The Role of the School Network

Concept Paper

Submitted to Northcentral University

Graduate Faculty of the School of Education
in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF EDUCATION

by

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April 2015

Table of Contents

Introduction

With the recent Partnership for the Readiness of College and Careers (PARCC) online assessments, the capabilities of the school network have come to the forefront in many school districts across the nation (Cavanaugh, 2014). Introducing the ConnectED initiative (ConnectED), President Obama stated, "The average school has the same Internet bandwidth as the average American home, but it serves 200 times as many people. Only around 30 percent of our students have true high-speed Internet in the classroom" (The White House, Office of the Press Secretary, 2014). The ConnectED Initiative sets four clear goals (upgraded connectivity, leveling the playing field for rural students, trained teachers, and new resources for teachers) to transition to digital learning across the country in five years as originally outlined in the National Education Technology Plan (NETP) (United States, Department of Education, Office of Educational Technology, 2010). NETP represented a model of learning powered by technology, which asserted that a crucial element for learning is an adequate broadband network infrastructure, including wireless coverage. According to NETP, adequate means enough bandwidth to support simultaneous use by all teachers and students to engage routinely on the Internet, multimedia, and collaboration software (United States, Department of Education, Office of Educational Technology, 2010). In addition, ConnectED calls upon the private sector to provide assistance to connect all schools to the digital age.

A federal initiative, high stakes online standardized assessments, and private sector involvement are shaping the environment where the school network is more important than ever before. Moreover school districts forge ahead into the digital world by introducing bring your own device (BYOD), ubiquitous computing, twenty-first century classroom equipment such as interactive white boards and document cameras, and digital curriculum initiatives. Educational

computing supported by high-speed networks is the gateway to a world of online learning and interactive content, a personalized education that readily adapts to student needs, and breakthrough advances in assessing understanding and mastery of concepts and curriculum.

Statement of the Problem

Superintendents with a comprehensive understanding of school networking are able to provide a strong foundation and reliable access to a twenty-first century education. The lack of an adequate network and connectivity potentially has a negative impact on staff and students, because they do not have access to twenty-first century educational technology (Hoffman, 2014; Hess, 2012; Sauers, Richardson, & Mcleod (2014). Mthethwa (2014) found that if the technology is unreliable it is less likely to be used. Superintendents can guide in planning and implementation of a school network by prioritizing it among other district projects (Hurley, 2014). Using the Internet for instructional delivery allows teachers to provide digital learning experiences but just being connected is not enough (Duffey & Fox, 2012).

Superintendents may be effected by the lack of scholarly research, which can cause misallocation of resources (Levin & Schrum, 2012). While using the Internet can provide support to traditional classroom teaching, some school districts struggle with accessing this instructional mode due to limited bandwidth and inadequate broadband connections (Redding and Walberg, 2012). According to a study by the Consortium for School Networking (CoSN) (2013), networks are not currently able to support broadband because of limitations with internal connections/wiring, backbone of the school local area network (LAN), and wireless capability. In many school districts, teachers struggle with inadequate networks, technology, and bandwidth (Mardis, Elbasri, Norton, & Newsum (2015); Sundeen & Sundeen (2015). There is no forum for feedback to educational leaders in terms of the technology needed in the classroom by teachers

(Coll, Rochera, & De Gispert, 2015; Wolfson, Cavanagh, & Kraiger, 2015; Keppler, Weiler, & Maas 2015). Because of the lack of relevant data and research, scholars recommend further research into school networks, connectivity, and twenty-first century technology integration (Jameson, 2013; Kong, 2014; Sauers, Richardson, & Mcleod, 2014).

Purpose of the Study

The purpose of this qualitative case study in a mid-size suburban Massachusetts school district is to gain an understanding and insight from teachers on how to best communicate with the superintendent about the technological capabilities of a school network that effects their ability to provide instruction. Data will be obtained through in-depth interviews with the superintendent of said school district, observing the teachers in school, and by forming a focus groups of teachers. A possible cause of this problem is a combination of lack of communication with the superintendent about current technology needs and requirements.

Research Questions

The following research questions focus on the research purpose and a district leader's plan for network implementation, upgrade, or improvement.

Q1. How do teachers perceive the use of twenty-first century devices?

Q2. How do teachers perceive network speed as related to instruction?

Q3. How do teachers perceive whether the superintendent is adequately equipped to make decisions regarding networking equipment and the use of school resources for access?

Definition of Key Terms

Bandwidth. The amount of data that passes through a network as measured in bits per second (bps).

Kbps. Kilobits per second. A kilobit is a data transfer rate of 1,000 bits per second. A

fax machine takes about 12 seconds to send a page at 30 Kbps.

Mbps. Megabits per second. A megabit is a data transfer rate of 1,000,000 bits per second. The State Educational Technology Directors Association (SETDA) (2012) recommends schools have a minimum of 1 Mbps per student. 1 Mbps of connectivity would enable a single student to stream a 10-minute high-definition video.

Gbps. gigabits per second. A gigabit is a data transfer rate of 1,000,000,000 bits per second. At this speed, 1,000 students could stream a 10-minute high-definition video in real time.

Internet Connection. The network connection to an Internet Service Provider (ISP) that provides connectivity to the broader Internet.

Local Area Network (LAN). The network connections within a school or district building, including both wired connections and the equipment used to provide Wi-Fi service.

Wide Area Network (WAN). The network connections between district locations, including the school campuses, district offices, and any support buildings.

Brief Review of the Literature

In the second decade of the twenty-first Century, superintendents may need to rethink their definition of leadership to include a technological school environment. The superintendent's role has evolved from master teacher, manager, and politician (Cuban, 1985) to chief executive officer and visionary (Devono & Price, 2012). The Consortium for School Network (CoSN) (2012) initially recognized the importance of school and district technology leadership nearly a decade ago, when a nationwide survey of technology decision makers revealed that visionary technology leadership, and the community support fostered by superintendents, is critical to the success of technology plans, budgets, and implementation.

More recent research echoes and elaborates on these findings. Visionary leaders understand and communicate present challenges and frustrations while offering a novel and compelling vision of the future. They inspire and motivate people to take collective action to reach that vision. Visionary leaders attract more followers, especially in times of change or crisis (Halevy, Berson & Galinsky, 2011). In schools, the followers may be principals, curriculum administrators, and teachers who can help superintendents achieve district technology goals.

A report by Project RED: Revolutionizing Education through Technology (Greaves et al., 2012) emphasizes the vital role of district and school leadership in making educational technology efforts effective. The Project RED report found that high-quality leadership from a superintendent or district leader was essential to technology integration. School districts whose leaders had properly implemented technology initiatives saw significant improvements in items from test scores to dropout rates over schools without proper leaderhips and those without properly implemented technology programs (Davis, 2013).

The field of educational technology has always had a predominant focus on teaching, training, and educational issues relating to the use of technology integration (Jameson, 2013). The study conducted by Jameson (2013) found that many journal articles in the British Journal of Educational Technology, published during 2000-2005, centered on innovation, yet very few of the articles examined school policies, plans, and procedures for district-wide adoption of technology and technology integration. The study hypothesized that this may be due to the limited direct influence and control that most teachers have outside the classroom.

The study of Rollins and Bailey (2014) studied the ways to assess public school districts in relation to technology and education. The study examined the goals and objectives of integrating technology and education that have been outlined by the participating school districts.

Based on the responses of 250 educators and/or administrators, the research of Rollins and Bailey (2014) made the following observations:

> Administrators should review the technology needs of faculty and students and utilize recommendations received by each of these groups. It may be necessary to develop a technology-guided strategic committee to address critical needs in specific areas such as technology resource shortcomings, prioritization of IT investments and improvements. This committee should be comprised of parents, educators, local community business leaders and administrators. It may also be necessary to include IT experts serving as representatives to advise on current IT capabilities and emerging technologies. 2.) Align curriculum and IT strategic plans so that short-term curriculum goals are attainable within IT initiatives. This would provide IT flexibility in terms of supporting current initiatives and long-term goals. (p. 2.)

In addition to implementing technology, schools must make decisions about how to integrate technology. Most educators agree that the focus must be on learning and allowing technology to enhance the learning process. The following are some suggestions to assist in this process:

> Eliminate technology committees that discuss hardware and software. The focus needs to be about integrating technology into the curriculum. Assign a student representative who would attend staff training sessions. Students can offer fresh insight and help identify the strengths and weaknesses of a particular program or concept. Do not expect teachers to be experts. Instead, ask them to become researchers with the students and to guide

students by asking questions. (p. 36)

Rollins and Bailey (2014) recommend forming a committee, which allows public school administrators the ability to provide their valuable expertise and insight in the curriculum and technology planning. School administrators will provide a clear and definitive explanation of the public school curriculum and strategic plan. Technology must be up-to-date in terms of hardware and software to accommodate the myriad of potential curriculum changes that may be required during an average school year. Obsolete networks and computing devices will not sufficiently provide the needed flexibility of new curriculum applications.

The importance of integrating technology is now recognized as an important step in improving the education of students. However, evidence shows that this integration has yet to be fully implemented in most school districts because of the limited role of teachers outside the classroom regarding technology policy. In the United States, it is the superintendent who serves as the essential conduit between larger educational reform efforts and the individual schools in charge of implementing them (Ellison, 2015). Therefore, the focus falls on the superintendents that are responsible for policy making and the efforts they make to initiate these changes. However, some superintendents have only limited understanding about recent advances in technology and their applications to education.

The study of Holt and Burkman (2013) discussed the challenges facing school administrators in a rapidly changing digital world. The purpose of this study was to investigate the behaviors and beliefs of school leaders managing school reform through technology. Using case study analysis of different school districts, the study determined that as technology capabilities continue to propagate across the world, schools still struggle to either incorporate or even keep up with these existing tools and devices. Holt and Burkman illustrate that schools

may be experiencing widespread technology integration problems. Integration issues include the lack of adequate professional development, lack of long range planning, lack of technology knowledge by school administrators, and intrinsic and extrinsic barriers to integration from teachers. District leadership plays a vital role in integrating technology effectively into the classroom and is considered a complex school-wide change (Schrum, Galizio, & Ledesma, 2011).

A major issue that can help explain these difficulties is that school administrators and superintendents have little or no formal training on how to integrate technology into the classroom. Schrum, Galizio, and Ledesma (2011) found that states do not require administrators to be licensed or certified in how to implement technology into the classroom. Holt and Burkman (2013) found that successful leaders learned on their own, had a dedication to technology integration, and promoted their faculty to implement technology integration. District leadership needs to be open to allowing change to occur authentically from the classroom and rely less on "experts" to devise plans for technology integration.

Similarly, the study of Sauers, Richardson, & Mcleod (2014) investigated the qualities of schools that have successfully implemented policies related to the use of technology in schools. The case studies conducted in the different schools determined that all of the schools in the study had a superintendent that has a firm grasp and knowledge about educational technology and the willingness to construct policies that make use of these policies in school. The superintendents in this study described their experiences overcoming common issues that many school leaders face when attempting to integrate technology into their districts. In all instances, the superintendents involved in the study all learned on the job about how to integrate technology.

Another study conducted by Webb (2011) found that technology integration has long

been an issue in schools. Participants were first-year, traditionally certified, full-time, regular education classroom teachers. This research study focused on the new classroom teachers' technology proficiency levels, attitudes toward technology, and integration of technology into the curriculum. The study determined that school instructional leaders indirectly influence students' learning environment. Teachers have a direct impact on student learning through the development of best practices, curriculum-based instruction, and the integration of technology into the classroom. Webb (2011) believed that administrative support, including that from the superintendent, played a key role in integrating technology into the classroom. Results of the study determined that there were three levels of leadership that affected technology integration; (a) superintendents, (b) campus leaders/principals, and (c) technology leadership. The study found that "a clearly defined and articulated technology message, coming from school and district administrators understood by their administrative team, and used to build broad community and school board support, is necessary to secure funding, goodwill, and buy-in" (p. 2). Webb (2011) also noted that direct involvement from the district administrators was essential and that teachers needed more knowledge and skills to successfully implement technology integration.

The study of Nworie (2014) had similar results, stating that continuous student learning improvements are made possible only when the entire system works together toward common goals, including school administrators and superintendents. The study determined that what is specifically needed is to make policy changes to ensure that the identified problems and issues that can be remedied using modern technology are heard by the school board. The primary challenge is to communicate the needs of the school and to justify the specific technology needed to address these problems (Nworie, 2014). Additionally, the study reveals the required points of

discussion needed when discussing policy changes. This includes vision, infrastructure, communication and professional development. The study has identified these main talking points when discussing school policy changes and should be considered when discussing policy changes involving technology.

Another similar study made by Levin and Schrum (2013) provides similar findings regarding the important factors to consider when integrating technology for school improvement. Through cross-sectional case studies consisting of analyzing data from interviews, direct observation of classrooms, and document analysis, the study identified eight integral factors that should be considered. These are vision, distributed leadership, technology planning and support, school culture, professional development, curriculum and instructional practices, funding, and partnerships. These factors necessitates as systems approach when discussing the use of technology in schools. It is not enough that the problems and possible technological solutions are identified as there are still other factors to consider to ensure the success of these policy changes. (Levin and Schrum, 2013).

To summarize, each of these studies agree that district leaders and administrators function as the instructional leaders within a district. Each of them need to have a comprehensive understanding of technology integration and must be willing to use their knowledge and resources to promote technology integration by providing new teachers with resources, funding for staff development, and time to integrate technology. Almost all of these studies have reached similar conclusions using case studies of different school districts, indicating that these issues are prevalent on more than one area.

