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Innovativeness: One School's Experience of Sustaining Educational Change

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Honor and Glory to God Alone

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Abstract

This single, embedded case study focused on educators' experiences of educational change as they adopted, implemented, and sustained a one-to-one computing innovation over 20 years. The purpose of the study was to explore the *innovativeness*, the capacity of a school community to take on change for continuous educational improvement over time. Through interviews and focus groups with administrators, teachers, students, and graduates, observations of current classroom practices, and archival data, the study provides an understanding of how individuals experienced change and how a school sustained change over an exceptionally long period of time. Data analysis revealed multiple rationales for the implementation of one-to-one computing, including the development of a constructivist environment, the empowerment of women, preparation of students for college and the 21st century work force, and the need to keep the school's educational program on the "cutting-edge." The study of this individual school community suggests the importance of a strong educational philosophy, flexibility of implementation, an environment that encourages risk-taking, and collegiality. The study also demonstrates that change occurred on a continuum and continued to progress as hardware, software, and the Internet evolved, and as faculty became more knowledgeable of the application of the program to teaching and learning.

Descriptors: *educational reform, educational change, one-to-one computing, ubiquitous computing, building capacity for change in schools*

Chapter 1: Introduction to the Problem

This study provides the framework of an educational change study of a school and the individuals associated with the school as it sustained one-to-one computing, ubiquitous computing over 20 years. Chapter one explains the purpose and significance of the study. The second chapter provides background information, the theoretical framework, and a review of the literature relevant to educational change and one-to-one computing. Chapter three explains the case study methods that were used in the study, as well as explanation of the participants, procedures, data collection, and data analysis. Chapter four reports the findings from interviews, observations, focus groups, and document analysis. The fifth and final chapter provides an analysis of the results and includes implications for practice and for future research.

Introduction

For more than 50 years, policymakers and educators have struggled with the low performance of students in schools in the United States (Cuban, 2007, 2008, 2009b; Elmore, 2004; Labaree, 2010; Seller, 2001). The launch of Sputnik, a Russian spacecraft, began a trend of concern that American schools were falling behind as compared to schools world-wide (Cuban, 2009b; Seller, 2001; Stake, 1998). In the 1980s, "U.S. presidents, corporate leaders, and critics blasted public schools for contributing to a globally less competitive economy, sinking productivity, and jobs lost to other nations" (Cuban, 1998, p. 462). Although some scholars and educators (Berliner & Biddle, 1995; Stedman & Smith, 1983; Vik, 1984; Vinovskis, 2003) believed that the educational crisis in United States was not as bleak as purported in *A Nation at Risk* (1983), concerns about the ability of the United States to remain competitive in a global economy have continued, as reflected in *No Child Left Behind* (Berliner & Biddle, 1995; Gutherie & Springer, 2004; Hayes, 2004; Ravitch, 2010; Stedman & Smith, 1983; Vik; 1984;

Vinovskis, 2003). This gave rise to the continuous influx of educational reforms aimed at improving student achievement (Cuban, 2008, 2009a, 2009b, 2013a; Elmore, 2004; Elmore & Burney, 1997; Labaree, 2010, Payne, 2008; Tyack & Cuban, 1995). Many of these educational reforms have focused on changing teaching practices to a more constructivist model (Cuban, 1993a, 1993b, 2008, 2009b, 2013a; Cuban, Kirkpatrick, & Peck, 2001). When teachers espouse a constructivist pedagogy, learning is less didactic and more student-centered, and students are engaged collaboratively in solving authentic, real-world problems (Fosnot, 1989; Jonassen, Peck, & Wilson, 1999; Means, Penuel, &, Padilla, 2001; Sandholtz, Ringstaff, & Dwyer, 1997; Solomon & Schrum, 2007; Zhao, Zhang, Lei, & Qiu, 2016). In constructivist classrooms, teachers facilitate students constructing knowledge through inquiry, reflection, and experience (Fosnot, 1989; Jonassen et al., 1999; Means et al., 2001; Sandholtz et al., 1997; Solomon & Schrum, 2007; Zhao et al., 2016).

In the 1980s, computers were introduced into schools as an educational reform for a variety of reasons. Some believed that computers would support the creation of constructivist learning environments (Means, 1994; Rogers & Price, 2007; Zhao et al., 2016), while others saw the introduction of computers into the classroom as a means of better preparing students for the knowledge-based workforce they would enter (Cuban, 2008, 2009a; Fullan, 2013a; Hargreaves, 2003; Schrum & Levin, 2009; Sheninger, 2014; Warschauer, 2011). Policymakers and educators soon realized that one, or even several computers, within a classroom did not significantly change instructional practices (Cuban, 2001, 2008, 2013a, 2013b; Papert, 1980, 1993; Stallard & Cocker, 2015). Proponents of educational technology suggested that the absence of significant instructional change was due to lack of teacher and student access to current hardware and software (Cuban, 2001, 2008, 2009b). In essence computers had failed to change pedagogy

because of the way they were used, not due to some inherent flaw in the machines. The invention of the portable or laptop computer offered a solution to this problem, and in the late 1990s, a small number of schools began to experiment with one-to-one computing programs as a tool for reforming education in the United States and other countries (Dixon & Einhorn, 2016; Johnstone, 2003; Livingston, 2006). In 2010, Tom Greaves, CEO of the Greaves Group and a key researcher in the "Project RED" study on the successful implementation of one-to-one computing estimated that 3,000 schools across the United States were in the process of implementing some form of a program in Grades 3-12 (McLester, 2011). Proponents of one-to-one computing believed that true technology integration resulting in a more constructivist learning environment could only occur when each student had access to technology anytime, anywhere (Livingston, 2006). The use of technology sporadically or as a reward held little promise of changing the manner in which teachers taught or students learned (Livingston, 2006). Thus began the pursuit to create classrooms with one-to-one student to computer ratio. This would come to be known as one-to-one computing.

Increasing student and teacher access to technology alone has not sufficed for the education reform that educators and technology proponents have sought. The power of microcomputers, access to the Internet, and decreasing costs have far surpassed what the early adopters of educational technology envisioned in the 1980s (David, 1994; Schrum & Levin, 2009; Stallard & Cocker, 2015). However, for the most part, providing technology to students and teachers has not substantially changed education in the United States (Cuban, 1993a, 2001, 2009b, 2013a; Cuban et al., 2001, David, 1994; David & Cuban, 2010; Prenksy, 2016; Stallard & Cocker, 2015). While there are examples of teachers and schools that have been able to leverage technology to support pedagogical reform, technology has not improved student achievement on

a large scale (Cuban, 2009b, 2013a, 2013b; David, 1994; Zhao et al., 2016). The promise that educational technologies would transform teacher-centered practices into student-centered pedagogies has not been fully realized for several reasons (Cuban, 2013a, 2013b; David, 1994; Zhao et al., 2016). The inability to substantially change the nature and practice of school and to diffuse one-to-one computing beyond small scale successes are two of the predominant reasons for why one-to-one computing has not fully transformed schools in the United States.

The Paradigm Problem

David (1994), Cuban (2013a, 2013b), and Stallard & Cocker (2015) argue that one reason educational technologies have not fulfilled the promise of reform is that the technology implemented was focused on improving the effectiveness of what schools were currently doing, not on transforming education. Cuban (2013a) notes that "most teachers have domesticated innovative technologies by incorporating them into their existing repertoire of teacher-directed practices" (p. 10). Educators are unlikely to implement innovations that require they change the traditional roles, behaviors, and structures known to schooling (McLaughlin, 1976); however, in a further review of the Rand Change Agent Study, it was noted that teachers required to implement change can change beliefs as they work with the reform (McLaughlin, 1990). Zhao et al. (2016) believe that technology has been seen as a tool to either replace or aid the teacher rather than as a means of facilitating authentic, real-life learning experiences for students. The current focus in schools on increasing standardized test scores and teaching technology as an isolated subject rather than as an integrative part of the curriculum, according to Zhao et al., has limited technology's potential to transform schools. The findings of Cuban and Zhao et al. are consistent with the much earlier findings of the Rand Change-Agent Study (McLaughlin, 1976) which concluded that the adoption of an educational innovation does not necessarily translate to

improved teaching and learning. In most cases, teachers have incorporated computers into their classrooms as means to support traditional teacher-centered practices rather than to transform teaching and learning into more constructivist, student-centered experiences (Cuban, 2008, 2013a, 2013b).

