shows the mean and standard deviation for the data, which were collected from the SDPBC school leaders.

Table 8

Descriptive Statistics

Statistic	Mean	SD
TISTotal	4.3019	1.49966
TRITotal	3.3244	.47897
Optimism	4.0044	.49916
Innovation	3.3107	.79754
Discomfort	2.7816	.76400
Insecurity	3.2358	.78049

Demographics

The section that follows will be a description of the sample's demographic makeup. Out of the original 160 population of K-12 school leaders in SDPBC, two declined participating in the study, leaving a population of 158. Of these a response rate of 33% was garnered with 53 out of 158 completing a survey. The majority were female, 32 to 21 male, making up 60% of the participants (Table 9). Racially, only three out of the six options were selected, with no representation of American Indian/Alaskan Native,

Asian or Pacific Islander, or Other. Of those who did participate the majority were White/Caucasian (35 = 66%), followed by Black/African American (14 = 26%), and Hispanic/Latino (4, = 8%)(Table 10).

Table 9

Gender

Gender	No. of participants	% of Participants
Male	21	40%
Female	32	60%

Table 10

Race

Race	No. of participants	% of Participants
American Indian/Alaskan Native	0	0%
Asian or Pacific Islander	0	0%
Black/African American	14	26%
Hispanic/Latino	4	8%
White/Caucasian	35	66%
Other	0	0%

To better illustrate the diversity of age within the school leaders, the data are visualized in Figure 4 as a bar graph, with each bar representing the age of one participant. The age range is from 35 to 74 (39 years), with a mean of 48, median of 47, and mode of 54. The slope of the line shows a consistent distribution of age.

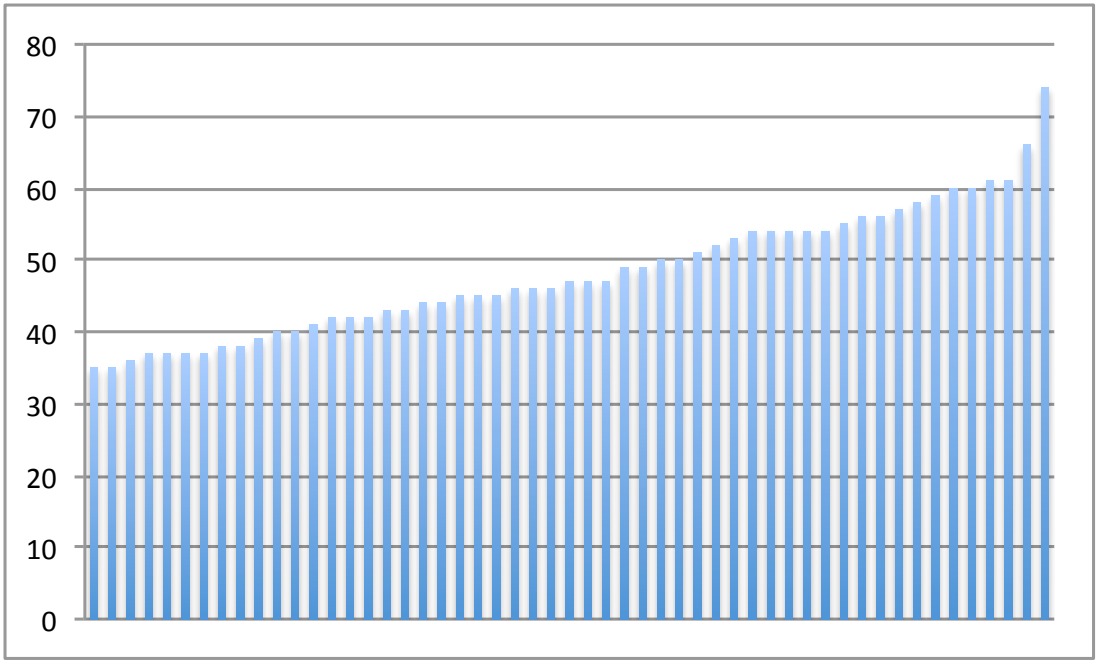

Figure 4. Age of participating school leaders.

Similarly, to the representation of age, the distribution of years of experience in education has a smooth distribution, as represented in Figure 5 as a bar graph. The range of experience was from 12 to 52 (40 years) with a mean of 24, median of 22 and mode of 15.

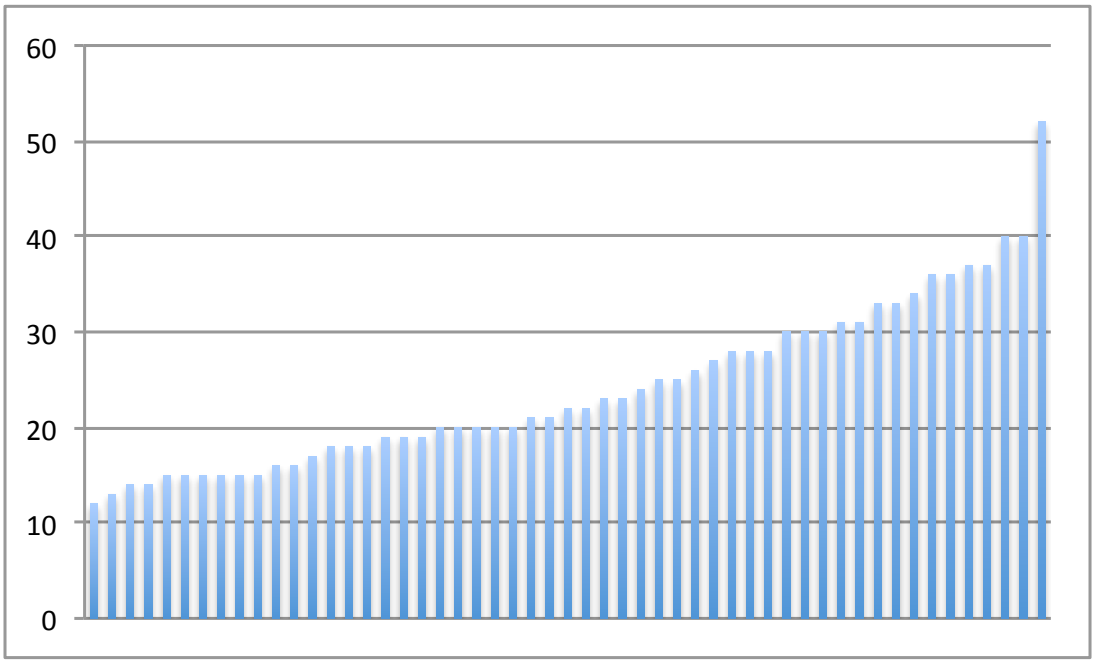

Figure 5. Years of experience of participating school leaders.