All of these studies have identified a number of important components affecting the integration of technology in education. These factors are vision, technological planning,

infrastructure, professional growth and development as well as institutional growth. For instance, any proposed changes made in schools should have to pass the district superintendent. In the United States, the most reliable way of affecting change is through the district superintendent and problems arose when those holding this post are not aware or knowledgeable enough to grasp the significance of certain technologies such as the Internet and the needed infrastructure to maintain them. Because of this, in order to cause any policy changes involving technology, it is integral that teachers find a way to communicate the needs of the school and student in terms that they can better understand and relate to.

These studies also demonstrate that while some district superintendents are not familiar with the technological specifications, almost all of them are highly qualified and experienced when it comes resource management, planning and organization so these aspects should be utilized to help explain technology integration. The example used in the study of Levin and Schrum (2013) about student's laptops is a good way to illustrate this scenario. In the study, one superintendent noted that although students' acquiring their own laptops for 24X7 access was preferable, having students bring their own devices requires different kinds of tech support and infrastructure to support multiple devices and a "campus style" network resulting into further costs and resources. In this scenario, while the initial policy solved a student need, other mitigating factors arose that needs to be addressed. Therefore, capable technology leadership and technical support at all levels was still needed and key to school improvement, even in schools and districts that were still purchasing technology for students.

The previously discussed studies were successful in identifying common traits of schools that have successfully integrated technology in their schools, as well as the factors that needs to be considered in planning and organizing technological integration. While all of these factors are

important, some of these factors have received more focus and interest because of their far reaching effects on the school, teachers and students.

One of these factors is technological planning. Technological planning in education is described as the process in which a school plans to execute the vision of a school or course using technology. Fundamentally, it is a guide on what type of technology to acquire or purchase depending on what the school wants to accomplish. For instance, in the district level, the primary motivation is for students to achieve high test scores to help the school attain state and national achievement and academic goals (Webb, 2011; Nworie, 2014) so technological planning should be made based on accomplishing that goal.

A study conducted by Bruce Campbell (2012) is a good example of how technological planning is applied. The research was a case study surrounding James Rydland, superintendent of schools, and Don Ringelestein, director of technology, from Illinois School District 129. These two individuals were the key leaders heading up the *Illinois Pathways to Prosperity* initiative. *The Pathways to Prosperity* initiative recognized that college is not necessarily the "preferred" option for all high school graduates. The goal is to prepare students for industry occupations that typically require a minimum of a high school diploma and specific skill training that may not require a college degree. Before the initiative, all computer technology was replaced in the school district, which included installing a wireless network in all 17 buildings of SD 129 (Ringelestein, 2012). Campbell determined that upgrading the network was only part of the strategy. The second part was to facilitate ongoing professional development and training to make it possible for teachers to use the newer technologies, such as wireless, interactive white board, and projectors. In this example, technological planning did not end with the acquisition of the needed technology, but served as a precursor to professional training and leadership of the

faculty that will use this technology to teach their students.

In own account on how he handled the *Illinois Pathways to Prosperity* initiative, Rydland (2012) stated that he focused on the kind of leadership, which is applied to complex problems, related to the need to prepare students for skills-based jobs in a rapidly changing economy, stressing the idea that "concepts such as value driven results, college degrees of value, simple solutions to complex problems, and, consensus building environments (Rydland, 2012). The concepts he highlighted are similar to the factors identified by the previous studies and is a common theme among the case studies made in this subject.

Professional growth and development is also another factor that has received increased study because this is the aspect that is often ignored when policies concerning technology integration are concerned and is often considered as not a priority for school administration. The study of Sorensen, Shepherd, and Range (2013) determined through case studies and document analysis that technology use in K–12 classrooms has increased over the years, yet many teachers indicate continued lack of comfort, knowledge, and professional development or training to effectively integrate technology into the curriculum. In order to alleviate this burden, many school districts hire district and building technology staff to model best practices and provide professional development. The study determined that while the hiring of outside staff for professional staff is beneficial, there is tension created between the staff and teachers as the latter feel apprehension when learning new technology for their classes. (Meltzer, 2012). As a result, the study determined that the means to promote professional growth should be included in the planning process and should include the teachers of the school.

In another case study, the study of Berrett, Murphy, and Sullivan (2012) found that educators use numerous technology tools to support student learning. Often, technology is a top-

down initiative with school administrators responsible for overseeing the implementation. Innovative technological approaches to learning often meet resistance in some schools. Educator resistance is counteractive to technology integration, which may be useful to curriculum, instruction, and assessment and may benefit students to learn the ever-growing level of technology present in our culture (Ertmer & Ottenbreit-Leftwich, 2010; Lloyd, 2012; Wastiau et al., 2011). The study provides another example of what happens when the planning of technological integration ends with the acquisition and implementation of acquired technology.

Based on the reviewed literature so far, the use of case studies to determine how different school districts implement policies concerning technological integration has revealed similar problems, issues faced by school administrators and the common factors needed to successfully implement these policies. While case studies have always been used to highlight similarities and differences, some cases have unique and innate qualities that can help local schools to implement technology integration policies.

Over the last two decades, education policy discussions in Alberta, Canada, have been divided by the use of technology in schools (Brooks, 2011). While technology policy implementation has significant ramifications for schools, the College of Alberta School Superintendents (CASS) did not engage in the discussions. The study of Brooks (2011) identified a plausible rationale for the historic lack of engagement in technology and education policy by CASS. Brooks (2011) found that Alberta has collective resources necessary to address three core areas of technology in education: network infrastructure, curriculum and resources, and professional development. Several large-scale infrastructure projects have provided schools with access to broadband, resources, and applications. Brooks (2011) found that although Alberta superintendents are silent about technology policies, they have led a variety of

technology-led initiatives resulting in a robust technical landscape but only infrequent changes in teacher practice affecting student achievement. The Alberta superintendents are under scrutiny as school stakeholders are questioning how schools measure and account for student learning. "Today's youth will inherit a global, socially connected, and media rich world. The competencies they require to live well differ from those even ten years ago" (Jacobsen & Friesen, 2010). This evolving reality is becoming a backdrop for school superintendents to engage in technology policy discourse relative to student learning in a technology-facilitated age.

The study of Seyal (2012) determined that the administrators' role in technology use in Bruneian schools. Sayal (2012) found that several structural reforms are not only overhauling the school curriculum and teaching methodology but also integrating technology to support the learning process. Schools in Brunei are confronted with serious pressure to use technology to enhance students' learning. Therefore, school administrators have been assigned with an additional responsibility of not only working with the technology but to introduce the technology to enhance teaching and learning (Augustine-Shaw, 2015). The researcher found that school administrators possess adequate computer skills and the majority of them routinely use word processing for managerial and administrative work. However, the use of email to communicate with staff and colleagues is not widely used. Similarly, administrators indicated a need for professional development to use technology for more accurate online research, developing finance and budget documents, creating databases, and making presentations. In addition, administrators highlighted a need for training to evaluate network infrastructure needs, hardware, and software. Seyal (2012) concluded that administrators' vision and ability to acquire technology expertise to collaborate with the teachers will further improve teaching and learning, and attain the potential of using technology in Bruneian schools.

Both of these studies centered on case studies of institutions outside the United States but both studies still show similar problems experienced by local schools. These two case studies made in two foreign countries proposed the same set of solutions to solve these problems similar to the previous studies discussed before, meaning that the problems experienced with technological integration may be rooted on the school system itself that has become a standard over the world.

Another point of consideration is what type of technology to integrate in an educational institution. While Internet access is already considered a basic necessity, school officials must then decide on the type of technology that the teachers and students will use. One of these options is the tablet that provides mobile access to the Internet. The study of Dogan and Almus (2104) researched school administrators' use of iPads in terms of training, impact on their productivity, and potential use of iPads for teachers. The training topics of the pre- and post-survey are iPad skills and use of workflow, note taking, calendar, productivity, file sharing, remote desktop (anytime, anywhere access to documents), presentation skills, and screen sharing applications. In addition, administrators participating in the study were surveyed about using their iPads for their daily school-related tasks, their beliefs about the effectiveness of iPads for administrative tasks, and if and how teachers should be using iPads in the classroom. According to the results of the post-survey, Dogan and Almus (2104) found the following:

> Nearly 80% of school administrators considered their iPad skills and knowledge at the level of intermediate to advanced. IPad use effects administrators' school related works and other school duties. Principals have positive thoughts on teachers' IPad use in the classroom. IPad trainings improve administrators' IPad skills and usage. School administrators should have more knowledge about IPad applications. Effective iPad use

> improves principals' and other administrators' school tasks quality and teachers' teaching strategies in the classroom. Principals and assistant principals should be open and interested in learning more about IPad applications for their school tasks. (pp., 245-247)

The need for technology leadership in K–12 schools is supported by several studies (Carnahan & Mensch, 2014; Davies, 2010; Fletcher, 2009). School administrators play a vital role in the implementation of new technologies, and they are widely regarded as the instructional leaders of their schools (Salleh & Kumar, 2014; Dalton, 2015). Once again, the key relationship between the technological integration and the role of the school administrator has been identified like in the previous studies. Since school administrators are the key facilitators in implementing new technologies in their schools, training for this group should be a priority (Topper & Lancaster, 2013). The challenge, as schools increasingly adopt iPads (Crichton et al., 2011; Dogan, 2012; Murphy, 2011), is in implementing and creating instructional goals for their use.

The study of Dogan and Almus also demonstrate the effectiveness of using a mixed method research design, combining a case study with quantitative data gathering methods like surveys. Some advantages of using a mixed method research design is that it allows easy interpretation of results, allows the generalization of qualitative data, and facilitate triangulation of data obtained from different sources (Yin, 2009).

Another technology that is commonly integrated in schools is cloud computing. Cloud computing provides the conditions for a new teaching and learning model. Given that cloud computing allows all categories of education end-users (students, teachers and administrators) to anytime, anywhere access documents, e-mail, database, and other applications (Nicholson, 2009). Koutsopoulos and Kotsanis (2014) suggested that cloud computing provides a need for an integrated approach in the following ways;

> Simultaneously pedagogic (new role of teachers), technical/technological (use of the internet), administrative (new role of school administrators), social (a different disposition of parents towards school), political (a different approach of government to school) and cultural (new role of students), being in dialectic harmony and respecting all aspects of teaching and learning, an integral part of which are pupils, teachers and school administrators. (p. 49)

The construction of school network is another form of technology that is also needed to integrate in schools and is often the most complicated to implement. Various studies have stated that network design, implementation, and maintenance require specialized skills that many school districts cannot afford or are unaware that they need. This causes school networks to operate below their potential and makes it difficult to align a school's broadband access to its learning objectives (Hurley, 2014). District or school administrators cannot ignore or neglect the importance of exploring (a) scalability (i.e., increasing network bandwidth); (b) security (i.e., firewall and content filtering) in protecting users; (c) budget in managing future enhancements or initiatives; (d) accountability in supporting successful student outcomes; and, (e) effective use of new technologies to provide more meaningful learning experiences and to increase proficiency among the school community (Dickerson, 2014).

In November 2014, President Obama addressed school bandwidth issues in the first Superintendent Summit on digital learning and future readiness. At the summit, President Obama stated, "Right now, fewer than 40 percent of public schools have high-speed Internet in their classrooms; less than half. It means that in most American schools, teachers cannot use the cutting-edge software and programs that are available today. They literally don't have the bandwidth." (The White House, Office of the Press Secretary, 2014). School technology

directors were not invited to the White House, but superintendents were. Superintendents have the authority to enact change through a given school district. According to Hurley (2014), superintendents can guide or assist in the planning and implementation of a school network by prioritizing it among other district projects and ensuring that it aligns with district educational and technology goals.

Another factor relevant to the discussion of network bandwith is that teachers are also expected to use this technology in school together with students. Teachers exploring new technologies may find that the school network is unable to support them due to inadequate wireless access, firewall restrictions, lack of bandwidth, or other issues (Fox et al., 2012; Hechter & Vermette, 2013). Therefore, this study will focus on how to rectify the problem of wireless access, lack of bandwidth, and resctrictions of firewall. In a recent study of 559 Ohio teachers, participants reported that restrictions on the school firewall filtered or blocked some Web 2.0 tools for the purpose of protecting students from unwanted or inappropriate materials. However, this action not only prevented students from accessing the Web 2.0 tools but also prevented and discouraged teachers from adopting these tools in their classrooms. Participants reported that acceptable use policies should be reviewed before integrating the Web 2.0 tools into instructional practice (Pan & Franklin, 2011).

In an urban Canadian district piloting iPods and iPads, staff was not prepared for the difficulties in synchronizing, powering, maintaining, and managing the devices (Crichton, Pegler, and White, 2012). In a study of K-12 teachers and students surveyed about the possible replacement of traditional textbooks with electronic textbooks, one of the essential findings was that the infrastructure needed to be considered before implementation. Participants in this study were very positive about the conversion from traditional textbooks to electronic textbooks and

they provided four suggestions for potential solutions to overcome the challenges of infrastructure issues: (a) multi-touch, (b) e-Paper, (c) Web 2.0, and (d) cloud computing (Lee, Messom, and Yau, 2013). When provided with a well-maintained network, teachers can explore technologies and successfully learn, thus building their knowledge base to become twenty-first century teachers. According to a report by the U.S. Office of Education Technology, Secretary Duncan states that because of the lack of reliable technology "we deny our teachers and students the tools they need to be successful. That is educationally unsound and morally unacceptable" (Waite, 2013).