Cuban (1986, 1993b, 2013b, 2018) proposes several reasons for why there has been a significant amount of constancy in teaching practices. He also notes that where change has occurred it has been more likely to be a hybrid change than a radical shift from teacher-centered practices to student-centered practices. Cultural beliefs and norms regarding how knowledge should be transmitted to another generation as well as beliefs regarding the societal purpose of school are strong forces for retaining the status quo in schools. Another reason, stated by Cuban (1993b), for the lack of movement towards student-centered instructional reforms is poorly planned implementation processes which quickly lose the attention and support of teachers. Over time, the organizational structure of education in the United States has become standard with few teachers "willing to upset their controlled, familiar world for the uncertain benefits of a student-centered classroom" (Cuban, 1993b, p. 18). Pressure to assure that students have obtained certain levels of knowledge adds to teachers' unwillingness to explore the unknown of student-centered practices. In general, teachers prefer stability and have a cautious attitude toward change (p. 18). According to Cuban, teachers' knowledge, beliefs, and attitudes toward teaching and student learning have also deeply impacted the practice of teaching. Cultural and societal beliefs and norms, as well as teacher beliefs, regarding the nature of schooling can be strong resistors to change, and hence, can account for why few educational innovations are implemented completely and as intended (Elmore, 2004; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Payne, 2008; Stallard & Cocker, 2015).

The Problem of Diffusion

A second reason that schools in the United States have not experienced transformation is the difficulty of transferring models of success from one classroom to another, from one school to other schools or school districts. (Dede, Honan, & Peters, 2005). Successful educational innovations are frequently difficult to implement in a variety of settings without making significant adaptations that compromise the integrity and effectiveness of the innovation (Dede et al., 2005). "Scaling up" an educational innovation, such as one-to-one computing, requires changes to the organization and to the culture of the school (Fullan, 2007, 2016; McLaughlin, 1976; Payne, 2008). DiMaggio and Powell (1983) suggest that innovation is difficult at both the micro and macro levels because of "institutional isomorphism" that is, institutions, such as schools, find their legitimacy in being more alike than different. Institutional isomorphism in schools is also fostered by the fact that schools must answer to other entities such as state and federal educational departments. Schools are more likely to seek homogeneity than they are innovation, even when the innovation demonstrates improved performance in schools. Others argue that an understanding of an innovation and change must begin at the local level, in the classroom, before the educational practice can be disseminated more broadly (Elmore, 2004; Wiske & Perkins, 2005). A change model that attends to the individual, group, and organizational capacity for change provides a more holistic approach to the adoption, implementation and sustainability of an educational innovation (Little, 2001). Fullan's Educational Change Model (2007, 2016) provides such a model for understanding how and why change occurred within a school community as it sustained one-to-one computing. More importantly, Fullan's model of change provides a lens in which to offer insights into what conditions are needed to ensure the success of an educational innovation over time.

Problem Statement

Schools in the United States have been in a continuous state of educational reform for decades (Fullan, 2007, 2016; Cuban, 2008, 2013a; Seller, 2001). The need to "fix" American education has led to the adoption of numerous innovations that have met with limited success, failed, or disappeared (Fullan, 2007, 2016). Intrinsic to the problem of unsuccessful or limited educational reform is our insufficient understanding of the complexities of change (Fullan, 2007, 2016). The success or failure of educational reforms is directly related to the capacity of individuals or schools to "put into practice" an innovation (Fullan, 2016, p. 6).

Fullan (2007, 2016) makes an important distinction between *innovation* and *innovativeness*. Innovation "concerns the content of a given new program, whereas innovativeness involves the capacities of an organization to engage in continuous and new improvement" (Fullan, 2016, p. 10). While some educational reforms should be rejected because they will not improve schools, many good reforms fail for lack of support. The success or failure of an educational innovation depends on the innovativeness, the capacity of persons, individually and collectively, to sustain change over a significant period of time.

The widespread introduction of one-to-one computing in the United States during the past two decades as an educational reform with the potential to transform schools into more constructivist learning environments has been successful in some classrooms and schools and has been totally abandoned in other educational settings (Hu, 2007; Huffington, 2012; Keengwe, Onchwari & Onchwari, 2009).

Purpose of Study

The purpose of this study was to explore through Fullan's Educational Change Model (2007, 2016) the individual, collective, and organizational capacity for educational change as a

school sustained a one-to-one computing innovation over two decades. Of interest was the *innovativeness* of individuals and a school community, as they adopted, implemented, and sustained one-to-one computing over such a long period of time. The researcher sought to understand why and how participants, individually and collectively, were able to embrace and sustain an educational innovation over a significant period of time. Through interviews, archival documents, and observations, the researcher sought to provide a description of the educational change that occurred in the school community over 20 years as the result of one-to-one computing. The researcher looked for commonalities which offer insights into how and why a school community sustained an educational innovation for nearly two decades. The perceptions of various individuals regarding one-to-one computing provided a deeper understanding of the capacity of schools to embrace change. The researcher explored what motivated or inspired individuals to embrace change, how individuals adopted or adapted the innovation to their local context, who the key individuals were in the process of change and why, and the role that the organization played in the process of change.

Significance of Study

An abundance of information on educational change exists relative to the implementation and adoption of innovations (Cuban, 1993b, 2013a; Fullan, 2007, 2016; Hall & Hord, 2015). Similarly, as two meta-analyses illustrate, a great deal of research exists on the process of implementing one-to-one computing programs in K-12 schools (Penuel, 2006; Zheng, Warschauer, Lin, & Chang, 2016). Research on ubiquitous computing programs has been primarily conducted during the first five years of a program, with the majority of studies being done in the first three years. Some researchers have called for more longitudinal studies based on the idea that innovative programs need to live through an implementation period before long-

term effects are realized (Dixon & Einhorn, 2014; Holcomb, 2009; Lei, 2010a). Some researchers of educational change note that most studies address the early years of implementation of educational reform, neglecting to determine what allows the sustainability of an innovation. Sustainability can only "be addressed by examining change experiences in a range of settings from the longitudinal perspective of change over time" (Hargreaves & Goodson, 2006). By providing a longitudinal description of educational change and the factors that allow for sustainability of an educational innovation over time, the study will contribute to the body of knowledge regarding educational change.

Policymakers and educators considering implementing a one-to-one program or discontinuing a program will benefit from an understanding of educational change as it was implemented over time. The study also seeks to provide educational leaders and teachers with a greater understanding of the *innovativeness*, the capacity to embrace and sustain change for educational improvement, of a school and its members. Through an in-depth understanding of one school's journey of educational change, the study intends to offer insights into what is needed in order to build capacity for change, especially change mediated by the use of technology.

Research Questions

The guiding research question for this study is: *How and why did a school community experience change as it adopted, implemented, and sustained one-to-one computing over time?*

Sub-questions to this research are:

1. Has teaching and learning changed since the implementation of one-to-one computing, and if so how do participants understand the changes that have occurred?

2. Has one-to-one computing changed over time in this school, and if so, what has changed and why has it changed?
3. How did the organization and individuals within it sustain one-to-one computing over time?

Limitations and Delimitations of the Study

Limitations

A limitation is an aspect of a study that the researcher knows may negatively affect the results or the ability to generalize the results but over which the researcher has no control (Gay & Airasian, 2003).

While the researcher was aware of pre-existing biases that may have existed due to her involvement with one-to-one computing and the fact that she has worked in three sister schools in the organization, precautions were taken through the use of triangulation of interviews, observations, and documents to minimize bias. In fact, as part of the observations, the researcher spent two full days following an upper school student and a middle school student through their classes to see if the reporting of how the Tablet PCs were used through interviews and observations was consistent with a day in the lives of these students.