Each school level was represented in the group with the majority being from elementary (31 = 59%), then middle (15 = 28%) and then high (7 = 13%) (Table 11).

Table 11

School Level Leaders

School level	No. of participants	% of Participants
Elementary	31	59%
Middle	15	28%
High	7	13%

This representation makes sense, generally following the trend of the number of school sites for each level, as of the 158 school leaders, in the population group, 103 (65%) were leaders of elementary schools, 32 (20%) were from middle, and 23 (15%) from high. It is likely that the higher than representative proportion of middle school principal participation is due to the influence of the researcher's role within SDPBC. The researcher oversees and supports middle school information technology and business academies, providing direct support to teachers, coordinators, and principals. This was a limitation to the study and was also noted within that section.

Table 12

Level of Education

Level of education	No. of participants	% of Participants
Bachelor's	0	0%
Master's	33	62%
Double Master's	2	4%
Specialist	7	13%
Doctorate	11	21%

To become a principal in SDPBC, a master's degree in education is generally the requirement. For this reason, as seen in Table 12, there were no school leaders whose

highest achieved degree (education level) was a bachelor's. For the participants, 62% had the minimal requirement of a master's degree, with 2 going further to acquire a double-master's, 7 a specialist, and 11 a doctoral degree. Overall 38% of the school leaders had advanced beyond their master's. Table 13 shows the universities at which the school leaders' most recent leadership coursework was completed. The top three represented local universities with Nova Southeastern University serving 23, Florida Atlantic University 18, and Lynn University 3. Eleven other universities were represented showing some diversity in training, with one participant indicating that their most recent leadership coursework was "on the job…not at a university."

Table 13

University of Most Recent Leadership Coursework

University	No. of participants	% of Participants
Nova Southeastern	23	43%
Florida Atlantic University	18	34%
Lynn University	3	6%
Argosy University	1	2%
Clemson University	1	2%
Georgia Southern University	1	2%
Long Island University	1	2%
Palm Beach Atlantic University	1	2%
Salem State University	1	2%
Walden University	1	2%
Western Michigan University	1	2%
On the job… not at a university.	1	2%

Null Hypothesis 1

Independent *t* tests were used to determine if the null hypothesis, that there is no difference between K-12 school leaders and the norm group in technology readiness, would be rejected. The mean, standard deviation and sample sizes of the norm group and

the sample were compared. To do this SPSS syntax from Field (2000) was used (Appendix D). This was done for the TRI Total and each of the TRI sub scores. Because this null was composed of five sub null hypotheses, one for each test, and in order to limit the possibility of committing a type 1 error over the cumulative null hypotheses, a Bonferroni adjustment was used, bringing our necessary per hypothesis α to .01 over the five. It was found that there were significant (p <.01) differences for total technology readiness, discomfort and insecurity; therefore, the null hypotheses for these variables were rejected. Summary statistics for null 1 are shown in Table 14. The participants mean score was higher for total technology readiness (.3), optimism (.25), and innovation (.29), while having a lower mean score on discomfort (-.31), and insecure (-.34). These indicate the greater readiness of the sample to the norm group in these areas. Additionally the effect size for the t tests were: total technology readiness (.51), optimism (.32), innovation (.29), discomfort (-.37), and insecurity (-.42). Following Cohen's (1988) suggested descriptions of effect size, that d = .2 is small, d = .5 is medium, and d = .8 is large, it can be seen that the effects are small to medium.

Table 14

Comparison of Sample and Norm Means on the TRI t(929)

	Sample (N = 53)		Norm (N = 878)		Difference between			
TRI	Mean	SD	Mean	SD	means	t	p	d
Total	3.32	1.49966	3.02	.61	.30	3.57	<.000	.51
Opt	4.00	.49916	3.75	.80	.25	2.29	.022	.32
Inn	3.31	.79754	3.02	1.02	.29	2.04	.042	.29
Dis	2.78	.76400	3.09	.84	-.31	-2.61	.009	-.37
Ins	3.24	.78049	3.58	.83	-.34	-2.94	.003	-.42

Null Hypothesis 2

In order to test the second null hypothesis, that there is no difference between K-12 school leaders and the norm group in concept of ability, again, an independent *t* test was used, and again the null was rejected. First the combined mean, standard deviation, and sample size was computed for the TIS norm group. This was accomplished by combining the scores for the 6 norm studies, and weighting appropriately for the sample size of each. The mean, standard deviation, and sample size were also computed for the participant group from the survey data. Similarly to above, the *t* test used Field's (2000) SPSS syntax (Appendix D). The participants showed a significantly ($p<.05$) higher mean score (.5 higher) than the norm group, with an effect size of .31 (Table 15).

Table 15

Comparison Statistics for Null Hypothesis 2

Sample ($N = 53$)		Norm ($N = 878$)		Difference between means	*df*	*t*	*p*	*d*
Mean	SD	Mean	SD					
4.3	1.5	3.8	1.3	.5	689	2.48	.014	.31

Null Hypothesis 3

Null Hypothesis 3, that there is no relationship between concept of ability and technology readiness of K-12 school leaders, breaks down into four comparisons, one for each of the technology readiness subsets and TIS. For this reason, and in order to limit the possibility of committing a type 1 error over the cumulative null hypotheses, a Bonferroni adjustment was used, bringing our necessary per hypothesis α to .0125 over the four.