Network infrastructure and bandwidth issues in schools exist worldwide. In a recent study by the European Commission Directorate General Communications Networks, Content and Technology (2011), research showed that fourth and eighth grade students in Bulgaria, Croatia, Greece, Hungary, Italy, Slovakia, Slovenia, Poland, Romania, and Turkey had bandwidth speeds of less than 10 mbps. In many schools in Jordan, students access the Internet through phone lines (Al-Ruz & Qablan, 2011). Teachers in China report low to moderate Internet speeds (Spires, Morris, & Zhang, 2012). In some areas of Manitoba Canada, schools are installing wireless broadband and fiber optic networks increasing bandwidth and allowing teachers to be on the cutting edge with access to technology. However, in other areas of Manitoba, the Internet access is available through dial-up phone connections, leaving teachers' ability to integrate certain technologies limited by geography, as well as infrastructure (Hechter and Vermette 2013). Fifty percent of teachers in six South African schools provided data on their perceptions of the challenges related to implementing technology reported that they needed faster Internet speeds and more equipment (du Plessis & Webb, 2012).

Even in today's world, there are examples of inadequate Internet in the United States. As

with the issues discussed earlier with policymaking, the problems encountered by schools regarding technology is mostly the same throughout the world. The discussed case studies so far have identified that there are still limits to education technology that are beyond the control of school administrators.

Several studies explain that many although some schools have greater Internet access than a few years ago, in many isolated or low-population areas, access to high-speed Internet remains limited due to the physical lack of high speed cabling and access (Howley, Wood, & Hough, 2011; Hechter & Vermette, 2013; Page & Hill, 2008). In one Alaskan case study, teachers' perception of whether students would benefit from using technology as a part of daily instruction was directly connected to the availability of broadband access. Teachers living in communities with terrestrial broadband availability (fast speed) had the highest percentage, with 71 percent of the teachers believing their students would benefit, compared to 45 percent of the teachers living in communities with satellite broadband availability (moderate speed), and 24 percent of the teachers living in communities with no broadband access (Lloyd, 2012).

A 2012 report prepared for the Ohio Digital Learning Taskforce asserted that access to the Internet can no longer been seen as a luxury especially in the field of education (Ohio's K-12 Network Upgrade Analysis, 2012). The primary goal of the research was to ensure that Ohio's schools have fast bandwidth to enable student achievement in the twenty-first century learning environment. The report stated that 20 percent (approximately 700 buildings) are in need of a connectivity upgrade (Ohio's K-12 Network Upgrade Analysis, 2012). While 20 percent is a relatively low figure, it represents approximately 300,000 Ohio students who either do not have or soon will not have adequate broadband access.

With very little academic research in school networking, bandwidth, and infrastructure,

researchers are forced to look to the private sector or government for information. Corporate sources such as the Cisco Corporation and Extreme Networks provide research through white papers and case studies on best practices for optimizing school network infrastructure for education. Organizations such as the Lead Commission, as well as state and federal authorities, provide survey data for educators on technology in schools. For example, research by the Lead Commission (2013) reported 97 percent of public schools have basic access to the Internet however; experts project a 100Mb+ bandwidth per school to support interactive content, but most schools have less than 5Mb of bandwidth available. Corporation propose that school network issues can be cured through expensive solutions, such as the rewriting of buildings, new and expensive equipment (10GB connections to all buildings, firewall, dedicated fiber connections, virtualization) that schools may or may not be able to fund. SETDA (2012) reported that America's K-12 schools need 100 Mbps (per 1,000 students/staff) of external Internet connectivity for the 2014-2015 school year and 1 Gbps (per 1,000 students/staff) by the 2017-2018 school year based on the bandwidth needs for current digital learning tools (e.g., streaming video and content). According to a report by the Office of Education Technology (OET), a survey was done by the Federal Communications Commission (FCC) in 2010 that found of the respondents almost half of them stated the schools had lower speed connectivity than the average home; in a 2011 survey also done by the FCC, 80 percent of those who responded stated that their broadband connections were inadequate to their teaching needs. Additionally, more than half of respondents indicated that the problem of slow internet connections prevented them from using technology in their classrooms (OET, citing FCC reports 2010 and 2011).

While limitations on technology exist, various methods can be used to maximize

available technology without sacrificing significant amount of resources. The study of Koutsopoulos and Kotsanis (2014) suggest that schools and school leaders/administrators must subscribe to the premise that knowledge is individually constructed and should lead to students engaged in building understanding, questioning information, and involved in problem solving. The major discovery made by the case study is the significance of using a holistic approach in making policies concerning technological integration. The study determined through comparative case study that school administrators that followed an holistic approach experience less problems with their school policies. An holistic approach is described as a perspective based on community ties and relations in policy making. This simply means that kan holistic appraoch considers various factors in policy making (Gialamas, Pelonis, & Medeirod, 2013), which is similar to the findings of previously reviewed literature. The study of Koutsopoulos and Kotsanis further suggested the need for a new paradigm where the integrating role and the advantages offered by cloud computing will provide the framework within which it has to develop. Cloud computing can be accessed and manipulated by a large number of users in real-time by using mobile devices in the classroom.

Integrating technology in education clearly has benefits for both teachers and students. The main reason why so many schools have yet to successfully integrate technology is that formulating an effective policy regarding the use of technology is complicated by a number of factors. The reviewed literature so far has focused on the various challenges faced by school administrators and district superintendents to make technology integration work in their districts. But there are still other issues outside of control of teachers and district superintendents.

One of these hindrance is the undelrying belief that technology integration is not needed in schools. Researchers have debated about the successful use of technology in schools (Ertmer

and Ottenbreit-Leftwich, 2010; Levin & Wadmany, 2008; Tamim, Bernard, Borokhovski, Abrami, and Schmid, 2011). While some embrace the use of technology to open new opportunities for students, others are reluctant to adopt new technologies that can fail. Some of the reluctance to adopt new technologies in the classroom comes from the barriers to successful use of technology (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Addison, Lane, Ross, & Woods, 1999). These studies mostly used case studies, interviews and document analysis to identify different barriers in the use of technology that include lack of resources, professional development, technical support, preparation time, teacher beliefs, and views about teaching. Despite an acknowledged emphasis on barriers in the academic literature, little research has been conducted on the impact of network reliability and speed on the implementation of technology. One of the most extensively researched topics in the literature is the barrier studies (Ertmer, 1999; Lloyd, 2012; Wastiau et al., 2011). These barriers were grouped into two categories; extrinsic and intrinsic (Wastiau et al., 2011). Extrinsic barriers consist of resource scarcity, technical support, and professional development as well as preparation time. Knowledge, technology integration vision, beliefs of teacher, and teaching and learning are considered to be barriers that are intrinsic. Despite an acknowledged emphasis on several of the barriers in the literature, little research has been conducted on the impact of the school network on the integration of technology by teachers.

Finally, considerable scholarly literature is focused on teachers' perceptions of technology integration; it fails to take into account that a reliable network is critical to teachers' successfully using technology in the classroom. Today's teachers need to rely on technology in order to be effective in the classroom. However, there are still some teachers that fear that their profession is threatened by education technology rendering them to be ineffective. Additionally,

students who do not have access to technology will lack in education compared to those who do (Duncan, 2014). It is imperative that, in order to ensure the successful integration of technology in the classroom, school administrators examine the role of a reliable school network.

Educators rely on technology not only for work in the classroom but also to communicate with each other in an effort to learn and seek help from each other. According to a report by the U.S. Department of Education, technology helps teachers collaborate with each other using communication networks such as email and Twitter. "A lack of access to high-speed Internet connections and overly restrictive acceptable use policies limits the reach of these new tools for professional learning and collaboration" (U.S. Department of Education, 2014).

A major theme identified by reviewed literature about the roles and difficulties of teaches is that teachers are often left to fend off for themselves. As discussed earlier, professional growth is a major component of effective technology integration policy, and in most cases, this component is absent. Most of the online learning and collaboration among teachers has been done through their initiative on their own time with their own resources. Teachers understand the need for this collaboration in order to become better professionals; working with each other helps and technology is the key to this collaboration. The lack of technology impedes the process of their work in the classroom but the lack of formal training and support for teachers ensures that integrated technology would have limited use if the teachers cannot use them properly.

Even with a strong network and commitment to professional development and the involvement of superintendents, school leaders, and teachers, developing a powerful plan for technology integration is a large undertaking. It is an ongoing challenge for districts to identify the evidence-based professional development and strategies to support technology integration.

Teachers who receive substantial professional development can boost their students' achievement (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007).

Technology can provide powerful and cost-effective support for professional learning and collaboration. Participation in online communities of practice and social networking produces tangible benefits through online learning spaces that educators can effectively access, share, and create knowledge (Chen, Chen, & Tsai, 2009; Duncan-Howell, 2010; Office of Educational Technology, 2011). The direct impact on student assessment and achievement is difficult to track, but research on online technology-based professional development suggests that it is at least as effective as equivalently structured face-to-face activities (Fishman et al., 2013). Teachers participating in technology-based online professional development report a strong sense of ownership and investment, and the cost of supporting them is modest compared with face-to-face equivalents (Office of Educational Technology, 2011).

Although much of the academic research regarding technology in schools centers on teachers' perceptions of integrating technology in the classroom or instruction, there appears to be a missing component in the research. As it exists now, teachers, administrators, and curriculum coordinators plan to use technology as a part of their instructional practice, but without a stable and robust school network to support their endeavors, successful technology integration cannot take place. Current academic research fails to take into account that a stable and robust network is critical to teachers successfully using technology in the classroom. Studies on barriers to technology integration, teacher comfort levels using technology, and the amount of teacher professional development is important; nonetheless research needs to done on how a strong network and adequate bandwidth is critical for technology to be viable in schools. The last decade has brought some level of Internet connectivity to nearly all the nation's schools

(Culatta & Duncan, 2014). However, teachers experience connectivity that was originally planned for a school library, office, or computer lab. The original connectivity falls short of providing our schools, classrooms, and teachers with the digital connectivity and tools necessary to provide a twenty-first century education. The bandwidth required for today's student to experience high-definition 3D multimedia content, participate in an online video conference, and create and publish an electronic portfolio far exceeds what was required to give students access to early online tools such as email and static reference materials. For students to access robust digital learning tools, schools need to upgrade their technical infrastructure to extend wireless and/or high-speed Internet access to every instructional space. If educational researchers continue to believe that teachers' professional development, barriers, or comfort level is an indicator of using technology in the classroom, we will never understand the larger question of what is needed from a school network capable of providing teachers with the successful use of technology in the classroom.

The National Telecommunications and Information Administration has reported bandwidths to be at capacities insufficient to accommodate even current applications by two-thirds of schools surveyed (National Telecommunications and Information Administration, 2011). One result occurs with streaming video when pausing, buffering, and skipping interrupts the flow of the media delivery. Without improvements in bandwidths, Internet access is of limited value. Recently, the Federal Communications Commission (FCC) adopted a Notice of Proposed Rulemaking (NPRM) proposing several comprehensive changes to the E-Rate program. The action proposes to establish goals for the E-Rate program, including a target that 99 percent of America's schools will have broadband speeds of no less than 100 Mbps by 2015, with an ultimate target of 1 Gbps by 2020. The ConnectEd Initiative (2013) calls for network

upgrades in a national effort that will require millions of dollars and an understanding of the current status of broadband in our nation's schools and libraries. In this Policy Brief, Connected Nation (2013) analyzes data on K-12 school and library connectivity collected across nine states and the territory of Puerto Rico. Approximately 34 percent of schools and only 3 percent of libraries surveyed by Connected Nation currently report having 100 Mbps download broadband connections. Connectivity across states analyzed by Connected Nation (2013) varies greatly, ranging from 54 percent of schools with 100 Mbps connections in Nevada to less than 1 percent of schools in Puerto Rico. As the FCC embarks on the modernization of the E-Rate program, these variations indicate that state and local decisions have had a significant impact on the adoption and use of broadband technology at schools and libraries. The success of the national initiative to expand digital learning both inside and outside the classroom will require the closing of the significant connectivity gaps that this Connected Nation analysis revealed.

Research Method

The review of related literature revealed that majority of studies that have explored the issue of technological integration utilized a qualitative, case study research design. The primary reason that justifies the use of this type of research is design is that the different school districts and the officials and teachers that reside in these districts all have distinct traits and circumstances that can only be identified effectively through a case study. Using the reviewed literature as basis, this study will also employ a qualitative case study in order to examine the relationship between teachers' perceptions of school network reliability and their integration of technology into classroom curriculum.

Through information gathering through interviews, focus groups and direct observation,

the perceptions and experiences of the teachers can be analyzed in order to synthesize their experiences and determine trends and correlations between teachers' perceptions of the reliability of school networks and the integration of technology into their classrooms. This information will then allow school administrators to provide for the network needs of teachers to maximize the use of technology in classroom settings within their schools and the district.

One consideration in the study is the allocation of resources among schools even within the same district. Budgetary considerations are often behind the specific resources available to teachers. In order to account for this consideration, the sample group should contain teachers from various schools in the district and if possible, multiple districts. This will provide a better cross-section of data as to the use of technology throughout a district or within a state through the ability to account for various budgetary limitations or excesses in the availability and integration of technology in the classroom. By selecting a sample group from various schools, the sample size will also be larger, which will provide greater and more accurate data for analysis.