Another limitation of this study was participant recall of the evolution of the one-to-one computing program over a substantial period of time. By conducting multiple interviews of a significant number of participants and analyzing archival documents and policies, the researcher sought to minimize the effect of this limitation. The inability to collect sufficient data from students and teachers who are no longer at the school but who were participants in the one-to-one computing program for a period of time also was a limitation to the study. Access to five former administrators, as well as the technology director and several teachers who have been a part of

the program since its inception, provided continuity regarding the evolution and sustainability of the program, and subsequently minimized this limitation.

Several other limitations occurred during the collection of data in this study. The first was the delay of visiting the site during the 2017-18 academic year due to flooding which closed the school for a week in early September. The researcher further delayed the visit out of sensitivity to members of the school community, as many were impacted by the flooding. Due to the weather-related situation, the school postponed its alumnae weekend which hindered the researcher's efforts to conduct a focus group of alumnae. Instead, 15 alumnae were interviewed either face-to-face or through video conference. While these interviews allowed for more data and the participation of alumnae from all over the United States, a focus group may have prompted individuals to remember more of their experiences. Another limitation was the fact that the pool of faculty willing to participate in the study was not large enough to allow for random selection of participants. Every faculty member who volunteered for the study was interviewed and observed twice, with the exception of one faculty member who had surgery and had not returned to teaching; however, this faculty member was interviewed. A final limitation is that the division heads chose the students for the focus groups and the participants of the faculty focus groups were voluntary.

Delimitations

Delimitations are typically constraints placed upon a study prior to data collection in order to narrow the scope of the study (Charles & Mertler, 2002). A delimitation of the study is the unit of analysis, the school. The researcher chose to limit the case study to a specific school, an independent Catholic school for girls PK-12 located in an urban location in southwest United States. While the scope of the study is appropriate for the case study conducted, the

demographics of the school affect the ability to generalize the results to a larger and more diverse population. As in any case study, the findings of this study only offer theoretical propositions (Yin, 2014). Hence, the findings of this study offer how one school was able to implement and sustain change over a period of time, and may not be applicable to schools that are not similar to the one studied. As a private, independent, faith-based school, Sophia Academy is not subject to the same forces as public schools, such as the types and levels of accountability. Although the school belongs to an organization of schools, it is autonomous in its operations and only accountable to the organization for its living of the educational mission. As Lichtman (2014) points out, "almost by definition, change is easier in private and charter schools than in many public settings" (p. xxi). Further limitations to the study were the size of the school, which is relatively small for a middle and upper school, and the fact that the school is single-gender.

Organization of Dissertation

Chapter 2 of this study provides a review of the literature on aspects of educational change applicable to this study, including Fullan's Educational Change Model (2007, 2016). Research on one-to-one computing regarding the operational components of educational change within the one-to-one computing school are discussed. The findings of studies regarding pedagogical change, technology integration, and sustained change are also included. Chapter 3 details the methodology used for this qualitative embedded, single-case design study. Chapter 4 reports the findings of the study, while Chapter 5 concludes the dissertation with a discussion of the findings and implications for future study. A description of the school and program studied is included in the methodology section.

Definition of Terms

For the purposes of this study, the following definitions will be used:

24/7 access – refers to the fact that students and teachers have access to computers and the Internet whenever and wherever they choose to use technology

Best practices – refers to practices that reflect current research on providing the most solid, reputable, state-of-the art methods in education (Zemelman, Daniels, and Hyde, 1998)

Organizational change – a planned activity of which the goal is to realign the organization with its environment

Change agent – an individual or group responsible for facilitating change

Change communication – the process of a change agent communicating an innovation to an intended adopter which takes place within a specific environment (Ellsworth, 2000)

Cooptation – an innovation is modified to conform to traditional practices of teaching either because of resistance to change or lack of skill on the part of implementers (McLaughlin, 1976)

Deep learning goals – a phrase used by Fullan & Langworthy (2014) to describe what they believe the current learning goals of educational reform should be: critical thinking and problem solving; communication; collaboration; creative thinking and imagination; character education; and citizenship (Fullan, 2013c)

Educational change – the process of adoption or adaptation for the purpose of achieving an educational goal(s)

Implementation – the initial process of putting a program or reform into practice (Fullan, 2007, 2016)

Innovation – the content of a new program (Fullan, 2007, 2016)

Innovativeness – the capacity of an individual or organization to engage in continuous and new improvement (Fullan, 2007, 2016)

Institutionalization – "the long-term viability and integration of a new program within an organization" (Johnson, Hays, Center, & Daley, 2004, p. 136)

Intended adopter – the individual or organization who the change agent hopes will adopt an innovation or program (Ellsworth, 2000)

Lethal adaptation – an alteration to an innovation that undermines the expected benefits of the innovation (Beabout & Carr-Chellman, 2008; McLaughlin & Mitra, 2001)

Mutual adaptation – the process by which an innovation and its adopter and/or environment change during implementation (Beabout & Carr-Chellman, 2008; Berman & McLaughlin, 1976)

New pedagogies – a term used by Fullan & Langworthy (2014) to describe changes that must occur to teaching and the learning environment in order for "deep learning goals" to be achieved. These new pedagogies require "changes in how relationships between students and teachers are structured, in how teaching and learning is practiced, and how learning is measured (p. 2)

One-to-one computing – a program in which every student and every teacher has a laptop or Tablet PC with Internet access for use at school and at home

Pervasive computing – all students and teachers, in a school setting, have 24/7 access to computers and the Internet in a manner that makes the use of technology seamless with the ordinary tasks of learning and teaching

Sustainability – an innovation's continued ability to meet the needs of its intended adopters (Johnson, Hayes, Center, & Daly, 2004)

Tablet PC – a device similar to a laptop, but which has the additional capability of allowing the user to write and draw upon the computer screen

Ubiquitous computing – all students and teachers, in a school setting, have "anytime, anywhere" access to computers and the Internet

For the purposes of this study, ubiquitous computing, one-to-one computing, and 24/7 access may be used interchangeably. In similar manner, laptop may refer to a laptop or a Tablet PC.

Chapter 2: Literature Review and Theoretical Framework

Chapter 2 begins by providing some background information on the use of technology to drive educational reform. This sets the context in which educational change will be considered in this study. The chapter includes a discussion of several aspects of educational change, including: capacity building, the role of school culture and professional development in educational change, and the diffusion of an educational innovation. A brief history of one-to-one computing as an educational reform and research on the impact of one-to-one computing in K-12 schools is provided. An explanation of Fullan's Educational Change Model (2007, 2016) as the theoretical framework, for this study follows. A brief conclusion aimed to situate the study as a study of educational change due to the innovation, one-to-one computing, as it was sustained within a school over 20 years, closes the chapter.

Educational Change and Innovations

There is a significant amount of literature on the adoption and implementation of education reforms and innovations within schools (Cuban, 1993b, 2013a; Fullan, 2007, 2016; Hall & Hord, 2015; Rogers, 2003). Research on individual school reform efforts focusing on adoption and implementation are legion, but few have illustrated what it takes to institutionalize or sustain change (Cuban et al., 2001; Fullan, 2007, 2016; McLaughlin & Mitra, 2001). In the area of technology, and specifically, one-to-one computing, much of the research has focused on programs during the adoption and implementation stages rather than on programs that have been sustained for a significant period of time.

Capacity Building for Change

A significant amount of research exists on the need to build the capacity for change within individuals, organizations or systems (Fullan, 2007, 2016; Harris, 2001, 2011; Johnson et

al., 2004; Stoll, 1999, 2009). Fullan (2016) defines capacity building as the on-going process of developing the knowledge, skills, and competencies of individuals, individually and collectively, to engage in change for educational improvement. Stoll (1999) believes capacity building is "the power to engage in and sustain continuous learning of teachers and the school itself for the purpose of enhancing student learning" (p. 506). McLaughlin and Mitra (2001) suggest that sustainable reform can only occur when the entire school community not only implements a reform, but also embraces and infuses throughout the school the fundamental principles behind the innovation or program. Those who embrace the moral purpose of education, of making a difference and bringing about improvements in the lives of students (Fullan, 1993), are constantly engaged in developing methods and programs intended to increase student achievement (Harris, 2011).