With this in mind the null hypotheses for these variables were rejected because a significant relationship exists between TIS and TRI sub score innovation, with a Pearson correlation of .365. The relationship between Total TIS and the other three sub scores of technology readiness, optimism, discomfort and insecurity, were found to be non-significant, with Pearson correlations of .115, -.249, and -.111 respectively. Table 16 outlines these data.

Table 16

Correlations Between Theories of Intelligence Scale (TIS) Score and Technology Readiness Index (TRI) 2.0 Sub Scores

Correlates	TIS	Optimism	Innovation	Discomfort	Insecurity
TIS	1.000	.115	.365*	-.249	-.111
Optimism	.115	1.000	.263	-.089	-.285
Innovation	.365*	.263	1.000	-.094	-.315
Discomfort	-.249	-.089	-.094	1.000	.492*
Insecurity	-.111	-.285	-.315	.492*	1.000

*2-tailed test, $p < .0125$. $N = 53$.

A multiple regression analysis revealed that the technology readiness sub scores, optimism, innovation, discomfort, and insecurity predicted a significant proportion of the variance of TIS Total, $R^2=.20$, $F(4,48)=2.94$, $p < .05$. As Table 17 indicates, no collinearity difficulties appear with all VIFs being less than 2. With the other variables present (Optimism, Discomfort, and Insecurity), Innovation significantly contributed to the model ($p<.05$). The other variables proved to be redundant, lacking significant contribution. The technology readiness sub score of Innovation was the best predictor for TISTotal and was also the only significant contribution to the model.

Table 17

Contribution of Technology Readiness Sub Scores to a Regression Model of TIS Total

	Unstandardized coefficient	Standardized coefficient			
Model	B	Beta	*t*	*p*	VIF
(Constant)	2.097				
Optimism	.106	.035	.256	.799	1.132
Innovation	.713	.379	2.727	.009	1.157
Discomfort	-.568	-.290	-1.941	.058	1.331
Insecurity	.309	.161	1.004	.320	1.532

Null Hypothesis 4

Each of the relationships derived by the analysis of Research Question 3 was analyzed through a regression in order to determine the effect of the moderating variables on said relationships. Through this process a moderator regression was computed for each of the moderators on each of the relationships between TIS and the four TRI sub scores.

The moderation of each demographic variable was tested by creating a multiple regression model predicting TIS from the TRI sub score, the demographic variable, and the product of TRI sub score and the demographic variable. Each of the nominal (gender, race, and university) demographic variables was first dummy coded into indicator variables. For continuous variables such as age and experience, scores were first centered to try to ameliorate the difficulties introduced by multicollinearity. Syntax (Appendix D) was used to administer each of the tests for nominal variables.

It was found that the relationships between TIS and the TRI sub scores were affected ($p<.05$) by the moderating variables. Table 18 summarizes the occurrences of the moderations.

Table 18

Summary of Significant Moderation on the Relationship Between TIS and TRI Sub Scores

TRI Sub Score	Gender	Race	University	Age	Experience	School level	Education level
Optimism					X		
Innovation	X						
Discomfort		X					
Insecurity		X					

Note. X = (p<.05).

Gender.

Only one of the TIS and TRI sub scores was significantly moderated by gender (Table 19). The relationship between TIS and Innovation differed (p<.05) between genders.

Table 19

Moderation of Gender on Relationship Between TIS and TRI Sub Scores

TRI sub score	p	R^2
Optimism	.411	.056
Innovation	.025	.172
Discomfort	.067	.328
Insecurity	.602	.037

To further explain this moderation, correlations were computed for both genders on the relationship between TIS and Innovation (Table 20).

Table 20

Correlations of TIS and TRI Innovation by Gender

Gender	N	Correlation	p
Male	21	.532	.013
Female	32	.232	.200

Correlations across genders were positive. The male correlation was significant (p<.05) and larger (.532) while the female correlation was not significant and smaller (.232). This result concurred with the outcome of Null Hypothesis 3, further showing that the relationship between TIS and Innovation is significant and that it is moderated by gender.

Race.

Only three of the six categories of race were marked by participants. These were Black/African American, Hispanic/Latino, and White/Caucasian. For this reason, through input into the regression model in SPSS, the three remaining categories were not included. Only two of the four TRI sub scores were moderated by race, TRI discomfort and TRI insecurity (Table 21). This shows that the relationship between discomfort and TIS, as well as the relationship between insecurity and TIS differed (p<.05) as race changes.

Table 21

Moderation of Race on Relationship Between TIS and TRI Sub Scores

TRI sub score	*p*	R^2
Optimism	.342	.042
Innovation	.469	.026
Discomfort	.043	.113
Insecurity	.015	.152

To further illuminate the moderating effect of race, correlations between TIS and the two significant TRI sub scores, discomfort and insecurity, were correlated with each of the races. As noted above only three of the race options were selected by participants. These data are shown in Table 22.

Table 22

Correlations of TIS and TRI Discomfort/TRI Insecurity by Race

Race	*N*	TRI discomfort		TRI insecurity	
		Correlation	*p*	Correlation	*p*
African American/Black	14	-.135	.646	-.016	.956
Hispanic/Latino	4	.806	.194	.891	.109
White/Caucasian	35	-.401	.017	-.388	.021

Significant ($p<.05$) correlation by race is limited to White/Caucasian participants for both the correlation between TIS and TRI discomfort and TIS and TRI insecurity. Both correlations are medium in size (TIS/Discomfort = -.401, TIS/Insecurity =-.388) and negative. This indicated that for White/Caucasian participants as TIS increases, both of the negatively scored TRI sub scores, discomfort and insecurity, decrease. The correlations across race indicated smaller negative correlations for White/Caucasian and African American/Black for both TRI sub scores. On the other hand, a strong positive correlation for Hispanic/Latino existed. But because of the small *N*, this relationship, thus the moderation effect, is limited in trustworthiness.

University.

There were no significant ($p<.05$) moderating affects on the relationship between TIS and the TRI sub scores by the university that the school leaders attended for their most recent leadership coursework (Table 23).