One limitation of the study is in the perceptions of teachers toward technology integration in the classroom. This study assumes that with the availability of technology and reliability of the school network, teachers would effectively integrate technology into their lesson planning and teaching processes. However, there are educators who are reluctant to adopt technologies regardless of their availability and reliability. This perception must be taken into consideration in the sample selection and data collection for this study. Teachers selected for interview and observation should be those who are not reluctant to integrate technology into the classroom. If teachers are reluctant to use technology to plan or teach lessons, it is likely that this would be reflected in the observation of their classrooms, which would impact the trends found in the data.

Conversely, there are educators who welcome technological advances in the classroom and who would integrate them regardless of limitations of the school network. The observation of these teachers' classrooms would also likely impact the trends of data since they would use the technology regardless of their perceptions of the network's reliability. Teachers who will use technology regardless of the limitations of the school network should also be avoided in the interview and observation sample group. Instead, the teachers selected for interviews and observation should be those who are open to the use of technology in the classroom but do not feel one way or the other strongly. These individuals can be identified through the surveys.

There are no significant ethical concerns in this study. All participants would be over the age of eighteen and would participate with full consent. Sensitive information about the school, its employees, or its students would not be used in the data collection process. Instead, data would focus on teachers' perceptions of the school network and their use of technology in the classroom. Student information that might be available on the intranet, such as students' grades, is not relevant to the study.

Measurement

The data will be collected through two methods: interviews and observation. The interviews will be separated into two stages. The first set would involve interviews with district superintendents other school officials while the second set will be conducted using a focus group composed of teachers. Each of these two methods will provide insight into both teachers' perceptions of the school network and their use of technology in classrooms. The various types of data collection will provide more in-depth data for analysis, and will allow the data to be put in context of the classroom setting rather than being viewed within the narrow context of the study parameters. In addition, the direct observation will provide unbiased data regarding the

integration of technology in the classroom rather than relying solely on self-reporting through a survey and interview. In addition, the data will be reviewed for trustworthiness. This involves establishing credibility (confidence in the truth of the findings), transferability (showing that the findings have applicability in other contexts), dependability (showing that the findings are consistent and could be repeated, and conformability)—a degree of neutrality or the extent to which the findings of a study are shaped by the respondents and not researcher bias, motivation, or interest (Lincoln & Guba, 1985).

The interview questions for both the focus group and the individual interviews will include open-ended questions that assess the level of integration of technology in the teachers' classrooms and their perceptions of the school network as it is available to them through the school and district. The interview will also assess the use of technology and the school network in the lesson-planning process.

Observation will provide data regarding the application of technology in the classroom. Through the observation of various teachers during the school day, data can be collected regarding how technology is used on a daily basis in the classroom with students and in the classroom outside of teaching time, such as during lesson planning during a free period. The teachers who participated in the interviews should be observed in the classroom in order to draw a further correlation between the teachers' perceptions of the school network's reliability and their application of technology in their classrooms.

Once the data is collected, it will be analyzed to identify trends regarding the use of technology in the classrooms and any correlations between the use of technology and the teachers' perceptions of the reliability of the school network. The data would first identify themes in teachers' perceptions of the reliability of the school network. The data would then

identify the overall use of technology in the classroom. Finally, these two elements would be compared in order to find a correlation between teachers' perceptions of the school network reliability and their decision to integrate technology in the classroom.

Once the data have been reviewed and there is a general understanding of the scope and contexts of the key experiences under study, coding provides the analyst with a formal system to organize the data, uncovering and documenting additional links within and between concepts and experiences described in the data. Codes are tags or labels, which are assigned to whole documents or segments of documents (i.e., paragraphs, sentences, or words) to help catalog key concepts while preserving the context in which these concepts occur (Miles and Huberman, 1994).

The analyzed data can be presented in tables and graphs, which will give a visual representation of the trends and themes identified in data collection. It should also be presented in a report which will allow for the explanation of the data and its analysis, as well as the integration of the observations that will help readers understand the relationship between teachers' perceptions of network reliability and their use of technology in the classroom.

Summary

Technology is a valuable resource for educators in the planning and teaching of the curriculum in classroom settings. However, limitations of school networks and the reliability of the networks can have an impact on the integration of technology by teachers.

The purpose of this study is to investigate the lack of understanding by superintendents and other school leaders on how insufficient bandwidth affects teachers' ability to effectively integrate technology with instruction. The study will serve as an exploration of how teachers are impacted by an unreliable and slow network and how it interferes with effective instruction.

Data will be obtained through in-depth interviews at a local school district.

This information can then be applied by school administrators to address teachers' concerns and enable technology to be more widely integrated by educators. In this way, schools and districts can ensure that teachers have the resources they need to give students their best chances for success.

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Appendix A

Annotated Bibliography

Kurt, S. (May 01, 2010). Technology use in elementary education in Turkey: A case study. *New Horizons in Education, 58,* 1, 65-76.

Dr. Serhat Kurt published the case study in May 2010. The author's assertion was that because of the heavy investment in technology made in Turkish schools; technology was a permanent part of the educational landscape. Because of said investment, teachers needed professional development to ensure the success of technology in schools. The author asserted that the adoption of technology and offering effective professional development is a major challenge to many school districts. The author reviewed available literature although most of it dated from the late 1990's and early 2000's. The author referred to his disagreement with politics affecting the educational progress in Turkey. The author's objective was the examine teachers' use of available technology using a case study approach. The study examined the ways available technology was being used. The study was conducted in what the author refers to as a "very typical elementary school". Twenty-nine teachers completed the survey. Additionally, ten teachers and three principals were interviewed. The research design employed both qualitative and quantitative methods. The data sources included structured and open-ended interviews, a survey, classroom observations, and an examination of relevant documents. In Table 1, results showed that when teachers were asked whether they believe they use instructional technologies enough in their teaching activities, the mean was very close to neutral. Table 2 results showed that when teachers were asked about different technologies used during instruction, teachers were using televisions, cassette players, and VCRs. The least used technologies were fax machines, camcorders, and digital cameras. The author noted that the school had an adequate

number of televisions, cassette players, and VCRs, but the school did not supply fax machines, camcorders, or digital cameras. Therefore, if teachers wanted to use these tools, they had to bring their equipment. The conclusions drawn were that teachers used technologies that were readily available to them. Based on the data, teachers preferred easier to use technologies such as TVs and VCRs. This study was the beginning of understanding the adoption of technology and the integration of technology in Turkish elementary schools. There has been little if any data on the integration of technology in Turkish elementary schools. How are teachers using technology? What is their process? This study may open a dialog, which will lead to more effective professional development in Turkey. Studying one school does not provide material for a comprehensive understanding of Turkish teachers' use of technology. The author stated that research should guide educational decisions and that the number of educational research in technology in Turkey is limited. In fact, many educational technology studies focus on middle and high school level use of technology integration. Little research has been done at the elementary level.

Lloyd, P. J. (2012). *Digital the dead ends along Alaska's information highway: Broadband access for students and teachers in Alaska's high school one-to-one laptop programs.* (Order No. 3534188, University of Alaska Fairbanks). *ProQuest Dissertations and Theses,* , 193. Retrieved from http://search.proquest.com.proxy1.ncu.edu/docview/1240937962?accountid=28180. (1240937962).

Pamela Jo Lloyd published her dissertation in 2012. The author analyzed the potential impact broadband availability has on technology adoption for high school students and teachers in Alaska. The author defined broadband into three categories: (a) terrestrial broadband, (b) satellite broadband, and (c) no broadband availability. The author did an extensive literature review of the digital divide in the United States, as well as the Connect Alaska initiative and the

use of American Recovery and Reinvestment Act (ARRA) funds in Alaska. The author did comparative work with laptop initiatives in Maine as well as Florida. The author disagreed with some the Maine and Florida research regarding socioeconomics barriers to laptop use. The sample population for the dissertation included high school 27 teachers and 243 students in one-to-one laptop programs from 13 school districts in 39 Alaskan communities. All participants were fully immersed in a one to one laptop program. In section 5, the author summarized answers to the question of teacher perception of whether students would benefit from a laptop for schoolwork. Teachers living in communities with terrestrial broadband availability had the highest percentage, with 71% of the teachers believing their students would benefit, compared to 45% of the teachers living in communities with satellite broadband availability, and 24% of the teachers living in communities with no broadband access. For teachers in the study, the value of technology was directly tied to broadband access. The author used mixed methods approach to corroborate her findings and expand the understanding of the researcher. One limitation of the study was that it was high school only. Many of the communities in this study have one to one laptop program at the middle and elementary school level. Further studies need to be conducted in Alaska regarding technology initiatives, in general. The lessons learned from Alaska could be applied to other rural areas of the United States as well as developing countries experiencing growing pains with broadband connectivity.

Cakir, R. (October 01, 2012). Technology integration and technology leadership in schools as learning organizations. *Turkish Online Journal of Educational Technology - Projet, 11,* 4, 273-282.

Recep Cakir published this study in October 2012. The author investigated technology integration in primary schools in Amasya, Turkey. The author examined the perceptions of

school administrators who had a role in technology integration as well as computer teachers who are mainly responsible for school technology integration. The researcher focused on the administrator attitudes towards technology, and the computer teacher awareness of technological developments. Thirty-eight school administrators and thirty-five computer teachers participated in this study. The study employed survey-based quantitative methodology to examine the attitudes of administrators and computer teachers towards the integration of new technologies. The administrators and computer teachers were also responsible for the school network infrastructure although there was little mention of it in this study. The administrators completed the Web 2.0 technologies. In addition, interviews were conducted in order thoroughly to understand school administrators and teachers' opinions about technology integration and technology leadership. Data from the questionnaire (Table 1) results showed that administrators' attitudes towards technology were largely positive. Data gather from interviews showed that although teachers were aware of Web 2.0 technologies, few used them in their instructional practice. Table 2 and Table 3 illustrated that with professional development and administrative encouragement the use of the Web 2.0 tools by teachers increased. The scope of this study claimed to include infrastructure required for technology integration but concentrated mainly on the use of the Web 2.0 tools with little mention of infrastructure. Nevertheless, the information on the use of the Web 2.0 tools was in keeping with research from other current studies. Further research could be conducted on the use of the Web 2.0 tools and the infrastructure necessary to use said tools.

du Plessis, A., & Webb, P. (2012). Teachers' Perceptions of their own and their schools' readiness for computer implementation: A South African case study. *Turkish Online Journal Of Educational Technology - TOJET*, *11*(3), 312-325.

Dr. André du Plessis and Paul Webb published this case study in July 2012. The case study involved thirty teachers from six South African schools and provided data on teacher perceptions of the challenges related to implementing Information and Communication Technology (ICT). The schools had minimal resources because of the South African apartheid policy before 1994. The schools were located in areas lacking basic infrastructure. Twenty computers were provided to each of the schools by a donor solicited to support ICT by the Nelson Mandela Metropolitan University (NMMU). A literature review was not done in this study. A quantitative Likert scale questionnaire, qualitative interviews, and a qualitative open-ended questionnaire were used to gather data. The data suggested that, despite the fact of the schools were provided with computers and teacher training, several barriers existed. Examples of these barriers were insufficient ICT resources such as computer labs, lack of technology leadership, and a need for ongoing professional development. These barriers have not allowed the teachers to go beyond an initial technology integration phase. One of the data points from Table 1 illustrated that 50% of the participants thought that network infrastructure and resources were lacking, while the other 50% were unsure about infrastructure and resources, however they desired more computers and a faster Internet connection. This case study underscores the importance of ICT planning before the implementation of technology equipment. Researchers need to look at the data on first and second order barriers to technology integration, as well as existing research on technology implementation in developing countries.

Vermillion, J., Young, M., & Hannafin, R. (June 06, 2007). An academic technology initiative for teacher preparation candidates: Implications for preservice teacher programs. *Journal of Computing in Teacher Education, 23,* 3, 99-104.

Jennifer Vermillion, Michael Young, and Robert Hannifin published this case study in June 2007. The case study highlights the increased pressure that teacher preparation programs are facing to prepare teacher candidates for technology integration. Lack of ubiquitous on-campus access and effective modeling by faculty were cited as barriers to reaching this goal. The Academic Technology Initiative (ATI) at a large Northeastern university provided laptops and support for all preservice teachers and faculty in an attempt to address these barriers. Using a grounded theory ethnographic approach, this study examined how the removal of access and infrastructure barriers affects technology integration and faculty modeling. The goal was through the modeling by university teachers; preservice teachers would become more comfortable using technology in their student teaching placements. Twelve university teachers were interviewed who were responsible for placing junior in student teaching placements. The findings showed that once infrastructure barriers were removed university teachers were able to use an assortment of technology for instruction, including course management systems, competencies-based electronic assignments, Web page development tools, threaded discussion, electronic portfolios, e-mail, instant messaging, presentation tools, personal response systems, DVDs, podcasting, digital video cameras, Web cams, and electronic submission of coursework. Table 1 illustrated that over half of the university teachers were successfully using email and course assignment software. However, data from interviews showed that some of the participating preservice teachers encountered network infrastructure issues in their student teacher placements and were unable to use university-supplied equipment. The study was small in scope with only twelve university teachers participating in the research. Further studies could include vertical research between the university and a K-12 school district for successful preservice teaching training with similar technology integration tools and network infrastructure

resources. In such a study, a university could collaborate with K-12 school district to provide preservice teachers with laptops and other technological equipment that was university and school district "ready" for either network providing the preservice teacher with seamless access to either network.

Crichton, S., Pegler, K., & White, D. (January 01, 2012). Personal devices in public settings: Lessons learned from an iPod touch/iPad project. *Electronic Journal of E-Learning, 10,* 1, 23-31.