Building the capacity for change occurs long before an innovation is introduced to a school (Fullan, 2007, 2016; Harris, 2011; Stoll, 2009). Capacity building is preparing the ground for seeds to be planted in the future. It is developing a culture in which the practice of teaching is enhanced by constant reflection and critique in an effort of on-going improvement for the moral purpose of education (Fullan, 2007, 2016; Harris, 2011; Senge, 2006; Stoll, 2009). It is a culture characterized by risk-taking, creativity, exploration, and adaptation, a culture that encourages and promotes innovation for student improvement (Stoll, 2009). A school engaged in building capacity for change is fertile ground for an innovation, such as one-to-one computing, and for an exploration of the innovation's potential to reform teaching practices and student learning.

School Culture and Change

A thorough understanding of a school's innovativeness, its capacity to embrace change for educational improvement, requires an in-depth look at its culture. Much has been written

about the role of culture in educational reform (Fullan, 2001; Hargreaves, 1997; Hinde, 2004; Sarason, 1996). School culture can be either a positive or negative force in the process of implementing change (Anyon, 1995; Hinde, 2004). Schools in which there is a shared commitment, a moral purpose to improving the quality of learning and the school are more likely to take risks and embark on new educational journeys (Hinde, 2004). The norms and values held by the adults in a school have the power to support the success or failure of change (Hargreaves, 1997; Hinde, 2004). Educational change often forces teachers, administrators, students, and parents to question their most fundamental beliefs about the nature of learning and the purpose of school (Mehan, Datnow, & Hubbard, 2003). A shift to a more student-centered pedagogy calls into question the role of the teacher. In the case of a technology-based and constructivist oriented change, each constituent group has to adjust to the teacher as a facilitator of learning, rather than a dispenser of information. The structure of time and the classroom is also changed. Longer blocks of time and different furniture, such as tables and chairs, or re-arranged furniture are useful for promoting project-based, student-centered learning. Even the most incremental of changes, such as the move from desks to tables, can be viewed as revolutionary by some. As Cuban (1986, 1993b, 2018) noted, the nature and structure of school, as it has been, tend to move reform toward constancy rather than change. Hinde (2004) notes that change in any form will reveal the most dominant features of a school's culture, such as shared leadership, collaboration, a spirit of innovation, or resistance to change, negativity, and a lack of shared values.

Reculturing or transforming the culture of a school is significant to building its capacity for innovativeness (Fullan, 2001). School cultures are extremely resistant to change for a variety of reasons. Sarason (1996) noted that school reform efforts are often short-lived because reformers failed to address changes to the school culture. Teachers often resist change because

they do not have the skills to implement a given innovation (Elmore, 2004). Technology can be intimidating for the best of teachers who lack the skills and knowledge to effectively integrate technology. School cultures which possess healthy relationships among all constituents are more likely to embrace change. Hargreaves and Fullan (2012) suggest that in order to enact change, a school may need to create a collaborative culture. Collaborative cultures in which adults can learn from each other, share and reflect upon curriculum, pedagogy, and change can support capacity building within a school.

Professional Development for Change

Of importance to facilitating the implementation of an innovation and sustaining change in schools is the availability and type of professional development provided. Several researchers suggest understanding the concerns of teachers in order to facilitate the type of professional development needed (Donovan, Hartley, & Strudler, 2007; Ellsworth, 2000; Hall & Hord, 2015). Hall and Hord's framework suggests that teachers implementing an innovation, such as one-to-one computing, have different levels of concerns, with most being concerned with how the innovation will personally impact them (Hall & Hord, 2015; Donovan et al., 2007). In many schools, the move to one-to-one computing has created a new paradigm in which students, teachers, and administrators are learning together. For some administrators and teachers, this shift can be unsettling (Tucker, Wycoff, & Green, 2017). Teachers at this stage of concern are typically involved in adapting the innovation to accommodate their teacher-centered strategies (Donovan et al., 2007). By allowing teachers' to have a voice in how one-to-one computing is implemented and sustained, administrators can plan professional development that addresses the current needs of teachers. In addition to addressing low-level uses of technology for administrative purposes and the use of certain software, professional development also needs to

focus on pedagogy in order to reframe teachers' beliefs about student learning. Professional development focused on constructivist learning and how to integrate technology into specific subjects to promote a more student-centered learning environment is more likely to enhance the sustainability of one-to-one computing (Donavan et al., 2007; Potter & Rockinson-Szapkiw, 2012; Valiente, 2010).

Through a quantitative study of 470 teachers in 25 schools, researchers were able to develop a model for transmitting knowledge among faculty at different levels of technology implementation (Frank, Zhao, Penuel, Ellefson, & Porter, 2011). This model has implications for the development of faculty professional development. Frank et al. found that teachers at the lowest initial levels of implementing an innovation benefitted significantly from input from an outside source, such as an expert from another school. Faculty at the intermediate level of implementation were more likely to gain knowledge from experimenting with technology within their own school where they could adapt the innovation to their specific context. Teachers at the highest level of implementation frequently decreased their classroom integration of technology over time, but benefitted from interaction with other colleagues in their school. The interaction among colleagues could produce further knowledge growth among the most proficient of teachers, an important factor to consider in sustaining the growth of an innovation over time.

Other research supports the benefit of professional learning communities within schools for the continued growth of the practice of teaching and for changing teacher beliefs (Dawson, Cavanaugh, & Ritzhaupt, 2008; Downes & Bishop, 2015; Hargreaves & Fullan, 2012). In a study of ubiquitous computing in high school science classes, it was noted that the use of laptops alone did not make a significant impact on student learning (Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010). Teacher knowledge of science software and programs on the Internet and of

how to use science probes was essential to the successful use of technology in science classes (Drayton et al., 2010). Teacher knowledge of software programs and what is available on the Internet is predominantly obtained through good and focused professional development. Another study, conducted in two middle schools, noted that professional development is essential in order for teachers to know what practices, instructional, curricular, and managerial, work best in one-to-one classrooms (Dunleavy, Dexter, & Heinecke, 2007). In a study of eight award-winning secondary schools/districts across the United States, researchers found that professional development was essential to the success of their programs, and that the best professional development programs were those that were continuous and differentiated to meet the various needs of teachers. In these schools, administrators relied heavily on their technology trailblazers to attend to the professional development needs of their colleagues (Levin & Schrum, 2013).

Research indicates that professional development can be significant to educational reform if the professional development addresses both the knowledge and skills needed by teachers as well as their fundamental beliefs about pedagogy and change. The most successful professional development for change addresses teachers' concerns and expertise, allows for teacher input in the design, and provides time and opportunity for collegial sharing of ideas and practices.

Diffusion of an Educational Innovation

In his *Diffusion of Innovations* theory, Rogers (2003) emphasizes that the nature of an innovation influences the rate at which it is adopted. Diffusion is dependent upon perceived characteristics of the innovation: its relative advantage, compatibility, complexity, trialability, and observability. The presence or absence of any of these attributes will influence the decision to adopt the innovation by the intended adopter. In a school setting, the intended adopter of a program is typically the teacher, though some research has indicated that the student should also

be considered as an intended adopter (Fullan, 2013a). A teacher is more likely to embrace an educational change if he or she perceives the relative advantage the practice has for teaching or student performance. The compatibility of an innovation refers to how well the innovation aligns with the values, experiences, perceived needs, and existing practices of the intended adopter (Rogers, 2003). In schools, there is an inherent complexity in the compatibility attribute in that acceptance of an innovation is dependent on the congruence of the innovation with the values, experiences, and perceived needs of individual teachers, as well as the institution (Ertmer & Ottenbreit-Leftwich, 2010; Kim, Kim, Lee, Spector & DeMeester, 2013). The third attribute, complexity, pertains to how easily an innovation can be understood and adopted. The fourth attribute, trialability, and the fifth attribute, observability, can diminish the level of complexity and increase rate of adoption, diffusion, of an innovation (Ellsworth, 2000; Rogers, 2003). Providing teachers with time to explore and learn a new program prior to its implementation, as well as observe others use the innovation, can increase the success and rate of diffusion of an innovation (Ertmer, 2005; Frank et al., 2011; Kim et al., 2013). This has been especially true in the area of technology in which so many teachers feel ill-prepared. Professional development and the opportunity to exchange ideas regarding what works and what does not can enhance the implementation of an innovation, such as one-to-one computing (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Frank et al., 2011; Fullan, 2007, 2016; Kim et al., 2013). Innovations tend to diffuse to others when individuals begin to see the value of the innovation (West, 2012).