Table 23

Moderation of University on Relationship Between TIS and TRI Sub Scores

TRI sub score	*p*	R^2
Optimism	.467	.202
Innovation	.296	.213
Discomfort	.569	.174
Insecurity	.460	.204

Age.

Age does not moderate the relationship between TIS and any of the TRI sub scores, as indicated by the non-significant beta scores (Table 24).

Table 24

Moderation of Age on Relationship Between TIS and TRI Sub Scores

TRI sub score	Moderation β	*p*
Optimism	-2.031	.087
Innovation	.028	.962
Discomfort	-.020	.964
Insecurity	.392	.425

Experience.

The only relationship that experience moderated significantly was that of TIS and TRI Optimism (Table 25).

Table 25

Moderation of Experience on Relationship Between TIS and TRI Sub Scores

TRI sub score	β(3)	*p*
Optimism	-2.362	.039
Innovation	.204	.766
Discomfort	.034	.940
Insecurity	.512	.302

The Beta (-2.362) is significant ($p<.05$), indicating that experience moderates the relationship between TIS and TRI optimism. Also, with a negative Beta, as experience increases the relationship between TIS Total and TRI optimism becomes more negative. It should be noted that despite centering experience, there were still issues of collinearity, as shown in the high VIF scores (Table 26).

Table 26

Moderation of Experience on Relationship Between TIS and TRI Optimism

Model	β(3)	*p*	VIF
TRI Optimism			1.301
Experience Centered			64.647
Product of Experience Centered and TRI Optimism	-2.362	.039	66.910

Further exploration into the moderation of experience on TIS and TRI optimism was analyzed separating the participants into low and high experience groups, delineated as being below or above median experience (22 years). These data are shown in Table 27.

Table 27

Correlation of TIS and TRI Optimism by Low and High Experience Groups

	N	Correlation	*p*
Experience<=22	28	-.156	.429
Experience>22	25	-.575	.003

Note. Low and high groups delineated as below or above median experience (22 years).

A significant ($p<.05$) negative correlation (-.575) was found for the high experience group, while a smaller negative correlation (-.156) existed for those with low experience, though with less strength. This difference in correlation shows the moderation of experience.

School level lead.

The ordinal data for school level lead was used to compute composite variables for each of the TRI sub scores. These scores along with TIS, school level lead and the corresponding TRI sub score were used in a regression analysis. None of the relationships between TIS and the TRI sub scores were moderated by school level lead (Table 28).

Table 28

Moderation of School Level Lead on Relationship Between TIS and TRI Sub Scores

TRI sub score	β(3)	*p*
Optimism	1.848	.122
Innovation	.801	.126
Discomfort	-.106	.844
Insecurity	.285	.612

Educational level achieved.

The ordinal data of education level achieved were used to compute combination variables for each of the TRI sub scores. These combination variables, as well as their corresponding TRI sub score, education level achieved, and TIS were analyzed through a regression (Table 29).

Table 29

Moderation of Educational Level Achieved on Relationship Between TIS and TRI Sub Scores

TRI sub score	β(3)	p
Optimism	.881	.452
Innovation	-.345	.570
Discomfort	-.258	.659
Insecurity	.295	.625

None of the relationships between TIS and the TRI sub scores were moderated by the education level achieved ($p<.05$).

CHAPTER 5: CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

This chapter provided the conclusions, discussion, and recommendations for further research.

Purpose of the Study

The purpose of the study was to determine the concept of ability and technology readiness of K-12 school leaders in the SDPBC.

Conclusions

A summary of the results is presented in this section, organized by research question and null hypothesis.

This study sought to answer the following questions:

1. What is the technological readiness of SDPBC K-12 school leaders and how does it compare with the norm?

$H_0$1: There is no difference between K-12 school leaders and the norm group in technology readiness.

It was found that there were significant (p <.01) differences for three of the five comparisons (Total TRI, Discomfort, & Insecurity); therefore, the null was rejected. Furthermore SDPBC school leaders scored higher than the norm group on the two positively scored indicators, Optimism and Innovation, while scoring lower on the two negatively scored indicators, Discomfort and Insecurity.

2. What is the concept of ability of SDPBC K-12 school leaders and how does it compare with the norm?

$H_0$2: There is no difference between K-12 school leaders and the norm group in concept of ability.

The participants showed a significantly (p<.05) higher mean score (.5 higher) than the norm group. Therefore the researcher was able to reject the null hypothesis.

3. What is the relationship between SDPBC K-12 school leaders' concept of ability and their technology readiness?

$H_0$3: There is no relationship between the concept of ability and technology readiness of K-12 school leaders.

The null was rejected because a significant (p< .0125) relationship existed between TIS and Innovation.

4. How is the relationship between concept of ability and technology readiness moderated by contextual variables?

$H_0$4: The relationship between concept of ability and technology readiness is not moderated by contextual variables.

Analysis of the moderating variables was organized into categories of variables, with gender, race, and university being nominal, age and experience being continuous, and school level lead and educational level achieved being ordinal. Table 30 indicates the moderation of the relationship between TIS and the TRI Sub Scores.

Table 30

Summary of Significant Moderation on the Relationship Between TIS and TRI Sub Scores

TRI sub score	Gender	Race	University	Age	Experience	School level	Education level
Optimism					X		
Innovation	X						
Discomfort		X					
Insecurity		X					

Note. X = (p<.05).

The relationship between TIS and Innovation was positive for both males and females though stronger and significant (p<.05) for males.

The correlations across race indicate smaller negative correlations for white/Caucasian and African American/Black, over the relationships between TIS and Discomfort and TIS and Insecurity, indicating a lesser contribution to the moderating affect. On the other hand, a strong positive correlation for Hispanic/Latinos existed, though because of an N of 4, it is limited in trustworthiness.

The moderation of years of experience on TIS and Optimism was not consistent across levels of experience. After comparing those with experience longer and shorter than the median years of experience (22), it was found that a significant (p<.05) negative correlation (-.575) existed for the high experience group, while a smaller non-significant negative correlation existed for those with less experience. This shows that, for the participants with 22 years or more experience as an educator, as experience is gained the negative correlation of TIS and TRI optimism strengthens. The other moderating variables, university, age, school level lead, and educational level, did not moderate the relationship between TIS and the TRI Sub Scores with significance (p<.05).