Susan Crichton, Karen Pegler, and Duncan White published this study in January 2012. The study reported the findings from a deployment of iPod Touch and iPad devices in a large urban Canadian K-12 school district. The purpose of the study was to gain an understanding of the infrastructure required to support iPod Touch and iPad devices in classrooms, the opportunities and challenges teachers faced as they began to use handheld devices for instruction, as well as the challenges students faced when gaining access to handheld devices and a wireless network. A mixed method approach was used to collect data through an online survey about monthly professional development activities with teachers, analysis of lesson plans and student work, as well as classroom observations. Data was collected at elementary through high school levels. Interviews showed that elementary students seemed to prefer iPods to iPads and high school students preferred the opposite. Both groups of students were frustrated by not being allowed to take the devices home. Although infrastructure was cited as one reason for the study, a large part of the study discussed the physical logistics and management of the devices, such as: charging, storing, deploying software and items, and syncing the devices. The findings of the study illustrated the importance of creating a deployment plan for how the devices and apps are synched, powered, maintained, and managed. Further studies need to be done in this Canadian

district to examine how the devices were used for instruction after the technological issues were overcome. This study was a “cautionary tale” for a device-heavy technology implementation.

Staples, A., Pugach, M. C., & Himes, D. (June 06, 2005). Rethinking the technology integration challenge: Cases from three urban elementary schools. *Journal of Research on Technology in Education, 37,* 3, 285-311.

Amy Staples, Marleen Pugach, and DJ Himes published this case study in June 2005. In this paper, case studies of three urban elementary schools were conducted to document the integration of technology given matching resources from a local university's Preparing Tomorrow's Teacher's to Use Technology (PT3) grant. The authors used a qualitative research method to examine how a common set of technology support resources made available through the PT3 grant was used at three urban elementary schools within one urban school district. Multiple sources of data were gathered over the three years of the project. Fifteen formal, semi-structured interviews were conducted. The interviewees were principals, technology teachers, and classroom teachers. One similarity that presented itself across the three case studies was the need for ongoing professional development. Additionally, the interviews illustrated that without clear set of technology goals, it was easy to teachers to “get lost” in hardware, acquisition of equipment, purchasing, productivity (non-educational uses of computers), and network issues. There was no literature review done as a part of this study. However the authors showed a clear bias toward the need for professional development. One limitation of the study was that there was no data presented in the areas where the teachers felt “lost”. The authors felt that professional development could solve every issue. Professional development may have solved some of the issues in the schools that were a part of this study however some of the issues cited

such as purchasing, acquisition of equipment, and network issues may not be solved by professional development.

Spires, H. A., Morris, G., & Zhang, J. (June 01, 2012). New literacies and emerging technologies: perspectives from U.S. and Chinese middle-level teachers. *Rule Online: Research in Middle Level Education, 35,* 10.)

Authors Hiller A. Spires, Gwynn Morris, Jun Zheng Zhang, and Datong, Shanxi published this article in June 2012. The study focused on middle school teachers from the United States and China. The correlation for the study was that the United States and China are the two countries with the highest Internet use. The goal was to uncover similarities and differences between the groups of teachers in terms of perceptions and current practices related to technology. Two hundred ninety-one middle school teachers completed the survey: 193 U.S. teachers from North Carolina and 98 Chinese teachers. Authors used surveys and focus groups to explore and quantify teachers' perceptions about integrating technology. Table 3 illustrated a similarity that both groups felt that they needed more professional development and administrative support in their use of technology. Table 2 illustrated another similarity that teachers in both countries used the same types of technology in their classrooms: digital cameras, video editing software, power point presentations, blogs, wikis, computerized gaming, mobile devices, video conferencing, and podcasts. One difference was that Internet speed in the U. S. participant school districts was moderate to high while the Chinese had low to moderate Internet speeds. Both groups experienced problems with inadequate equipment, problems with content filtering (useful sites blocked), and lack of tech support. The authors acknowledged the difference between American and Chinese average classroom size. The average size of the American classroom in the study was 25 students. The average size of the Chinese classroom in the study was 65. The authors

acknowledged limitations of the study including translation issues with the survey questions and the fact that rural North Carolina area schools may differ greatly from Chinese rural area schools. China and the United States are both undergoing widespread educational reform: the US with accountability (NCLB, high stakes assessments) and China with infusing creativity into their educational system, however teachers from both countries are integrating technology into instruction in similar ways. Future studies could be done on how teachers could share intellectual or educational knowledge using technology.

Hixon, E., & Buckenmeyer, J. (April 01, 2009). Revisiting technology integration in schools: Implications for professional development. *Computers in the Schools, 26,* 2, 130-146.

Emily Hixon and Janet Buckenmeyer published their research in April 2009. As the technology infrastructures of schools expand, a common concern has been the underutilization of computers and other technologies in the classroom. In some cases, teachers are blamed for failing to integrate technology into their teaching. Teachers cite reasons such as lack of time, training, equipment, and support. However, the authors suggested that these are not the "real" reasons technology is underutilized. Instead, inadequate professional development may cause barriers to classroom technology use. The authors conducted an empirical literature review of the five commonly identified barriers to technology integration: (a) resources, (b) knowledge and skills, (c) institution, (d) attitudes and beliefs, and (e) subject/discipline culture. The authors included many theories as to why teachers did not integrate technology into the classroom. Many of the theories they included were those of which they did not agree. Working with information from other studies, the author compiled the information into Stages A through F, with Stage A being teachers who saw technology as a passing fad through F, being teachers who saw the power and potential of technology to transform education. The authors clearly showed that successful

technology integration involved more than just having computers in classrooms. In order to promote effective technology integration, schools must find ways to address all of the barriers that teachers are facing around technology integration. The use of first-order and second-order barriers was a strength of this study. First order barriers to technology integration are those that are external to the teacher. This would include lack of resources, institution, and subject culture. Second-order barriers are internal to the teacher; representing underlying personal beliefs that would include attitudes, knowledge and skills. A limitation of this study was that no actual group was studied. The entire article was based existing research form other studies. The implication for professional development is clear from this article in that the current "one-size-fits-all" technology training done in so many school district may not be effective. Successful technology integration calls for more personalized, professional development that focuses on teachers' fundamental beliefs about teaching and learning. Future research on customized or personalized professional development may be necessary to develop this theory fully.

Reinhart, J. M., Thomas, E., & Torskie, J. M. (January 01, 2011). K-12 teachers: Technology use and the second level digital divide. *Journal of Instructional Psychology, 38,* 181-193.

Julie M. Reinhart, Earl Thomas, and Jeanne M. Torskie published their research on the Second-Level Digital Divide (SLDD) in 2011. The commonly known term Digital Divide refers to the difference between the technology "haves" and "have nots". The SLDD refers to the difference in how technology is utilized in K-12 education. The objective of the research was to examine the differences in K-12 educators' use of technology for instruction across different economic factors. This study found that schools' economic factors explained the variation in how teachers used technology to promote higher-order thinking skills. Additionally, the study identified a

need for access to technology facilitators, as well as in-service training for teachers on how to use technology to promote higher-order thinking skills. The authors conducted a literature review including research around digital natives versus digital immigrants, access to equipment in the home and other factors affecting teachers' comfort using technology. The authors considered all positions during their research. They did not show bias toward any position. However, they included a wide variety of possibilities for the SLDD including race, age, gender, access to equipment, and socio-economic factors.

This exploratory study investigated physical, digital, and social factors and the influence on how teachers use technology in the classroom. The research was conducted in a large midwestern city, its suburbs, and in the outlying rural areas. Ninety-four teachers participated in the study ranging in age from 21-60. The results supported the existence of a Second-Level Digital Divide. The manner in which technology was used to promote higher-order thinking was found to be significantly different from school economic factors. The first conclusion was that schools with a lower percentage of students who receive free and reduced lunch used technology in a way that promoted higher-order thinking. A second conclusion was that schools with a better socio-economic standing were more likely to have a technology facilitator. Technology facilitators worked directly with students to create projects thus reinforcing higher order thinking skills. The strength of this study was that the authors used a city and suburb, and a rural area in the data collection. A limitation of the study was that it was one in one city in the Midwest. The results of this exploratory study provided evidence for the SLDD in K-12 environments. Further studies need to be conducted to determine other areas of the SLDD.

Hsu, S., & Kuan, P. (2013). The impact of multilevel factors on technology integration: The case of Taiwanese grade 1-9 teachers and schools. *Educational Technology, Research and Development, 61*(1), 25-50. doi:http://dx.doi.org/10.1007/s11423-012-9269-y

Shihkuan Hsu and Ping-Yin Kuan published this article in August 2012. The authors examined the issue of teacher support for information, communication, and technology (ICT). The authors asserted that professional development is not the only significant factor in the successful use of technology in the classroom. Important variables included access to Internet connectivity, the availability of projectors, and the stability of computers and the computer network. The authors' objective was to explain the successful use of technology in the classroom by examining a combination of factors rather than just one factor using a multilevel analysis of influencing factors. The authors examined a variety of relevant literature for this study. A sample comprising 3,729 teachers from 315 elementary and junior high schools in Taiwan was collected. The sampling method used probability proportional to the size (PPS) in a multistage cluster sampling design. Table 1 delivered results that suggested access to the Internet, computer, as well as network stability, and LCD projectors are essential for teachers to produce instructional materials to use ICT successfully. School size and school type (elementary or middle school) did not seem to influence teacher ICT integration. One strength of the study was that elementary school was included. Elementary school is typically an underserved population in K-12 technology research. Although the sample size was large, one limitation was that only 15 teachers were selected for each school, and not all of them participated in the survey. Future research should collect more data from each school to confirm the current findings.

I-Hua, C. (2012). The effect of principals' technological leadership on teachers' technological literacy and teaching effectiveness in Taiwanese elementary schools. *Journal of Educational Technology & Society, 15*(2), 328-n/a. Retrieved from http://search.proquest.com.proxy1.ncu.edu/docview/1287026619?accountid=28180

The author was I-Hua Chang, and the article was published in March 2011. The purpose of this study was to investigate the relationships among principals' technological leadership, teachers' technological literacy, and teaching effectiveness. The author sought to examine how principals' technological leadership can affect teachers' technological literacy. The author examined relevant literature dating back to the 1990's which suggested that in order for a principal to be a capable technological leader, the principal must be trained in the following areas: (a) vision, planning and management, (b) staff development and training, (c) technological and infrastructure, (d) evaluation and research, and (e) interpersonal and communication skills. The target population consisted of 1,000 teachers randomly selected from 100 elementary schools in six metropolitan cities in Taiwan. Teachers were randomly selected to participate in the survey. The survey asked teachers to evaluate the principal's role in leading and facilitating technology use, teachers' technological literacy, and teaching effectiveness in their schools. There was a 60.5% return rate on the surveys. Figure 2 illustrated that principals' technological leadership improves teachers' technological literacy significantly. Table 2 illustrated that principals seen as successful technology leaders supplied teachers with technological and infrastructure support when needed. A strength of this study was that it opened a dialog in Taiwan for principals to be given the opportunity for training around technology leadership in their schools. In addition to technological leadership positively influencing technology integration, the results show that principals' technological leadership influenced overall teaching effectiveness. One strength of this study was its difference in focusing on principal professional development rather than teacher professional development. A predominance of the literature is devoted to teacher professional development. From this study, one could conclude that professional development for any group positively affects the use of technology in schools.

Wefky, E., Douglas, J., Faid-Douglas, R., & Abed, A. (2010). School networking and the Internet use: Do Bahraini teachers have sufficient skills to be effective? *Association for the Advancement of Computing in Education*.

Eman Weekly, Jamal Douglas, Rachida Find-Douglas, and Ahmed Abed wrote this article that was published in May 2010. The purpose of the study was to determine the skills that English, math and science secondary school Bahraini teachers have to be successful in using the Internet and the e-classroom network. The authors objective in conducting the research was to ascertain the necessary management level of three skills: (a) management of the e-classroom network (b) management of Internet browsers, and (c) management of network printers. The author did not perform a literature review. The sample of the study consisted of 60 teachers (30 male and 30 female) in eleven secondary schools, which represented 60.8% of the total population. SPSS was used to analyze the data and to find the percentages, median, and the mean. Table 1 illustrated that less than half of the participants (49.1%) possessed the skills necessary to manage the e-classroom which consisted of connecting an interactive white board, connecting computers in a lab, controlling student screens from the teacher station, controlling student interactions on computers, installing and distributing software and files from teacher stations to student stations, and connecting the computers to the network. Teachers faired better in Table 2 with 75% having adequate Internet skills as well as in Table 3 with 71% possessing adequate network printer skills. The strength of this study was that the author succinctly presented the identified skills into three types: e-classroom, the Internet, and printers. One limitation of the study was that the author included only secondary English, science, and math teachers. The author identified future openings for research as the project is still growing and expanding to reach all public schools and grade levels.

Morishita, T., & Higashibara, Y. (2012). Development of a promotion model on the digitization of education in K-12 - A report on the progress at a university-affiliated elementary school. *Association for the Advancement of Computing in Education (AACE)*.