Berman and McLaughlin (1976) in their RAND change agent studies were the first to introduce the concept of *mutual adaptation*, the process by which an organization or individual makes changes to an innovation in order to accommodate the needs, knowledge, skills, etc. of the organization or individual (Beabout & Carr-Chellman, 2008; McLaughlin, 1976). Cuban (1998)

notes that this process of organizations and individuals adapting the innovation and/or themselves in the process of implementing an innovation makes it difficult to assess the success or failure of educational reforms. School reforms are:

> adopted and, as implemented, undergo changes that transform them in ways that few designers of the original reform could predict, or even claim ownership. Because schools change reforms as much as reforms change schools, judging an innovation's success or failure is no easy task (Cuban, 1998, p. 455).

Complete fidelity to the implementation of an innovation, that is, without any changes to the intent of its adoption is highly unlikely (Berman & McLaughlin, 1976; McLaughlin, 1990). Hybrid models often develop in ways that better meet the needs of teachers and students and are easier to implement (Cuban, 2009a, 2013b, McLaughlin, 1990; West, 2012).

While *mutual adaptation* is more likely to advance an educational innovation, serious attention must be given to how much adaptation has been made to the innovation and the process, that is, to the fidelity of implementation. An innovation can be adapted in a manner that only supports traditional pedagogical practices, such as using a computer for taking notes in a lecture. This form of adaptation is known as cooptation (McLaughlin, 1976). So many alterations can be made to an educational innovation that it may no longer look or function as it was originally intended. This is referred to as *lethal adaptation* (Beabout & Carr-Chellman, 2008; McLaughlin & Mitra, 2001). The layering of technology upon traditional teaching could be considered a lethal adaption depending upon the original intent of the program. Most implementers of one-to-one computing would consider the use of computers for only note-taking or creating presentations in secondary schools as examples of lethal adaption.

The Change Agent Study concluded that successful implementation of educational reforms is characterized by mutual adaptation. The longevity of a program would suggest that mutual adaptation occurred. For this study, attention was given to the process by which administrators, teachers, and students incorporated one-to-one computing into the classroom and into the school. Some adaptations may have been necessary for sustaining an innovation over a substantial period of time. Understanding who and what adapted, and for what reasons, was crucial to understanding the process of change that occurred during adoption, implementation, and sustainability of one-to-one computing.

Sustainability vs. Institutionalization of Educational Reforms

After nearly two decades of one-to-one computing, the literature lacks examples of how schools moved beyond the adoption and implementation stages to sustainability of an innovation. An important distinction needs to be made between the terms, *sustainability* and *institutionalization.* Sustainability focuses on an innovation's continued ability to meet the needs of its intended adopters, whereas, institutionalization is "the long-term viability and integration of a new program within an organization" (Johnson et al., 2004, p. 136). While the terms are often used interchangeably in the research, sustainability is a more suitable definition for the process of adoption of one-to-one computing, with its continual evolution to meet the needs of the learner and teacher. Institutionalization does not necessarily allow for continual evolution of an innovation. This qualitative study contributes to the body of literature on educational change and ubiquitous computing by exploring how one school community navigated the process of change as it implemented one-to-one computing and what led to the sustainability of the program over a substantial period of time.

Change, Educational Reform, and Ubiquitous Computing

Much has been written regarding paramount changes that have occurred in society and the evolution of education from the agrarian age to the industrial age to the present information age (Reigeluth, 1994; Sheninger, 2014; Stallard & Cocker, 2015). In the agrarian and industrial ages, schools reflected the tenets of the society in which they existed. The one room school house, with flexible times and a focus on the needs of local children, worked in predominantly rural communities. The move to a more industrial age, with larger urban areas and greater means of transportation, brought about the current model of schooling that is more bureaucratic and reflective of the mass production of factories that spurred its existence (Reigeluth, 1994; Sheninger, 2014; Stallard & Cocker, 2015). Kelly, McCain, and Jukes (2008) refer to today's schools as "cookie cutter" schools which support an assembly-line approach to instruction. In the current information age, a new paradigm of education has yet to make a significant difference in how students are educated (Reigeluth, 1994; Sheninger, 2014; Stallard & Cocker, 2015). In this new system, time and space may no longer be factors and achievement will no longer be standardized, but will vary according to the learner (Reigeluth, 1994; Sheninger, 2014; Stallard & Cocker, 2015). The educational system envisioned would allow students to reach set benchmarks at their own pace, recognizing that individual learners have different needs (Reigeluth, 1994; Sheninger, 2014; Stallard & Cocker, 2015). Some of the asynchronous learning environments created by online learning opportunities are congruent with the educational system envisioned. Reigeluth notes that "the new educational system will likely grow parallel with the current system, will be separate from but coexist with it, and will slowly grow while the current system slowly declines" (p. 5). Stallard and Cocker believe that the structure of school must change, including "eliminating the role of the teacher as the primary deliverer of instruction" (p.

173). An abrupt change such as eliminating the role of the teacher completely is unlikely to occur, but rather, a gradual movement towards a new system while maintaining some of the old system is more likely to occur (Reigeluth, 1994), and in fact, has been observed to some extent in some schools. Reigeluth's description of a new educational system for the information age that gradually emerges is very reflective of Clayton Christensen's theory of disruptive innovations (Christensen, 1997; Christensen & Eyring, 2011; Christensen, Horn, & Johnson, 2011).

In the late 1990s, Clayton Christensen introduced the term *disruptive innovation* to describe technologies which enter society not as a better product, but as a different product from what is currently available and which over time surpass the trajectory of sustained improvements to the original technology (Christensen, 1997; Christensen & Eyring, 2011; Christensen et al., 2011). A good example of disruptive innovation is what occurred to the mainframe computer when the portable computer entered the lives of people. At first, the portable computer offered no external threat to the market of the mainframe computer, but over time as the capacity of the portable computer increased, the market for mainframe computers became non-existent (Christensen, 1997).

According to Christensen (2011), "A disruptive innovation is *not* a breakthrough improvement," rather, it is a new technology which in time proves itself disruptive to existing technologies (p. 47). Most innovations are not immediately accepted as more useful than its predecessor (Christensen, 1997; Christensen & Eyring, 2011; Christensen et al., 2011). In 1997, providing students and teachers with their own personal computer was not widely accepted in the United States, and the impact of one-to-one computing on education was hindered due to limited infrastructure and useful software, as well as the inertness of schools. While the number of

schools with one-to-one computing programs has grown, whether or not one-to-one computing will become a disruptive innovation to education in the United States remains to be seen.

In some of his most recent works on educational reform, Fullan (2013a; 2013b; 2016) states that there is a convergence of powerful dynamics occurring in schools today. With the growing pervasiveness of technology, both students and teachers are finding school, as it has existed for the past 100 years, less and less enticing as evidenced by student boredom and lack of engagement, and teacher dissatisfaction with the learning environment and their inability to reach a variety of learners. Fullan (2013a) describes what is occurring in schools today as the *push-pull factor*. School is increasingly boring for students and alienating for teachers; hence, making school less and less enticing, while the digital world is more attractive. The fact that students find school boring makes it difficult to engage them in meaningful ways (West, 2012). Unless schools "reinvent themselves to engage students" and prepare them for a global society, not only will the country fall behind economically, but our educational system will have failed generations of students (West, 2012, p. 1). Technology alone will not reinvent schools, but technology has the potential to change pedagogy, curriculum, and the structure of schools (Stallard & Cocker, 2015; West, 2012). This may be the first sign of technology being a disruptive innovation in schools in the United States and a move towards a new age of education (Fullan, 2013a).

Both Fullan and Reigeluth foresee in the near future a paradigm shift in the manner in which education occurs (Fullan, 2013a; Fullan, 2016; Reigeluth, 1994; Reigeluth & Garfinkle, 1994). This paradigm shift calls for systemic change, that is, an overhaul of the whole system. The pervasiveness of technology and information in society may be a catalyst towards this change (Collins, Morrison, & Newman, 1994). An understanding of the process of change as

ubiquitous computing is introduced into schools is essential for anyone who wishes to successfully navigate this educational change. Understanding the individual and collective experiences of teachers and students as one-to-one computing was introduced and sustained over time may provide insights on how to "scale up" one-to-one computing for systemic educational change in schools across the United States.