Discussion

The anticipated outcomes for this study were validated by the data analysis. The SDPBC school leaders outscored the norm groups for both the TIS and TRI 2.0, indicating that they possess both a more incremental concept of ability, as well as a greater level of technology readiness. It was also validated that TIS and TRI Innovation shared a significant positive relationship.

Colby and Parasuraman's (2003) Technology Readiness Segments (Table 1) mark those with higher optimism and innovation, and lower discomfort and insecurity as being technology explorers. As a group, the SDPBC school leaders are similar to this segment; they stand among the most technologically ready segment.

From an adult learning standpoint (Brookfield, 2005), critical thinking is necessary in order to achieve learning. For school leaders who struggle to achieve innovative use of technology, it may be that they do not hold an incremental concept of ability toward technology skill. Furthermore, this self-assumption about ability may need to be challenged and changed if learning in this area is to be actualized. Leaders need to create a school climate that maintains an organizational mindset that is willing and ready to embrace new technology.

Their above norm level scores on the TIS and TRI 2.0 show that the school leaders of SDPBC possess some of the foundational attitudes that will enable them to lead their schools in the knowledge-based economy (Drucker, 1993). They have a more incremental concept of ability, which leads them to understand that "although people may differ in every which way—in their initial talents and aptitudes, interests, or temperaments—everyone can change and grow through application and experience"

(Dweck, 2006, p. 7). It was the expectation of the researcher, that educators, especially those in leadership roles, would embrace a philosophy of intellectual growth consistent with the goal of facilitating student learning. The significant ($p<.05$) link between TIS and TRI Innovation shows that, during the constant growth of technology we are experiencing today, those with an incremental concept of ability will be better able to stay on the cutting edge.

Heifetz et al. (2009) have noted that in climates of high complexity, such as technologically transitioning learning organizations, leaders should help, "manage yourself in that environment and help people tolerate the discomfort they are experiencing" (p. 29). SDPBC school leaders were found to experience less technological discomfort than the norm group, showing that they are at least in part fulfilling this call.

The lower than normal TRI Discomfort and TRI Insecurity of SDPBC school leaders are also positive indicators for education. These indicators may show a more positive attitude toward technology that McLeod stresses as vital for technology leaders (2008a). School leaders who experience discomfort and insecurity with new technologies are likely to proceed at a pace that will limit their students' exposure. On the other hand, those who experience them less will have a greater technology readiness and be less resistant to technology change.

Prensky's (2001) notion of digital natives was not validated by this study. For SDPBC school leaders there is no significant moderation on the relationship between concept of ability and technology readiness by age. If Prensky's (2006) view was represented in this population, one would expect there to be some significant moderation

by age, but instead those who had grown up in the digital world showed no significant difference in this relationship.

Through age played no significant part in the moderation of TIS and TRI 2.0, the very similar variable of experience did. The data on age and experience were very similar as a visual comparison of Figure 4 and 5 indicate. Experience however did moderate. This may indicate that SDPBC school leaders, despite having a higher than normal incremental concept of ability, are less likely to show a connection between that mindset and optimism toward technology if they have greater years of experience.

With both male and female participants showing a positive correlation between concept of ability and TRI Innovation, the assertion that concept of ability and technology implementation being unaffected by gender are partially validated (Dawson & Rakes, 2003; Dweck et al., 1995). However, male participants did indicate a larger significant correlation.

This study was able to validate part of the researcher's conceptual framework (Figure 1), though with some revisions. These revisions may be seen in Figure 6.

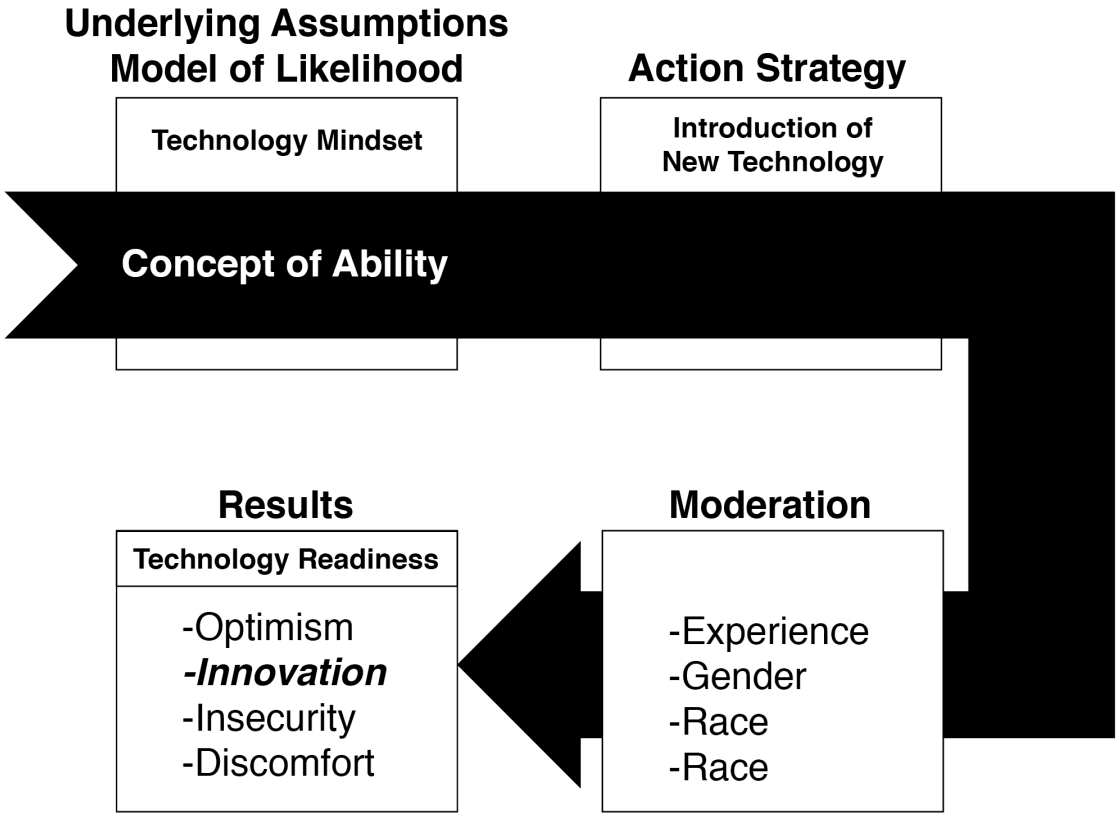

Figure 6. Revised conceptual framework. Derived from Argyris and Schon (1974), Bruner (1957), Dweck (2006), and Parasuraman and Colby (2001).