The authors were Takeshi Morishita and Yoshinori Higashibara. The paper was published in October 2012. The purpose of this study was to develop a model for the digitization of education for schools in Japan. The authors' objective, in conducting the research, was to determine which and how much ICT hardware should be installed. There was no literature review. The research subject was the Nagano Elementary School, which is a Shinshu University-affiliated, elementary school in Nagano City, Japan. There were three classes in each grade (one through six) with between thirty-five and forty students in each class. Surveys were distributed to staff requesting information as to what type of technology were required by teachers. Table 1 illustrated the types of technologies teachers hoped to use with their students. The hardware items included interactive white boards, digital cameras, touch pads, digital pens, and printers. Information was not provided as to how teachers ascertained the types of hardware they needed. The strength of this study was that the authors reported spending time listening to the teachers as outlined in step 4 of the research process. The study was small in scope as it was limited to one elementary school. In addition, a large university in Japan funded the elementary school. Typical elementary schools in Japan do not have funding for this kind of technological endeavor. One issue identified during the installation of the hardware was that teachers believed all students should have access to a computer. Funding was not available at the time of this paper for that to occur. The authors cited that a pilot program was slated for two students to share one computer. There has been a little academic research available from elementary schools in Japan, so insight

into their process of allowing teachers the freedom to be involved in the choice of hardware was surprising. There was no mention of a technology director of any technology administration.

Siu, C. K., Chan, T., Griffin, P., Hoppe, U., Huang, R., Kinshuk, . . . Yu, S. (2014). E-learning in school education in the coming ten years for developing 21st century skills: Critical research issues and policy implications. *Journal of Educational Technology & Society, 17*(1), 70-78. Retrieved from http://search.proquest.com.proxy1.ncu.edu/docview/1502989108?accountid=28180

The authors were Siu Cheung Kong, Tak-Wai Chan, Patrick Griffin, Ulrich Hoppe, Ronghuai Huang, Kinshuk Chee, Kit Looi, Marcelo Milrad, Cathleen Norris, Miguel Nussbaum, Mike Sharples, Wing Mui, Winnie So, Elliot Soloway, and Shengquan Yu. The study was published in 2014. This paper discussed the research issues and policy implications critical for the development of learners for 21st century skills through daily learning activities. The authors identified six research issues critical for e-learning. The authors conducted a brief, but current literature review that indicated K-12 schools could e-learning to maximize the development of 21st century skills. Table 1 highlighted the technological supports conducive to learning for developing 21st century skills and summarizes the research issues and policy implications critical for e-learning for the next ten years. A strength of this study was the forecast of critical research issues and policies both at the local and global level. Even with such a large scope, the authors never strayed from their original mission of a curriculum-based focus. A limitation of the paper was its call for three separate and distinct groups (policy makers, academic researchers, and educational practitioners) to work together with no road map for that to occur. Future research on this topic may include the perspective of IT sector groups.

Gibbs, M. G., Dosen, A. J., & Guerrero, R. B. (January 01, 2009). Bridging the digital divide: Changing the technological landscape of inner-city catholic schools. *Urban Education, 44,* 1, 11-29.

Michael Gibbs, Anthony Dosen, and Rosalie Guerrero published this article in 2009. The article presented an evaluation of the *Bridging the Digital Divide Program*, an intervention in five inner-city Chicago Catholic schools during one academic year. The authors' objective for the research was to evaluate the intervention. The intervention included a needs assessment of the hardware, software, and infrastructure of the schools, review of on-site technology support personnel, teacher and administrator technological levels of ability, and technology integration. The authors based their literature review on two studies from the 1990s: one from the Chicago Public Schools and the Apple Corporation. Both of these studies contained information that is out of date for today's infrastructure, but may be in keeping with where the Catholic School administration were in terms of accepting technology into their schools. The authors did not show support for their research for disagreements to their research. In fact, they only cited research that showed "the excitement" that classroom teachers displayed in having new technology equipment in their classrooms. Table 4 illustrated that from a possible 133 teachers for the combined five schools, 94 responded to the survey. Of the 94 responses, 44 individuals attended the initial technology professional development workshops. Eight individuals did not attend the workshops because they professed prior knowledge of the topics under discussion, and 24 did not attend due to scheduling conflicts. The authors presented conclusions based on data for teacher proficiency with technology and professional development in this paper. A limitation of the study was that data and following discussion did not correspond to the original objective of the study. There was no data on the needs assessment of the hardware or the school infrastructures. One strength of this study was that it included research on the Catholic schools that is often an underserved population in the academic community. The authors stated that the goal, of bridging the digital divide, was met, so no further research was necessary.

Mingaine, L. (2013). Leadership challenges in the implementation of ICT in public secondary schools, Kenya. *Journal of Education and Learning, 2*(1), 32-43. Retrieved from http://search.proquest.com.proxy1.ncu.edu/docview/1438941100?accountid=28180

Laura Mingaine published this article in the Journal of Education and Learning in March 2013. The author stated that school leadership determines how Information Communication Technology (ICT) is implemented. The author's objective in conducting the research was to explore leadership's commitment to implementation of ICT programs, school leadership championing the implementation of ICT programs in schools, and school leadership interest in implementation of ICT programs in schools. The author performed a comprehensive review of available literature including research on distributive leadership and transformational leadership around ICT implementations. The study was performed in Meru County, Kenya. Questionnaires were distributed to administrators in 304 public secondary schools. Out of the 315 questionnaires distributed, 220 (69.8%) were appropriately answered and returned. From the study, it was evident that school leadership supported implementation of ICT by lobbying stakeholders to finance its implementation. However, at the school level, budget figures demonstrated that school leadership did not consider ICT a high priority. The questionnaires showed that school leaders were concerned that students and teachers might damage the ICT infrastructure and hardware. One issue that became known from this study was that the leadership of an ICT implementation could be delegated to curriculum administrators, lead teachers, and other school administrators and not fall totally on a school principal. Another model suggested was that ICT could be a shared responsibility of several school administrators. Further research needs to be studied in Africa regarding existing economic and social

inequalities between those who have access to technology and those do not. The author may want to review the digital divide research for correlations with Africa.

Howley, A., Wood, L., & Hough, B. (2011). Rural elementary school teachers' technology integration. *Journal of Research in Rural Education (Online), 26*(9), 1-13. Retrieved from http://search.proquest.com.proxy1.ncu.edu/docview/877890715?accountid=28180

Aimee Howley, Lawrence Wood, and Brian Hough published this article in 2011. The authors explored technology integration by rural elementary school teachers. The objective of the research was to ascertain whether factors such as teacher attitude, availability of Internet and adequate bandwidth, schools' remoteness, and/or socioeconomic status had a significant impact on the integration of technology. The authors reviewed relevant literature, which reinforced the theory that many rural districts do not have the infrastructure, bandwidth, or technical personnel necessary for consistent technology integration. The research involved a survey of a random sample of teachers in rural Ohio. The response rate was over 500. Some of the responses received were from non-rural districts, so the sample size was 157 based on free and reduced, per pupil expenditure, and location to determine rural school status. Table 1 showed that teacher attitude was the strongest predictor for technology integration despite inadequate infrastructure, bandwidth, lack of professional development, and lack of equipment. The remoteness of the school had little effect on technology integration. The study suggested that technical support and professional development is still needed in order to help rural teachers integrate technology in more sophisticated ways to engage students. Providing these supports to rural teachers is likely to improve their ability to integrate technology into instruction. One striking piece of data from this study was teachers' willingness to integrate technology with the presence of many barriers. Limited hardware, software, and adequate Internet speed did not seem to deter rural teachers from integrating technology into their instruction.

Mosley, V. (2013). In McBride R., Searson M.(Eds.), *Qualitative study: Why technology is underutilized in K-12 education*. New Orleans, Louisiana, United States: AACE.

Vicky Mosley was the author of this qualitative study published in 2013. The goal of this qualitative, multi-case study was to identify the factors that influence teachers' decisions to accept and use technology in K-12 education. The author's objective, in conducting the research, was to discover why technology is underutilized and three sub-questions that determined acceptance of technology, the barriers to using technology, and ways to overcome the barriers. The author reviewed the existing literature (since 2000) on the known barriers to technology acceptance. These barriers included: (a) technology is a reality, (b) more technologically aware administrators, (c) better infrastructure/bandwidth, more equipment. The study used a sampling size of 21 participants from six school districts in Maryland, with a minimum of one year of teaching experience. Table 2 illustrated that although some of the old barriers have been removed from why technology is no longer an issue for most teachers, there are new barriers in place such as lack of time. Lack of time to adequately plan technologically-based lesson plans seem to be the number one issue for teachers. The second issue was that teachers still do not have the equipment that they want or need, and the third issue is they still require additional professional development. The strength of this study was its strong tie-in to past "barrier" research. Although many of the barriers such as network infrastructure and bandwidth are off the radar for this group of Maryland teachers, professional development and planning time remain. The author concluded that until all of the barriers are removed, technology will remain underutilized. A limitation of the study was its small sample size. A strength of the study was that the six districts chosen has recently completed a large

infrastructure and fiber upgrade to address slow Internet speeds. A follow-up study may be in order when the lack of time and professional development has been addressed.

Hechter, R. P., & Vermette, L. (2013). Technology integration in K-12 science classrooms: An analysis of barriers and implications. *Themes In Science & Technology Education*, *6*(2), 73-90.

Richard P. Hechter and Laurie Anne Vermette published this research in 2013. The analysis examined the barriers to technology integration for Manitoban K-12 science educators based on a 10-item online survey. The aim of this research was to determine the barriers Manitoba science teachers experienced when integrating technology into science instruction. The barriers were grouped by level: (a) kindergarten, (b) elementary, (c) middle school, and (d) high school. Additionally, the authors tried to ascertain whether the barriers were grade specific or unique to specific grade levels. The authors examined a wealth of relevant literature of barriers to technology use by teachers. This included the work of the first order and second order barriers by Ertmer. Out of the 505 teachers who were given the survey, 433 Manitoban K-12 science educators completed it for a response rate of 85.74%. Participants were located in both urban and rural schools settings, as well as both private and public schools. Table 2 illustrated that the four biggest barriers to successful integration were the Internet access at 67%, planning time at 55.1%, lack of equipment at 53.7% and professional development at 59.1%. However, there was an overall technology satisfaction rate of 80% of teachers said there were no factors that kept them from integrating technology into their classrooms. At the time of the study, Manitoba Schools completed an installation of fiber to increase bandwidth. This increased bandwidth allowed teachers to be on the cutting edge and encouraged science teachers to incorporate technology into their teaching. The fiber installation was due in part to low science standardized

test scores. In addition, Manitoba Schools installed interactive white boards in every science room in grades kindergarten through twelve. Further research may be done on the barriers teachers are experiencing with high-speed Internet and interactive white board usage.

Levin, B. B., & Schrum, L. (January 01, 2013). Using systems thinking to leverage technology for school improvement: Lessons learned from award-winning secondary schools/districts. *Journal of Research on Technology in Education, 46,* 1, 29-52.

Barbara B. Levin and Lynne Schrum published their "lessons learned" in January 2013. This paper offered a cross-case analysis of what it takes to leverage technology successfully for school improvement based on eight award-winning secondary schools/districts in the United States. The objective of the research was to identify eight factors that must be addressed simultaneously when technology is used for school reform: vision, distributed leadership, technology planning and support, school culture, professional development, curriculum and instructional practices, funding, and partnerships. The authors evaluated the relevant literature including the barriers to technology integration, as well as how technology leadership plays a role in school improvement. One of the questions was how are leaders of award-winning schools districts using technology to improve their schools. Since the study was performed with school districts from around the country, a checklist was created to capture best practices, as seen in Table 3. Although all of the school districts achieved success with technology, what they had in common were teams of people working together on technology planning and support, tech support on site at each school, and technology facilitators who provided professional development and worked directly with teachers. Another measure of technological success was a director of technology responsible for technology planning at the district level (see Table 1). The authors concluded that there are many school districts in the country that have had the

technology guide them to school improvement and reform. Although eight districts may seem like a small sample size, the authors presented a clear guide to success from the participant districts. Further research could be done to provide this theory in different parts of the country or the globe.

Bebell, D., & Kay, R. (January 01, 2010). One to one computing: A summary of the quantitative results from the Berkshire wireless learning initiative. *Journal of Technology, Learning, and Assessment, 9,* 2.)

Damian Bebell and Rachel Kay published their summary in January 2010. The authors presented empirical evidence of the effectiveness of one to one (1:1) computing models. This paper examined the educational impacts of the Berkshire Wireless Learning Initiative (BWLI), a pilot program that provided 1:1 technology access to all students and teachers across five public and private middle schools in western Massachusetts. The authors did not include a literature review. Using a pre/post comparative study design, the current study explored a wide range of program impacts over the three years of the project's implementation. The study detailed how teaching and learning practices changed when students and teachers were provided with laptops. In addition, all classrooms were equipped with wireless Internet and selected classrooms with LCD projectors, as well as technical and curricular professional development and support to help teachers integrate the new technology into their curriculum. The results of the study found that both the implementation and outcomes of the program were varied across the 5 1:1 settings and over the three years of the student laptop implementation. Despite these differences, there was evidence that the types of educational access and opportunities afforded by 1:1 computing led to measurable changes in teacher practices, student achievement, and student engagement. The study was comprehensive in scope. It was the first study of its kind where student achievement

data based on high stakes standardized testing was linked to a 1:1 initiative. The Berkshire study was the catalyst for many one to one initiatives in Massachusetts as well as the United States.

Abu, A.-R. J., & Qablan, A. (September 01, 2011). How do science teachers, students, and school principals evaluate the availability, connectivity, and utilization of ICT resources at Jordanian schools?. *Journal of Turkish Science Education, 8,* 3, 14-29.