Fullan's Educational Change Model (Fullan, 2001, 2007, 2016) provides two lenses in which to view educational reform, one focused on the innovation and its implementation, and the other focused on the innovative capacity of individuals and organizations to embrace change for continuous improvement. In order to obtain an understanding of the educational change that occurred in the school studied, it was necessary to look at the changes that occurred to the innovation over time, the individuals involved in the process of change, and the learning environment in which the innovation was introduced. Fullan's Educational Change Model provides the theoretical framework for this study.

One-to-One Computing and Education Reform

For more than two decades, educators in the United States, Australia, and other countries have debated the educational benefits of providing students and teachers with 24/7 access to technology and the Internet or what is frequently referred to as "ubiquitous computing" within K-12 schools. In an article written in 1991 titled, *The Computer for the 21st Century*, Mark Weiser used the term, "ubiquitous computing," and described it as the pervasive, seamless and invisible presence of technology in the lives of people. Though hardly pervasive, seamless or invisible, researchers suggest that the presence of one-to-one laptop programs in K-12 schools has propelled the use of technology in schools to a new level, in which the computer is a

personal tool for learning rather than just a machine that students are sometimes allotted time to use (Dixon & Einhorn, 2016; Warschauer, 2006).

One-to-one computing in the United States began in 1985 with the Apple Classrooms of Tomorrow (ACOT) program which involved providing some students and teachers in five schools in four states with desktop computers for school and home. Ten years of research by ACOT indicated that "technology has the potential to change education in beneficial ways, but only under certain circumstances" (Sandholtz et al., 1997, p. 170). Similar to later research, Sandholtz et al. found classrooms in which the technology was seldom used and other classrooms in which the use of technology was fostering classroom change, from a teacher-centered to a student-centered environment. Sandoltz et al. found that the successful integration of technology in classrooms occurred when: 1) teachers were willing to challenge their own beliefs about learning, 2) technology was one of many tools integrated into meaningful curricular and instructional experiences, 3) teachers were encouraged to take risks and to collaborate with others, and 4) technology integration was considered an on-going, evolutionary process, requiring continuous adaptation and change. This study considered these findings as data was collected within a school community that has experienced one-to-one computing for 20 years.

One-to-One Computing and Constructivism

The impetus for one-to-one computing within K-12 schools is rooted in the educational reform movement to create environments for learning that are more constructivist than didactic (Means, 1994; Rogers & Price, 2007; Sheninger, 2014; Wenglinksy, 2005; Zhao et al., 2016). Constructivist learning environments are characterized by project-based activities, authentic and complex real life tasks that allow each student to construct knowledge based on previous experience in an environment guided by the teacher (Sandholtz et al., 1997).

Constructivism is a theory of learning rooted in the thought that students learn by constructing their own knowledge. According to this theory, students learn best when they are either presented with new ideas and/or information which they must assimilate into their bank of knowledge or when they are presented with ideas and/or information which are contradictory to what they already know and must find a way to accommodate these new ideas and/or information (Brooks & Brooks, 1993; Gredler, 2005).

Many educators believe that the best means of developing higher order thinking skills, such as the ability to comprehend, analyze, synthesize, and extrapolate meaning, are acquired not through the "the transmission of facts, but through the learner's interaction with content" (Means, 1994, p. 5). Proponents of the constructivist model of learning believe that a student's knowledge and learning are enhanced and deepened by the student actively building new knowledge based upon previous knowledge and experience (Mayes & de Freitas, 2013; Means, 1994. Fosnot (1993) suggests that there are five overarching principles of a constructivist pedagogy. A constructivist pedagogy structures by scaffolding learning based on what students do know as well as misconceptions that they have, focusing the curriculum around broad ideas with real-life problems that are relevant, allowing and valuing students' ideas, and assessing learning in a variety of ways that focus on the ability to perform a task rather than score a test.

Although these overarching principles can occur in situations void of computers, the use of technology can enhance constructivist learning (Means, 1994; Rogers & Price, 2007; Sheninger, 2014; Wenglinksy, 2005; Zhao et al., 2016). Supporters of one-to-one computing advocate that ubiquitous access to technology should further promote constructivist learning within and outside of school. As an educational reform, one-to-one computing has been heralded by proponents as a tool that would change the learning environment from a teacher-centered,

didactic model to a more student-centered constructivist environment (Means, 1994, Rogers & Price, 2007; Sheninger, 2014; Wenglinsky, 2005; Zhao et al., 2016). Rockman et al. (2000) noted in their third study that teachers reported shifts in their pedagogy towards more constructivist teaching, including more inquiry-based and collaborative work. In many situations, the implementation of one-to-one computing has led to changes in the manner in which curriculum content is delivered (Grimes & Warschauer, 2008). Technology-rich environments allow for authentic learning situations in which students can explore possible solutions to real-life problems (Zhao et al., 2016). As technology has evolved within schools, students are using one-to-one computing to give form to their ideas through the use of robotics, 3-D printers, and CAD software (Zhao et al., 2016). Access to the Internet and one-to-one computing have allowed students to individualize and construct their own learning while also collaborating with peers and experts about their work (Zhao et al., 2016).

One-to-one computing proponents have used the benefits of constructivist learning to further the implementation of one-to-one computing. They have heralded the best examples of technology integration as those that have allowed students to construct their own knowledge through the use of computers. A likely conclusion regarding one-to-one computing programs that have been sustained over time is that these programs promote constructivist learning. Hence, in this study, the researcher looked for the frequency and extent that constructivist learning is occurring in the school studied.

Roots of One-to-One Computing: Anytime Anywhere Learning Program (1996 – 2000)

Prior to 1996, a few private schools had experimented with the implementation of one-to-one computing, the most famous being Methodists Ladies' College in Melbourne, Australia whose program inspired Microsoft, Inc. and Toshiba America to launch their *Anytime Anywhere*

Learning laptop program in 1996 (Johnstone, 2003). Fifty-two elementary, middle, and high schools, including private and public schools, on 26 sites, comprised the pilot year of the *Anytime Anywhere Learning* program (Johnstone, 2003).

The *Anytime Anywhere Learning* program was the impetus for many other schools to launch one-to-one computing programs and the program and its vision continues to guide schools as they implement ubiquitous computing (Lei, Conway, & Zhao, 2008). Several factors contributed to the momentum of the *Anytime Anywhere Learning* program. Microsoft provided educational and technical support to the 52 pilot schools in the first year (Johnstone, 2003). Rockman et al.(1997, 1998, 2000) were enlisted by Microsoft and Toshiba to conduct evaluations of each of the first three years of the program. The initial results of the first year evaluation, as well as presentations by pilot schools, framed the *Anytime Anywhere Learning Summit* in April 1997, a gathering of 450 educators from U.S. public and private K-12 schools who were interested in finding ways to make technology more available to their students (Johnstone, 2003).

Rockman (1997) et al. conducted the first substantial research on one-to-one computing in the first three years of the *Anytime, Anywhere Learning* Program. In the first year, Rockman et al found evidence of changes in student attitude, motivation, and behavior, as well as enhanced student writing and organizational skills. Anecdotal and self-reporting evidence also indicated a shift towards more student-centered learning, with more collaborative and project-based instruction. In the second year of the research, Rockman et al. (1998) focused extensively on four pioneer sites, two private K-12 schools and two public school districts. The second year confirmed enhanced writing and organizational skills, as well as students engaged in more collaborative, project-based learning, as a result of the one-to-one computing program. Anecdotal

and self-reported evidence indicated that the program also enhanced student communication and research skills. Teachers, again, reported that their teaching was more student-centered, with less time spent lecturing and more time spent facilitating learning. In an attempt to provide more empirical data, using test scores, surveys, and interviews, in the third and final year of the research, Rockman et al. (2000) concluded that laptop students used their computers more frequently for homework than non-laptop students, student writing was enhanced and the pedagogy of teachers was more reflective of constructivist teaching practices. For a variety of reasons, including insufficient comparable data and the inability to control for student background variations, Rockman et al. was unable to substantiate gains or losses on standardized test scores as a result of the program; thus, concluding that standardized test scores might not be the best indicator of positive results from the program.