Specifically focusing on the first three steps of the double-loop learning model (Argyris & Schon, 1974), where concept of ability, acting as an underlying assumption, is presented with an action strategy, in this case the introduction of a new technology. The results are shown to be moderated by contextual variables. The relationship between concept of ability and optimism was moderated by experience with those with less experience (≤22 years) having a smaller negative correlation while those with more experience (>22 years) had a larger negative correlation. The relationship between concept of ability and innovation was moderated by gender with females having a smaller positive correlation while males had a larger positive correlation. The relationship

between concept of ability and both insecurity and discomfort was moderated by race. White/Caucasian participants had medium negative correlations for the two while Black/African American participants were similarly negative but smaller correlations. The Hispanic/Latino participants had a large positive correlation for the two, though because there were only four participants with this background, the trustworthiness of this finding was questionable. Within the results, innovation is bold and italicized because it was the only technology readiness sub score that was significantly correlated with concept of ability.

With the negative correlation between concept of ability and technology optimism being greater for those with more experience, it may be considered that as administrators gain experience, those with a more incremental view of intelligence become less optimistic about new technologies. Dweck (2006) notes that a concept of ability can be compartmentalized to different areas. This moderation may be evidence of this compartmentalization.

Although both males and females correlated positively between concept of ability and technological innovation, the relationship was moderated by the male correlation being larger than that of females. This larger correlation shows that for male participants an incremental concept of ability was more likely to correlate with innovative technology use than with the female participants. This may be due to greater interest on the part of males for technology use or greater reliance on technology for personal growth. These speculations are areas for further study, as they are not answered within the scope of this research study.

The bulk of the moderation effect of race was due to the low participation Hispanic/Latino group that showed a strong positive correlation between concept of ability and technology discomfort and insecurity, as compared with the small to medium negative correlations between the two other groups in both TRI sub scores. With the low participation of this group, the moderation is unlikely to occur in a replication study. Despite this, the modification may be explained by cultural conceptions of learning and technology. Further study is recommended to find if this moderation is found in a study with greater representation of Hispanic/Latino participants.

According to the National Educational Technology Standards for Administrators (NETS-A, 2012) "educational administrators create, promote, and sustain a dynamic, digital-age learning culture that provides a rigorous, relevant, and engaging education for all students" (p. 1). This description falls under the category of *Digital Age Learning Culture.* As this study has given evidence of the positive correlation between concept of ability and innovative technology use, and because of the recommendation of Dweck (2009), the incorporation or addition of Mindset theory into the language of the standards would be appropriate. The addition of 'Promote an incremental concept of ability towards technology growth' under the *Digital Age Learning Culture* is therefore recommended.

Recommendations for Future Research

The following section will present recommendations for future research based on the study.

1. This study was conducted with school leaders of a single role, the school principal. Further studies should be conducted with a greater variety of leadership roles, such as assistant principals, district level administrative support staff, directors, and

superintendents. This would add to the understanding of leadership role dynamics within a school system.

2. This study should be replicated with instructional staff, comparing results with this study to determine if there is a difference between instructional staff and the school leaders of SDPBC.

3. Replication of this study in different locations is advisable. SDPBC is a large urban district, so, it would be beneficial to replicate both among other large urban districts in Florida, in large urban districts in other states, in smaller school districts, and internationally. This would add the variable of the types of districts to the conversation.

4. While this study was well suited to the field of K-12 education, it is not limited there. Both of the instruments are designed for and remain valid for diverse use. Given the technologically rich, complex work environment of the 21st century, many other fields should be considered.

5. This study was conducted at the end of the school year, with the survey being administered at the beginning of the first week after school let out for the students, while administrative staff were still on duty. This time was chosen because the researcher thought that more participation would be garnered during this less active time of year. This may have had an effect on the results; and therefore, this study should be replicated at different times of the school year, even during a busier season to determine if time of year has any effect on the results.

6. Replication of this study should be done with the addition of years as an administrator as a moderating variable. The experience variable for this study measured "how many years have you been an educator?" and in essence marks the year a

participant began as a teacher, since almost all principals started their careers as teachers. With this being a study on leadership it would be appropriate to add an additional variable for the years of administration, or years as a principal.

7. This study should be replicated with some kind of technology outcome data incorporated. Data on the implementation of technology within schools would be an illuminating variable to the study showing how the mindset and technology readiness scores manifest within the schools.

8. Different delivery methods could be used in a replication study, as an email survey for technology readiness may be less appropriate and only measure those who are more technologically ready.

9. Mixed methods with more qualitative measures should be added to this study in order to collaborate results and provide rich narrative to the topic.

10. This study should be replicated, while seeking a greater representation of racial diversity.

11. It would be beneficial to replicate this study with the addition of moderation analysis on Research Questions 1 and 2.

12. Investigation into the reasons for the moderation effects would add to this line of research.

Final Thoughts

The cultivation of a culture that promotes student learning is a central tenet of, and most effective, tool of a school leader. Achieving this goal is multifaceted and increasingly complex in today's technologically rich world. Encouraging a cultural mindset that supports the incremental growth of each individual, both students and

teachers, has been shown to add to the capacity of the learning organization and to the innovative use of technology. By challenging the assumptions that hold our system back, supporting the tensions of change, and modeling best practice for both 21st century pedagogy and perspective, leaders can edify their fellow educators in their learning and growth process.