Jamal Abu Al-Ruz and Ahmad Qablan. Published this article in September 2011. The goal of this study was to evaluate the availability, connectivity and utilization of information and communication technologies (ICT) resources in Jordanian schools. The authors' objective, in conducting the research, was to ascertain how students and staff were using ICT resources. There was a brief literature review conducted on issues and student attitudes of ICT in developing countries. The multi-case study approach was used. Study participants were selected from 10 public schools. Seventeen interviews with science teachers, students, and school principals were conducted. Both the schools and the participants were sampled purposefully to represent the various geographic locations and socioeconomic status in the middle and northern parts of Jordan. The authors presented the findings in themes with anecdotal evidence rather than data. The three major themes were: (a) providing better technical support solutions (b) moving toward wireless access (c) emphasizing teacher training. Regarding theme A, the authors stated that Jordanian schools were "in line" with the rest of the world in terms of technical support solutions. However, the evidence they provided showed that the schools in the study were presenting issues common in the United States during the early 1990's such as the problems that arise with outdated antivirus licenses. Regarding theme B, the authors stated that the schools were moving toward wireless access but they were presently using phone lines to access the Internet. Wireless implementation cannot be accomplished using phone lines. The

authors concluded that the teachers needed more technology training. The authors of this study need to review studies on technology integration in developing countries. Follow-up studies could be done in Jordan when more progress has been made in network infrastrasture.

Wastiau, P., Blamire, R., Kearney, C., Quittre, V., Van, . G. E., & Monseur, C. (March 17, 2013). The use of ICT in education: a survey of schools in Europe. *European Journal of Education, 48,* 1, 11-27.

Patricia Wastiau, Roger Blamire, Caroline Kearney, Valerie Quittre, Eva Van de Gaer, and Christian Monseur published this article in March 2013. This report was commissioned in 2011 by the European Commission Directorate General Communications Networks, Content and Technology to benchmark the access, use and attitudes pertaining to ICT in schools. Despite substantial funding for technology in schools and its stated importance in achieving national and European targets, there was a lack of reliable comparative data and indicators. The authors sought to provide more solid evidence of access, use, and attitudes pertaining to ICT. The authors did not perform a literature review of this report. The authors collected data from school administrators, teachers, and students in grade 4, grade 8, and grade 11. A two-step cluster analysis method using SPSS software was used to identify groups of students, teachers, and schools. The report findings were based on 156,634 answers from students, 24,522 from teachers and 10,137 from administrators in 27 countries collected between September and December 2011. Figure 1 illustrated student access to educational technology and broadband by country. Across Europe, 25% and 35% of students in grades 4 and 8, and around 50% of students in grade 11 are in highly equipped schools, with fast broadband (10 mbps or more). However, the percentages of such schools differ enormously between countries. At least 80% of students in grades 4 and 8 are in schools with fast broadband in Denmark, Finland, Norway, and Sweden.

Conversely, less than 20% of students in grade 4 and less than 10% in grade 8 have access to fast broadband in Bulgaria, Croatia, Greece, Hungary, Italy, Slovakia, Slovenia, Poland, Romania, and Turkey. A survey of this scope can be unwieldy, however; the authors succinctly represented the plight of the students in countries with low broadband access. In Europe, ICT is governed by the European SchoolNet, which supplies the Internet access for all countries in Europe. The European SchoolNet is continually studied for review and improvement. Future research needs to be conducted as to how technology integration is affected by the inadequate broadband access in the countries cited in this report.

Ohio's K-12 network upgrades analysis. (2012, March 8). Retrieved March 16, 2014, from http://www.mcoecn.org/wp-content/uploads/2012/06/ODLTF-30812-FINAL.pdf

This report was prepared by eTech Ohio and the Management Council Ohio Educational Computer Network (MCOECN). The report was published in March 2012. The authors asserted that the Internet can no longer be seen as a luxury. It is a necessity especially in the field of education. Access to fast broadband speeds is necessary for learning in today's schools. The primary goal of research was to ensure that Ohio's schools have fast bandwidth to enable student achievement in the 21st century learning environment.

The authors did not perform a literature review when preparing the research. Information from local and state ITC (Information Technology Centers) and Federal E-Rate filings provided the data in Table 4 illustrated that 223 schools have severely restricted bandwidth with less than 10 Mbps and 476 buildings with restricted access of more than 10 Mbps but less than 100 Mbps. The number of students affected in severely restricted schools is 77,256 while the number of students affected in restricted schools is 216,662.

Further data from the report showed that 20% (approximately 700 buildings) are in need of a connectivity upgrade. Approximately 223 buildings or 6%, have inadequate connectivity that prohibits them from using all but the most basic broadband services. While 20% is a relatively low figure, it still represents approximately 300,000 students who either do not have or soon will not have adequate broadband access. Although, not an "academic study" this report directly addressed the broadband access concerns of students throughout Ohio. One strength of the study was the break down of the numbers of building and then by a number of students affected. That kind of number presentation gave the report more of an "educational feel". No mention of teacher numbers was included in this report. Further studies could be done how broadband is used for instructional purposes in Ohio.

Lee, H. J. J., Messom, C., & Yau, K.-L. A. (January 01, 2013). Can an electronic textbooks be part of k-12 education?: Challenges, technological solutions and open issues. *Turkish Online Journal of Educational Technology - Tojet, 12,* 1, 32-44.

HeeJeong Jasmine Lee, Chris Messom, and Kok-Lim Alvin Yau published this article in January 2013. The authors provided research on the challenges associated with the process of electronic textbooks replacing traditional textbooks. The author's objective was two-fold: (a) the challenges and factors relevant to the adoption or refusal of electronic textbooks and (b) the technological solutions to the challenges and factors relevant to the adoption or refusal of electronic textbooks. The authors conducted a literature review in which they found some evidence in the United States, United Kingdom, and Australia that electronic textbooks may become the preferred method in the future, however there were issues preventing their implementation currently, including infrastructure concerns. Schools may not have adequate infrastructure to deliver electronic textbooks properly. The case study involved 180 students and

20 teachers. The participants were interviewed about the challenges of electronic textbook usage and adoption. The data was not presented in this article. Extracted quotes of the interviews were presented in text format. The authors concluded from the interviews that some of the benefits associated with the migration from paper-based textbooks to electronic textbooks were providing lower prices, standardizing format of content, improving quality and accuracy of content, increasing life of ownership, reducing health risk and visual fatigue, improving readability, and protecting copyright. Technologies such as multi-touch, e-Paper, the Web 2.0 and cloud computing were identified during the interviews as potential solutions to overcome the infrastructure challenges. One limitation of the study was that the authors chose to interview a large number of students (180) with a disproportionately low number of teachers (20) without an explanation. In addition, the study was unclear as to whether any of the students and teachers was currently using or piloting an electronic textbook.

Sisman, E. E., & Sahin-Izmirli, O. (December 07, 2012). Problems and solution suggestions related to information technology course according to elementary school principals and information technology teachers (A case from Eskisehir). *Educational Sciences: Theory and Practice, 12,* 4, 2882-2888.

Esra Şişman Eren and Özden Şahin-İzmirli published this article in December 2012. The purpose of the study was to determine the concerns experienced with an elementary school information technology (IT) course and to seek solutions to the problems. One problem was because of elective status; the course was perceived as unimportant. The other problem was the some of the technologies in the course were outdated. The purpose of the research was four-fold: (a) to ascertain the problem with the IT course from the principals perspective, (b) from the teachers perspective, (c) the solutions from the principals perspective, and (d) the solutions from the teachers perspective. A brief literature review was performed specifically in the area of IT

course electives at the elementary level. The authors ascertained that because the course was not compulsory there was not much literature done in this area. The phenomenological study was conducted with ten school principals and ten IT teachers from elementary schools during the 2010-2011 school year. The authors held informal conversations with the study participants. The conversations were transcribed and organized using inductive analysis method. The responses from the two groups were in keeping with one may have expected based on the role of each. While eight IT teachers thought the problem with the IT course was its elective status, only 3 principals thought that was a problem. While 2 IT teachers thought that the school infrastructure needed an upgrade, six principals thought otherwise. The authors of this study concluded that the course should be mandatory for grade 6 and elective for grades 7 and 8. Additionally, the authors concluded that the network infrastructure should be upgraded for the course to be optimized for student achievement. The study was very limited in scope, although the authors claimed similar issues with elementary school IT elective courses existed in developed countries throughout the globe. Future research could be done at the elementary level in developed countries to see if this in a trend and to find possible solutions.

Hayward, J., & Holt, C. (January 01, 2011). Micro-level allocation of ARRA funds. *International Journal of Educational Leadership Preparation, 6,* 1.)

Jacob Hayward and Carleton Holt Lee published this article in 2011. The authors examined the American Recovery and Restoration (ARRA) funds to 103 districts as they pertained to instructional technology, technology infrastructure/support, and non-computer technology. There was no literature review performed for the study. Of the 103 districts that qualified for the study, only one district was selected for the micro-assessment based on three criteria: (a) they

agreed to participate, (b) they had a manageable number of schools with the district, and (c) their request for ARRA funds was mainly to benefit the student population. Table 1 illustrated that $78, 177.21 of the total $210, 946.49 was spent on instructional technology, $91, 317.09 was spent on technology infrastructure, and $38, 582.22 was spent on non-computer technology. Non-computer technology was security items such as electronic doors and card readers. The authors provided a breakdown by high school, middle school, and elementary school. The microanalysis of this district gave the researchers an insight into how the ARRA monies were being used for which type of technology spending. Further studies could be conducted nationwide to ascertain where districts concentrated their ARRA funds in regards to technology. ARRA was “one-time” funds from the federal government and is no longer available, however, a study on the long-term effects of district or school infrastructure could be beneficial.

Pan, S. C., & Franklin, T. (December 01, 2011). In-service teachers' self-efficacy, professional development, and web 2.0 tools for integration. *New Horizons in Education, 59,* 3, 28-40.

Shu Chien Pan and Teresa Franklin published their research in December 2011. The authors examined the relationship between teachers’ self-efficacy and the integration of the Web 2.0 tools in K-12 public schools. The authors attempted to predict the factors that precipitated utilization of the Web 2.0 tools in classroom instruction. The authors also examined the barriers to future implementation. The authors did a comprehensive literature review of self-efficacy, professional development, and school administrator support. They chose self-efficacy as the theoretical framework. Quantitative data was collected through a survey with a sample size of 559 teacher participants. The authors used the Web 2.0 tools in K-12 classrooms. The authors concluded that administrative support increases the use of the Web 2.0 tools especially in policy for filtering or blocking websites. Limitations in accessing websites can inhibit the successful

use of many Web 2.0 tools. The authors identified that without administrative support teachers rarely used the Web 2.0 tools as a part of their instructional practice, even though students are immersed in those tools as a part of their personal and academic life. The authors found that professional development significantly predicted the outcome with a Pearson correlation coefficient of $r = .142$, $p = .020$ ($p < .05$). This suggested that an increase in professional development was correlated with the Web 2.0 tools. The authors concluded that with the proper professional development and administrative support, teachers were more inclined to use Web 2.0 tools. The authors had a large sample size that made this an effective study. Future studies could be performed on whether "acceptable use" and content filtering policies negative or positively affect the use of the Web 2.0 tools in K-12 school districts.

Inan, F. A., & Lowther, D. L. (November 01, 2010). Laptops in the K-12 classrooms: Exploring factors impacting instructional use. *Computers & Education, 55,* 3, 937-944.

Feh Inan and Deborah Lowther published this article in November 2010. The authors examined the factors affecting teachers' integration of laptops into classroom instruction. The authors used a research-based path model based on data gathered from 379 K-12 school teachers to examine direct and indirect contributions of the following institutional factors: (a) overall support for school technology, (b) technical support, and (c) professional development, as well as the following teacher factors: (a) teacher readiness and (b) teacher beliefs. There was no literature review completed by the authors. Three hundred and seventy-nine teachers from 195 Michigan schools participated in the study. The schools represented both private and public districts. All schools were Freedom to Learn (FTL) grant recipients. Additionally, the participating schools were both rural and urban. The authors used a hypothesized path model as described in Table 1. Using a five-point Likert-type scale that ranged from (1) strongly disagree to (5) strongly agree,

teachers rated their level of agreement with statements regarding six main technology integration-related areas: teacher beliefs, teacher readiness, overall support for school technology, technical support, professional development, and laptop integration. Figure 2 presented a summary of key findings: (a) teacher beliefs and readiness directly influence teachers' laptop integration, (b) school-level factors (overall support for school technology, technical support, and professional development) indirectly influence teachers' laptop integration, (c) school-level factors (overall support for school technology, technical support, and professional development) positively influence teacher beliefs and teacher readiness, and (d) teacher beliefs and readiness mediated the indirect effects of school-level factors on teachers' laptop integration. This study was in keeping with many others that proved effective teacher professional development positively encourages technology integration and use of technology into classroom instruction. The study (Table 2) also showed that quality technical support had direct and indirect positive effects on teacher beliefs about using technology in classroom instruction. This study did not evaluate the quality of integration of technology or laptop in instruction. Further studies may include the effectiveness or quality of lessons using laptops in classroom instruction.

Gray, L., Thomas, N., Lewis, L., Tice, P., & National Center for Education Statistics. (2010). *Teachers' use of educational technology in U.S. public schools, 2009: First look*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Dept. of Education.