Growth of One-to-One Computing Programs in the United States

Over the past two decades, school districts and non-public schools have continued to implement some form of one-to-one computing. In 2008, 27.1% of U.S. school districts had some form of one-to-one computing (Greaves & Hayes, 2008). According to a report by The Greaves Group, these programs consisted of at least one grade having access throughout the school day (Greaves & Hayes, 2008). According to The Greaves Group, "30.6% of the district pilots involved three or more schools" (p. 3). Of those programs, 40% included over 1,000 students, and 10% included over 5,000 students. A survey conducted in 2008 by K-12 Computing Blueprint suggested that at least one-third of U.S. public schools had at least one laptop or Tablet PC program, including pilot programs, providing ubiquitous access to students and teachers operative in the district (Zheng & Warschauer, 2013; Zheng, Warschauer, Lin, & Chang, 2016). MCH Strategic Data (MCH) (2012) surveyed approximately one-third of U.S.

public school districts in 2012 and found that 54% use some form of tablet computer, including eReaders, and that an additional 10% planned to implement this form of computing in the next 18 months. While more current data regarding the number of U.S. schools with one-to-one computing programs is not available, the findings of The Greaves Group and MCH Strategic Data indicate that one-to-one computing has been widely implemented.

When computer-student ratios approached a 1:1 ratio, educators began referring to these programs as *ubiquitous computing.* The type of device and other technological resources available to teachers and students varies across the United States. This, as well as many models of implementation, limit a comparison of programs. Some researchers have indicated that the inconsistency of results reported on one-to-one computing may be the result of the variations in the model implemented and other factors, such as teacher beliefs, administrators' support, and professional development (Bebell & O'Dwyer, 2010). Several researchers have argued for more empirical large-scale studies focused on teaching and learning in one-to-one classrooms (Bebell & O'Dwyer, 2010, Penuel, 2006). The variation of programs may in fact be the reason for the lack of large scale studies.

With the increased number of programs, there has been increased interest in what added value one-to-one computing brings to student learning (Dunleavy et al., 2007), as well as what factors contribute to the success of, or lack of, one-to-one computing programs. Researchers have continued to stress that technology alone does not necessarily equate with more or better use of technology and with the attainment of the learning goals of these programs (Lei, 2010a; 2010b). In studying the value of one-to-one computing to students, researchers have focused on four areas: student achievement, student motivation and engagement, student learning and

preparation for the future, and equity (Abell Foundation, 2008). Much of the research conducted over the past 19 years has focused on one or more of these goals.

The Impact of One-to-One Computing

Student Achievement

From the early beginnings of one-to-one programs in the United States, policy makers, educators, and parents have sought a correlation between the 24/7 use of technology and student learning (Bebell & O'Dwyer, 2010; Lei & Zhao, 2008; Rockman et al., 1997, 1998, 2000). Proponents of one-to-one computing have argued that it would create "higher standards, better ways of thinking, more thoughtful learners, and more powerful learning environments in schools (Lei et al., 2008). At the core of the debate over the impact of one-to-one computing is the appropriate means of measuring student learning. In our current educational climate, standardized tests are the acceptable tool for determining academic achievement, though variations exist among different states and the tests are frequently incapable of measuring learning attributes such as critical thinking and creativity (Warschauer, 2011). Coincidentally, these are the skills often sought as goals of constructivist teaching. The research on the impact of one-to-one computing and student achievement as measured by standardized testing is mixed (Islam & Gronlund, 2016; Penuel, 2006; Zheng et al., 2016).

Large Scale Programs. Shortly after the *Anytime, Anywhere Learning* was launched, several large state or school district one-to-one computing programs were begun. While these programs are similar in scope, it is impossible to compare these programs directly due to the fact that the programs were implemented at different grade levels and under different circumstances. It should be noted that most of the research on student achievement in large scale programs

consisted of comparisons of student scores from the previous year or a comparison of scores with a previous class of students.

Henrico County Public School System in Virginia was one of the first large scale initiatives, with approximately 31,000 teachers and students in Grade 6-12 in 22 high schools and 48 elementary schools receiving laptops by 2002 (Abell Foundation, 2008). In Henrico County, students who used laptops the most showed significantly higher scores in world history, biology, reading and chemistry and significantly lower scores in Algebra I and II and writing on the state's Standards of Learning tests. In addition, to these mixed results, the significantly lower score in writing was contrary to other research studies where writing skills were observed to have improved because of the program (Bebell, 2005; Gulek & Demirtas, 2005; Lowther, Inan, Ross, & Strahl, 2012; Russell, Bebell, & Higgins, 2004; Silvernail & Lane, 2004; Warschauer, 2006). Another school district, Talbot County Public School System in Maryland found some positive effects after students had been immersed in the program for two years, although these results contradict the results of Henrico County Public School System. A significant number of students passed the Algebra I, biology, and English tests than the class preceding them who did not have laptops (Abell Foundation, 2008).

Maine and Michigan launched state-wide initiatives shortly after Henrico County. Both, initially, found no significant gains on state standardized assessments (Abell Foundation, 2008; Lowther, Strahl, Inan & Bates, 2007; Silvernail, 2005). Maine did find an appreciable change on the writing assessment, especially after the program had been in existent a few years. In a later study of 16,000 students, Silvernail & Gritter (2007) found a significant increase in the number of 8th grade students in Maine who met the writing proficiency standard. Additionally, they found that students who had learned to use the laptop for composing, editing, and producing a final

paper did significantly better on the writing proficiency test than students who had not developed these skills; thus, indicating that how the laptop is used is significant in student performance. This study also determined that there was no significant difference in scores between students who used the laptop for taking the writing assessment and those who did not. The results of the Michigan program of seven paired schools were more inconclusive. One laptop school showed no significant difference with its comparison school, while four laptop schools outperformed their comparison school in math and writing, and three non-laptop school outperformed their laptop comparison school in math, English, and writing (Lowther et al., 2007).

The Texas Technology Immersion Project (TIP), using the state assessment (TAKS) found no significant impact on student reading scores, and the social studies, science, and writing scores were inconclusive (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2009). Researchers found that for the cohort of students in the third year of the program, positive effects on student achievement in all areas, except writing, and thus, concluded that positive effects become stronger over time. Further studies of the TIP program, found a high correlation between the amount of usage of the laptop and student achievement on reading and math scores (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010; Rosen & Beck-Hill, 2012).

The State of Pennsylvania launched another large scale program, *Classrooms for the Future (CFF)* with "the goal of placing a laptop computer on every student desk in every public high school classroom in which the four core subjects were taught" (Peck, Clausen, Vilberg, Meidl, & Murray, 2009, p. ES-1 After three years, researchers noted that this goal had not been realized and records had not been kept as to who had access to a laptop, making it difficult to analyze the impact of laptop computers on state standardized assessment scores. Using an

alternative, but less than-optimal analysis, researchers did not find any impact on student achievement due to the program (Peck et al., 2009, p. ES-11).

Smaller Scale Programs. Several research studies of smaller scale programs or programs focused on smaller groups of students also exhibited mixed results concerning student achievement as measured through standardized test scores.

Several studies were conducted of programs in California. In one middle school, researchers found substantial differences in the GPAs of the laptop and non-laptop students, with the laptops students out-performing the control group (Gulek & Demirtas, 2005). This same study found that laptop students did significantly better on the district writing assessment and the state assessment in mathematics and language arts. The research of Grimes and Warschauer (2008), using control and experimental groups at each of three economically and culturally diverse elementary schools in California, failed to support significant academic achievement due to students having access to laptops. Their analysis of math and English scores actually revealed that the laptop students fell behind the non-laptop students in the first year, but in the second year the laptop students made strong gains, catching up with the non-laptop students. A study of 4th and 5th graders at an ethnically diverse school in southern California used an unmatched control-case design and found that the laptop students performed significantly better than the non-laptop students in English/language arts, mathematics and science.