APPENDICES

Appendix A: Survey Instrument

Thank you for participating in this survey. The survey is composed of 3 sections. The first records demographic factors, the second measures your theory of intelligence, and the third measures your technology readiness. The instrument should only take 5 minutes to complete.

Demographic Data

1. Please create a 5 digit identifier that will be unique to you, but will not be able to be traced back to you. This will be used so that you can view your scores while remaining anonymous. Make sure you remember your 5 digit identifier as there will be no way of linking it to you. Consider using upper and lowercase, punctuation and numbers to create your identifier.

   _____

2. What is your gender?
   a. Male
   b. Female

3. What is your race?
   a. American Indian/Alaskan Native
   b. Asian or Pacific Islander
   c. Black/African American
   d. Hispanic/Latino
   e. White/Caucasian
   f. Other

4. What is your age?

   _____

5. How many years have you been an educator?

   _____

6. What is your highest educational level achieved?
   a. Bachelors
   b. Masters
   c. Double Masters
   d. Specialist
   e. Doctorate

7. At which university did you earn your most impacting leadership coursework? (Please write out full formal name)

   _____

8. Rank the quantity of online coursework that you have taken.
   High□ □ □ □ □Low

9. Rank the quality of online coursework that you have taken. (If you answered "Low" for the previous item please exclude this item)
   High□ □ □ □ □Low

Theories of Intelligence Scale (TIS)

1. You have a certain amount of intelligence and you really can't do much to change it.
   Strongly Agree □ □ □ □ □ □Strongly Disagree

2. Your intelligence is something about you that you can't change very much.
   Strongly Agree □ □ □ □ □ □Strongly Disagree

3. You can learn new things, but you can't really change your basic intelligence.
   Strongly Agree □ □ □ □ □ □Strongly Disagree

Technology Readiness Index (TRI) 2.0

1. New Technologies contribute to a better quality of life.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

2. Technology gives me more freedom of mobility.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

3. Technology gives people more control over their daily lives.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

4. Technology makes me more productive in my personal life.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

5. Other people come to me for advice on new technologies.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

6. In general, I am among the first in my circle of friends to acquire new technology when it appears.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

7. I can usually figure out new high-tech products and services without help from others.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

8. I keep up with the latest technological developments in my areas of interest.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

9. When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

10. Technical support lines are not helpful because they don't explain things in terms I understand.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

11. Sometimes, I think that technology systems are not designed for use by ordinary people.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

12. There is no such thing as a manual for a high-tech product or service that's written in plain language.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

13. People are too dependent on technology to do things for them.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

14. Too much technology distracts people to a point that is harmful.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

15. Technology lowers the quality of relationships by reducing personal interaction.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

16. I do not feel confident doing business with a place that can only be reached online.
   Strongly Agree□ Agree□ Neutral□ Disagree□ Strongly Disagree□

Appendix B: Permissions to Use Theories of Intelligence Scale (TIS) and Technology Readiness Index (TRI) 2.0

From: **Carol S Dweck** <dweck@stanford.edu>
Date: Wed, Apr 2, 2014 at 3:02 PM
Subject: Re: Permission to use and modify PBS
To: David Atwell <davidcatwell@gmail.com>

Dear David,

You have my permission. If you'd like me to look over the modified version, I'd be happy to do so.

Best,
Carol Dweck

Lewis & Virginia Eaton Professor
of Psychology
Department of Psychology
Stanford University
Jordan Hall, Bldg. 420
Stanford, CA 94305

----- Original Message -----
From: "David Atwell" <davidcatwell@gmail.com>
To: dweck@stanford.edu
Sent: Wednesday, April 2, 2014 10:16:07 AM
Subject: Permission to use and modify PBS

Dr. Dweck,
I am a Doctoral student at Florida Atlantic University in the Educational Leadership Program. I am interested in studying the mindset of school leaders towards technology based knowledge and how their mindset affects the content that they offer to students in their schools. I am emailing to gain access and permission to use and modify your Personal Beliefs Survey (PBS) for my study.

Thank you for your time and consideration,

David Atwell

From: **Charles Colby** <CColby@rockresearch.com>
Date: Tue, Nov 25, 2014 at 10:59 AM
Subject: RE: Permission Request to use Technology Readiness Index (TRI)
To: David Atwell <davidcatwell@gmail.com>

Thanks David. You now have a license to use the TRI 2.0 for academic purposes. Attached is a list of scale items and instructions for use. Good look with your research!

Charles L. Colby
Principal, Chief Methodologist and Founder
Rockbridge Associates, Inc.
10130-G Colvin Run Road
Great Falls, VA 22066
703-757-5213, x12
Fax: 703-757-5208
www.rockresearch.com

From: David Atwell [mailto:davidcatwell@gmail.com]
Sent: Tuesday, November 25, 2014 10:58 AM
To: Charles Colby
Subject: Re: Permission Request to use Technology Readiness Index (TRI)

Thank you,

Here are the signed forms.

On Tue, Nov 18, 2014 at 6:09 PM, Charles Colby <CColby@rockresearch.com> wrote:

David, that sounds like a very interesting topic. You can license the TRI 2.0, free of charge, for non-profit academic research. Kindly complete, sign and return the attached forms, and I will follow up with more details on deploying the scale.

Regards,

Charles L. Colby
Principal, Chief Methodologist and Founder
Rockbridge Associates, Inc.
10130-G Colvin Run Road
Great Falls, VA 22066
703-757-5213, x12
Fax: 703-757-5208
www.rockresearch.com