The National Center for Educational Statistics published their findings in 2010. *Teachers' Use of Educational Technology in U. S. Public Schools, 2009: First Look* provides national data on the availability and use of educational technology among teachers in public elementary and

secondary schools. The purpose is two-fold: (a) to determine the availability of technology and (b) to determine how often technology is used. *The teacher survey included: (a) information on the use of computers and Internet access in the classroom, (b) availability and use of computing devices and software, (c) availability of school or district networks including remote access by teachers and students, (d) use of educational technology, (e) teacher preparation for educational technology in instruction, and (f) technology-related professional development activities.* The survey was conducted by the Office of Educational Technology (OET) in the U.S. Department of Education (US DOE) and the National Center for Education Statistics (NCES). NCES developed a survey to ascertain what technology proficiency means in the public school system. NCES used the Fast Response Survey System (FRSS) to conduct these surveys. FSRR collects issue-oriented data useful to educational analysts, planners, and decision makers. 2005 public schools in the United States were asked to provide lists of full-time teachers. Surveys were mailed to 4133 teachers. The survey findings presented a major difference in use of technology in high-income districts over low-income districts. Teachers reported increased use of technology is more common in middle and high school rather than elementary school. Teachers reported that the following activities prepared them to make effective use of educational technology: (a) professional development activities, (b) training provided by tech support or integration staff, and (c) independent learning. Teachers reported that they used blogs, wikis, and other social media for parent and student communication as well as class assignments. Teachers indicated the school network was available for entering or viewing the following: (a) grades (94 percent), (b) attendance records (93 percent), and (c) the results of student assessments (90 percent).

Peck, C., Mullen, C. A., Lashley, C., & Eldridge, J. A. (March 07, 2012). School leadership and technology challenges: Lessons from a new American high school. *AASA Journal of Scholarship & Practice, 7,* 4, 39-51.

School Leadership and Technology Challenges: Lessons from a New American High School is an article originally presented at the American Association of School Administrators Journal. The authors investigated the challenges that school staff face in high **schools is** undertaking large-scale **technology** reform. The researchers studied an American comprehensive high **school** in southeastern United States. Due to a poor network infrastructure, **school** administrators and teachers used "workarounds" that alleviated **technology** problems while seeking to create innovative **technology**-infused instructional practices. The research team consisted of university faculty and graduate students with K12 administrative experience who were not staff at the study site. The study was conceived non-experimental. The onsite research included observations of predominant technology practices in classrooms, media spaces, hallways, and large common spaces (e.g., library cafeteria, gymnasium). To augment understanding, the researchers conducted interviews with classroom teachers, technology integration, and tech support staff. The researchers concluded that three issues existed: (a) an inadequate network structure that negatively affected technology implementation; (b) teachers' conflicting obligation to encourage and police student technology use due to an unsatisfactory firewall, and (c) a digital media culture which gave students access to online resources. Based on the study, researchers could not predict whether instructional technology reform was a disruptive innovation that will radically alter schooling or whether the widespread rethinking of education will result from technological advances.

Carmichael, P., & Procter, R. (January 01, 2006). Are we there yet? Teachers, schools, and electronic networks. Curriculum Journal, 17, 2, 167-186.

Are We There Yet? Teachers, Schools and Electronic Networks explored teacher use of school networks in primary and secondary **schools** in the United Kingdom (UK). In the UK, teachers made less use of electronic networks to develop their professional practice. Researchers hoped to discover what factors encouraged the development and sharing of the best practice and use of electronic networking. A range of data for the use of electronic **networks**, tools, and resources were collected that included: (a) a survey of over 250 teachers, (b) an audit of participating **schools**' information technology infrastructures and available resources, and (c) semi-structured interviews. Researchers discovered that while use of information technology (IT) is a well-established element of classroom practice, teachers made less use of electronic **networks** to develop their professional practice. Researchers found that more professional development needs to be done to provide resources, services, and online environments that support knowledge creation about teaching and learning. While school administrators verbalized the possible uses of the school network, teachers do not understand them. School administrators need to provide additional professional development for the possible uses of the school network. Researchers found that one exception was that email and text messaging appeared to have become embedded in the daily professional lives of many of the study participants.

Scimeca, S., Dumitru, P., Durando, M., Gilleran, A., Joyce, A., & Vuorikari, R. (December 01, 2009). European schoolnet: Enabling school networking. European Journal of Education, 44, 4, 475-492.

Enabling School Networking builds on the activities and experience of the longest established European initiative called the European Schoolnet regarding information, communication, and

technology (ICT). The purpose of the study was an examination of how schools make strategic and effective use of ICT to improve educational outcomes as well as how school networks support best the use of technology in learning. Researchers sought to explain the impact of ICT on students engaged in the teaching and learning process and their achievements, as well as the impact on teachers in terms of their instructional practice and professional development. The researchers examined a meta-analysis of 17 impact studies including national evaluations of ICT initiatives, ICT monitor reports, large and small technology implementations, national research reviews, international and European comparisons, as well as European case studies. Researchers concluded that ICT improves the achievement levels of students in science, design, and technology at age 7 through 16. There was a positive association between the length of time that ICT was used and students' performance in mathematics. The mathematics results were based on the Program for International Student Assessment (PISA). Researchers also discovered that students, teachers, and parents agree that ICT has a positive impact on student learning. In the European Schoolnet, researchers found that 90% of teachers use ICT to prepare their lessons. Additionally, teachers use ICT to prepare lessons collaboratively with colleagues.

Craig, B., & Stevens, K. (December 01, 2011). Learning without limits: The promise of high-speed learning networks for rural and inner-city communities. *International Journal of Learning, 18,* 1, 537-550.

The authors were By Barbara Craig and Ken Stevens. The article was published in December 2011. In *Learning without Limits: the Promise of High-Speed Learning Networks for Rural and Inner-city Communities*, researchers examined whether Web 2.0 technologies promote collaboration and participation among students, teachers, and experts outside the school and the local community. A major 21st Century challenge for schools is to provide a school network

infrastructure that can support up-to-date applications that require fast synchronous bandwidth speeds. The researchers explored the premise that connecting institutions through a high-speed learning network benefits students with the promise of individualized learning and digital opportunities to pursue academic interests. The researchers examined two projects: (a) project one was conducted in remote rural communities in Canada where linking classes across schools to share teaching and learning resources makes possible a wider range of academic subjects available to students in very small schools, and (b) project two was conducted in a major New Zealand city where benefits of aggregating learning across a network and linking schools to other institutions was investigated. The researchers considered the outcomes for students, the implications for teachers, and the concept of the traditional standalone school. Researchers found that although school districts exist mainly as self-governing stand alone institutions, collaboration between districts may provide high-speed networks as a shared resource, which will provide educational and economic opportunities. In the case of technology finance and procurements, this was particularly true of sharing servers to store resources but also minimizing the risk of making bad technical decisions that could prove costly. Researchers found that urban and rural schools may need to collaborate, so their students are working in an open online learning environment with the flexibility of anytime, anywhere learning provides a wide range of academic opportunities. The future organization of school networking lies in aggregated networks, not competition among autonomous institutions.

Raob, I., Al-Oshaibat, H., & Ong, S. L. (May 01, 2012). A factor analysis of teacher competency in technology. *New Horizons in Education, 60,* 1, 13-22.

Ismail Raob, Hussein Al-Oshaibat, and Ong Saw Lan published this analysis in May 2012. The authors sought to analyze the factors of teaching competency in technology. The authors asserted that teachers' ability to integrate technology was "stalled" by the lack of successful professional development opportunities in Thailand. In the quantitative study, the authors surveyed 317 secondary school teachers from private schools in the Pattani province of Thailand during 2011 academic year, which were selected by a stratified random sampling procedure. They used frequencies and exploratory factor analysis in the study. The authors' conclusion was that three themes emerged as the factors predicting successful use of technology by a teacher: (a) basic technology operations, (b) personal use of technology tools, and (c) teaching with technology. A very brief literature was included in this analysis. The literature review presented information about what 21st century students could do with technology and what students expected in the 21st century classroom. The factor of the basic technology operations totals variance was 30.327%. The teachers had the ability to open and close applications, setup a printer, change desktop settings, install/uninstall software and create keyboard shortcuts. The factors of personal use of technology tools total variance explained were 14.414%. The teachers used Microsoft office for communicating, collaborating, conducting research, and email. The factor of teaching of technology, that total variance explained, was 11.304. Teachers applied computers and related technologies to support curriculum and instruction in their grade level and subject areas. The authors concluded that effective technology integration begins with identifying and understanding the factors of teaching competency with technology. The authors presented the quantitative results of this study but never tied them to the original precept of why professional development opportunities were stalled in Thailand.

Lai, K. -. (2010). School readiness for using ICT adapted to student needs. *Technology and Teacher Education Annual, 3*(Conf 21), 1487-1490.

Kwok-Wing Lai published this article in March 2010. The author asserted that schools have to consider the relationship between technology and pedagogy as well as the infrastructure required to support technology-enhanced pedagogies. The author's objective for the research was for schools using technology need change the physical infrastructure of the school. The author also provides students with access to technology, allowing access to digital content, and encouraging the use of personal computing devices. The author did not perform a literature review. The author used data from other studies for this paper. The author stressed that students could learn outdoors especially in science classes when wireless was available. In this way, learning could be "outside the four walls" of the traditional classroom. The author concluded with three recommendation for schools "serious about utilizing technology to benefit teaching and learning." (a) schools should use technology to support student-centered pedagogies; (b) student-centered learning means personalizing learning and technology can give learners choice and voice, and (c) technology can support personalized learning by going beyond the classroom walls. The author provided no recommendations of information for readiness as the title of the paper suggested.

Bauder, D., Ford, K., & Paben, S. (January 01, 2006). Are we ready for the virtual neighborhood? An assessment of teachers' readiness for e-learning. *Technology and Teacher Education Annual, 2,* 1445-1450.

Deborah Bauder, Ken Ford, and Sandy Paben published this research in Mar 19, 2006. As districts in the central New York region prepared to embrace new technologies, the authors were

afforded an opportunity to assess current use and proficiency of a wide range of educational technologies. The survey results presented in this paper offered a look at the current state of technology adoption. The authors reviewed literature produced in the 1980s, 1990s, and the 2000s. The teacher study was designed to examine the integration of information technologies into the curriculum and readiness for e-learning. In total, 1382 surveys were collected from teachers in 12 school districts and the Oneida Boards of Cooperative Educational Services (BOCES). It represented 63% of the teachers in the region. Table 1 illustrated that no teachers scored in the advanced level of proficiency in any of the technology tools included in the survey. In the interviews, teachers stated that when they did not know how to use a technology, they asked the students to use it. The strength of the study was the large number of participants in a relative small region of New York State. However, the study size is limited to one geographical area by that limiting its relevancy to areas outside that region. The authors recommended that teachers should get the continued professional development.

The Richard W. Riley College of Education and Leadership, & Walden University. (2010). *Educators, technology and 21st century skills: Dispelling five myths*. Baltimore, Md: Walden University.

Walden University published this report in 2010. In *Educators, Technology, and 21st Century Skills: Dispelling Five Myths*, authors dispelled the five myths about educators, technology, and 21st century skills. In a study conducted by Grunwald and Associates, researchers sought the connection between technology and 21st century skills and their use in the classroom. The findings in this report depended on a 2009 survey of more than 1,000 U.S. educators, including 783 teachers and 274 principals or assistant principals. The researchers explored the use of technology from the point of view of educators. The first myth was that both newer teachers and

those with greater access to technology are more apt to use technology in the classroom. Veteran teachers, in fact, use technology to support learning just as much and as often as the newer teachers. Myth number two is that only the smarter students benefit from the use of technology. Technology enhanced the academic needs of both challenged and gifted students. The third myth was students growing up in the digital age and who have become so accustomed to technology that it is no longer an important aspect of student learning. With the use of technology, students show a higher degree of engagement in learning when compared to those who spend a little time with technology in school. The fourth myth was that school administrators share the same understanding as teachers when it comes to technology integration and 21st century skills. This study discovered that administrators believe that people use technology more often than it is to support learning in the classroom and have higher expectations about the impact of technology integration. Finally, the fifth myth is that teachers have had sufficient professional development in technology and 21st century skills. In this study, most teachers felt that their training in the area of technology was inadequate and that they need more help with learning how to operate new technologies and how to incorporate them adequately in the classroom. It was especially true of pre-service and teacher training programs. The authors made recommendations to both teachers and administrators on how to expand the educational benefits from the use of technology integration in the classroom. The study shows that while teachers seem open to the idea of using technology in their instructional practice additional work must be done in the area of effective professional development, especially in the area of pre-service teachers.

United States. (2010). *Transforming American education: Learning powered by technology : National Education Technology Plan 2010*. Washington, D.C: U.S. Dept. of Education, Office of Educational Technology.

The United States Office of Educational Technology (US OET) wrote The National Education Technology Plan (NETP) with input from the public, industry officials, educators, and students. The plan is entitled "Transforming American Education: Learning Powered by Technology". Each section outlines concepts for using technology to transform education. NETP contains five key goals: (a) learning, (b) assessment, (c) teaching, (d) infrastructure, and (e) productivity. The goal for completion of NETP is 2015. The infrastructure goal cited in the plan was to provide broadband connectivity for all students, “everywhere in schools, throughout communities and in students' homes”. As the country moves closer to the due date for broadband access, it does not seem that students are closer to the goal. Overall, the plan addresses technology trends that could transform education, such as mobility and accessibility, the rise of digital content, and the rise of online social networks for information, collaboration, and learning. Some research could be conducted using sample school districts to ascertain the goals of NETP and how districts measure up against the goals of the plans.