Appendix C: SPSS Syntax: Independent T From Means.SPS

From Field (2000)

```
COMPUTE df = n1+n2-2.
COMPUTE Diff = x1-x2.
COMPUTE poolvar = (((n1-1)*(sd1 ** 2))+((n2-1)*(sd2 ** 2)))/df.
COMPUTE poolsd = sqrt((((n1-1)*(sd1 ** 2))+((n2-1)*(sd2 ** 2)))/(n1+n2)).
Compute SE = sqrt(poolvar*((1/n1)+(1/n2))).
COMPUTE CI_Upper = Diff+(idf.t(0.975, df)*SE).
Compute CI_Lower = Diff-(idf.t(0.975, df)*SE).
COMPUTE d = Diff/poolsd.
COMPUTE t_test = Diff/SE.
COMPUTE t_sig = 2*(1-(CDF.T(abs(t_test),df))).
Variable labels Diff 'Difference between Means (X1-X2)'.
Variable labels SE 'Standard Error of Difference between means'.
Variable labels poolsd 'Pooled SD'.
Variable labels d 'Effect Size (d)'.
Variable labels t_test 't statistic'.
Variable labels t_sig 'Significance (2-tailed)'.
Variable labels CI_Upper '95% Confidence Interval (Upper)'.
Variable labels CI_Lower '95% Confidence Interval (Lower)'.
Formats t_sig(F8.5).
EXECUTE .

SUMMARIZE
  /TABLES=  x1 x2 Diff CI_Lower  CI_Upper df t_test t_sig d
  /FORMAT=VALIDLIST NOCASENUM TOTAL LIMIT=100
  /TITLE='T-test'
  /MISSING=VARIABLE
  /CELLS=NONE.
```

Appendix D: Testing the Contribution of Sets of Predictors Using SPSS: Syntax

From Morris (2015)

```
REGRESSION
 /DESCRIPTIVES MEAN STDDEV CORR SIG N
 /MISSING LISTWISE
 /STATISTICS COEFF OUTS R ANOVA COLLIN TOL
 /CRITERIA=PIN(.05) POUT(.10)
 /NOORIGIN
 /DEPENDENT gpa
 /METHOD=TEST (greq  grev) (mat) (ar).
```

Gpa, greq, grev, mat, and ar were replaced with appropriate variables for this study.

Appendix E: Recruitment/Consent

DIGITAL EDIFICATION: AN ANALYSIS OF TECHNOLOGY READINESS AND CONCEPT OF ABILITY IN THE SDPBC K-12 SCHOOL LEADERS
David Atwell MEd, Victor C. X. Wang EdD

Thank you for your interest in participating in our research study. The purpose of the study is to investigate the relationship between learner mindset and technology readiness in SDPBC K-12 school leaders.

Please click the link below to begin. It should take only 5 minutes to complete this survey. Your participation is your choice. You may skip any questions that make you feel uncomfortable and you are free to withdraw from the study at any time without penalty. The risks involved with participating in this study are minimal as data are anonymous and will not directly or indirectly identify the research participant.

You will be given the option to create a unique 5 digit identifier that will allow you to retrieve the results of your survey. At the end of the survey period results will be published along with an executive summary to the Internet on a spreadsheet indicating the unique 5 digit identifiers and scores. This will allow participants to find their data without knowing which scores are attributable to other participants.

Potential benefits that you may receive from participation include adding to the research on technology leadership in SDPBC, a personal knowledge of your concept of ability and technology readiness and access to an executive summary of the results.

If you experience problems or have questions regarding your rights as a research subject, contact the Florida Atlantic University Division of Research at (561) 297-0777. For other questions about the study, you should email the principal investigator: Victor Wang and David Atwell at davidcatwell@gmail.com.

Consent

I have read the information describing this study. All my questions have been answered to my satisfaction. I am 18 years of age or older and freely consent to participate. I understand that I am free to withdraw from this study at any time without penalty. I have printed a copy of this consent form for my records. By clicking the "I consent" button below, I am giving my consent to participate in this research study and will be linked to the survey.

I CONSENT to participate in this research study. (Link embedded in the word "consent")

Thank you for your participation,

David Atwell

Appendix F: SDPBC Research Request Approval

THE SCHOOL DISTRICT OF PALM BEACH COUNTY, FLORIDA

SANDRA RAYMOND ROBERTS, Ed.D
DIRECTOR

MARK HOWARD
CHIEF, PERFORMANCE ACCOUNTABILITY

DEPARTMENT RESEARCH AND EVALUATION
3300 FOREST HILL BLVD., SUITE #B-246
WEST PALM BEACH, FL 33406-5813

Ph: 561-434-8469 Fax: 561-357-7608
www.palmbeachschools.org/dre/

June 1, 2015

Mr. David Atwell
6232 Foster Street
Jupiter, FL 33458

Dear Mr. Atwell:

The Superintendent's Research Review Committee has approved your request to conduct research entitled, "Digital Edification: An Analysis of Technology Readiness and Concept of Ability in PBCSD K-12 School Leaders", in the School District of Palm Beach County (the District). According to documentation submitted, the purpose of this study is to determine the relationship between the concept of ability and technology readiness of K-12 school leaders in School District of Palm Beach County and how they compare with the norm. This research is approved and limited to the study, scope, and methods outlined in the proposal. The study will focus on data collected from surveys given to school leadership.

According to the District's Policy 2.142 and procedures, school participation is voluntary and subject to the authority of school administration.

As this study is conducted, please be governed by the following guidelines:

- Researchers must use independent research subjects in their studies. Researchers must not have a position of authority over proposed research subjects or have conflict of interest with proposed research subjects.
- Researcher must not use any survey/assessment instrument that will: use personal information, reveal student or parent political affiliation or religious practices, psychological problems, illegal, anti-social, self-incriminating or demeaning behavior, critical appraisals of others, privileged relationships (lawyers, doctors, minister) or income.
- Obtain written Informed consent from teacher participants.
- Contact only those schools that have agreed to participate. District policy provides that no one has the right to access students, staff or data, and prohibits researchers from requesting data directly from schools or departments.
- When contacting school administrators, either by email or in person, please provide a copy of your approval letter.
- Summarize findings for reports prepared from this study and do not associate responses with a specific school or individual. Information that identifies our District, schools, or individual responses will not be provided to anyone except as required by law.

- This research study must be concluded by May 31, 2016, when the IRB expires.
- If the study requires the use of additional resources or change in participants in the future, a written request must be submitted to this office. Please wait for an approval before proceeding.

Please submit one copy of the study results to the Department of Research and Evaluation no later than one month after completion of the research.

Thank you for your interest in our District.

Sincerely,

Sandra Raymond Roberts
Director

SRR/RP:wgl

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