Studies conducted in elementary and middle schools in other states revealed results similar to the California studies. In their research of the *Berkshire Wireless Learning Initiative*, Bebell and Kay (2010) found that after two years laptop students made statistically greater gains in the English/language arts, but not in math on the state assessment. In a study of 4th and 5th

graders in Texas, Rosen & Beck-Hill (2012) found that laptop students significantly outperformed non-laptop students in math and reading on the Texas state assessment (TAKS).

Two recent studies of high school science classes revealed positive results. However, both studies indicated that other factors needed to be considered in the analysis. An investigation of science students and teachers from three high schools in the United States suggests that the laptops alone would not have produced the changes in teaching and learning, that the use of the Internet and science probes were also factors leading to increase engagement and project-based learning (Drayton et al., 2015). A recent Australian unmatched case-control study of science achievement in 12 high schools found a positive impact on the standardized test scores of students in physics, biology, and chemistry (Crook, Sharma, & Wilson, 2015). Again, researchers noted that while the laptop was a catalyst for change, the positive results were more likely due to pedagogical changes which allowed for student-centered learning through the use of simulations and spreadsheets.

The use of standardized testing as the primary measure for determining student learning became more prominent with the advent of *No Child Left Behind* (NCLB) (Warschauer, 2011). Warschauer argues that while the NCLB goals of having all children achieve proficiency in math and reading are laudable, the focus on testing has limited other educational goals, such as producing "good citizens and lifelong learners" (p. 7). This is supported by the work of Rothstein, Jacobsen, and Wilder (2008) that some preparation for standardized testing may be detrimental, citing that some forms of teaching reading and math may "boost test scores in the short term but may be ineffective in the long term" (p. 7). Some researchers have noted that the use of computers for drill and practice may have negative correlations with standardized testing (Wenglinsky, 2005).

Studies on the impact of one-to-one computing on student achievement have been mixed with some indicating no impact at all and others showing significant impact in some subject-specific areas, such as writing. Additionally, what is not clear in many of the studies is whether or not the innovation solely was responsible for improvement in student achievement. Some researchers note that one-to-one computing has been a catalyst for pedagogical changes and that this, too, may have impacted student achievement. Several researchers reported that students with laptops used technology more frequently for writing, editing and gathering information from the Internet than students who did not have laptops (Bebell & Kay, 2010; Dunleavy et al., 2007, Lei, 2010a; Lei & Zhao, 2008; Lowther et al., 2012; Morrison, Ross, & Lowther, 2009; Peck et al., 2009; Shapley et al, 2010; Warschauer, 2007a). As Warschauer (2006) noted the laptop program enhanced student writing because they were able to employ an iterative process that allowed for input from peers and teachers and revisions. Researchers also found that laptop students were frequently engaged in project-based learning and were capable of individual and collaborative learning, which may have enhanced student achievement (Cavanaugh, Dawson, & Ritzhaupt, 2011; Corn, Tagshold, & Patel, 2011; Lowther et al., 2012; Lowther, Ross, & Morrison, 2003; Maninger & Holden, 2009; Windschitl & Sahl, 2002) The novelty of one-to-one computing may have also attributed to increased student engagement and motivation, and hence, may have positively impacted student learning. From the literature, it is difficult to substantiate a direct correlation between the use of laptops and student achievement, which supports further exploration as to why this innovation has maintained its status as an educational reform for a significant period of time.

Student Engagement and Motivation

A significant amount of research indicates that 24/7 access to technology can increase student engagement and motivation (Bebell & Kay, 2010; Bebell & O'Dwyer, 2010; Holcomb, 2009; Keengwe, Schnellbert, & Mills, 2011; Lowther et al., 2012; Lowther et al., 2007; Rosen & Hill, 2012; Rockman et al., 1997; Silvernail & Harris, 2003). A few studies did not find increases in student motivation and engagement, including the evaluation of the Texas Immersion Project (Shapley et al., 2009). Donovan and Green (2010) concluded that increased access to laptops does not necessarily equate to increased student engagement. They found that students were more off-task in classrooms that maintained traditional teaching pedagogies (e.g. teacher lectures) than classrooms with more student-centered teaching (e.g. project-based learning). Increased engagement and motivation may be partially indicative of the evidence supporting the acquisition of 21st Century Skills by students.

Student Learning and 21st Century Skills

Many scholars and educators believe that the greatest benefit of one-to-one computing is the enhancement of the knowledge and skills needed for future success in the U.S. workforce (Dede, 2010; Lowther et al., 2012). Wagner and Dintersmith (2015) argue that what matters for personal, financial, and civic success is "what you can *do* with what you know" (p. 23). They suggest that content knowledge, skills, and motivation are the foundation for future learning, and of the three the desire or motivation to continue to learn new skills and knowledge will best serve students in the 21st century.

Several organizations, educators, and researchers have written about the skills needed by students to thrive as adults in the 21st century (Dede, 2010; Lowther et al., 2012; International Society for Technology in Education, 2016; Partnership of 21st Century Skills, 2010, 2016;

Wagner, 2014; Wagner & Dintersmith, 2015). These skills are commonly referred to as *21st Century Skills*. The Partnership for 21st Century Skills (2010, 2016) classifies the skills needed into three areas: learning and innovation skills, information, media, and technology skills, and life and career skills. Many believe that in addition to providing students with content knowledge, schools need to foster these skills in students, and some research indicates that one-to-one computing can enhance student attainment of these skills (Rockman, 2003; Warschauer, 2006). One-to-one computing allows students greater access to information, as well as the ability to analyze, synthesize, and share information with others (Grimes & Warschauer, 2008). The self-directed, independent, collaborative learning environment created through one-to-one computing is viewed by many as promoting the work skills needed for the 21st century (Rockman, 2003; Warschauer, 2006; Lei et al., 2008).

Learning and Innovation Skills. While there are some differences in the nomenclature of the learning and innovation skills by organizations and individuals, consensus exists. Most agree that the skills needed are critical thinking, communication, collaboration, and creativity (Lowther et al., 2012; International Society for Technology in Education (ISTE), 2016; Partnership of 21st Century Skills, 2016; Wagner & Dintersmith, 2015).

Research indicates that one-to-one computing can enhance the communication skills of students. With wireless devices connected to the Internet, students and teachers use email for increased communication, student-student and student-teacher (Culp, Honey, & Mandinach, 2005; Dunleavy et al., 2007; Lowther et al., 2012). Teachers have noted that one-to-one computing has also enhanced communication between parents and teachers. The use of laptops has also broadened the spectrum of presentation forms available to students. Whereas students previously were confined to the use of paper and pen to express themselves, today various

software programs allow them to construct multimedia presentations consisting of the written language as well as photos, music, and videos.

The ability to express oneself clearly through the written word is an invaluable communication skill (Zheng & Warschauer, 2015). Several studies indicate that students write and edit more in laptop classrooms, often because writing and editing are the primary function of one-to-one computing (Suhr, Hernandez, Grimes & Warschauer, 2008; Zheng, Warschauer, & Farkas, 2013). Student writing skills are enhanced through opportunities that one-to-one computing provides, such as the frequency and ease of composing and editing work, more feedback on writing from teachers and peers, a wider range of resources to draw upon, and the ability to share their work more frequently (Bebell & Kay, 2010; Grimes & Warschauer, 2008; Lei & Zhao, 2008; Russell, Bebell, & Higgins, 2004). Increased student writing proficiency due to the one-to-one environment has also been substantiated through increased achievement on standardized tests by some studies (Rosen & Beck-Hill, 2012; Ross, Lowther, Wilson-Reyna, Wang, & Morrison, 2003; Silvernail & Gritter, 2007).

The ability to collaborate with others is considered a significant skill for success in the future global economy (Kay, 2010). Numerous studies and evaluations of one-to-one computing note that students having 24/7 access to technology enhances their ability to collaborate with other students and as well as with others, such as students in other schools or *experts* in the area that they are studying or researching (Peck et al., 2009; Rockman et al., 1997, 1998, 2000; Shapley et al., 2009; Warschauer, 2006, 2007a, 2007b, 2011). While project-based learning, which is frequently observed in one-to-one laptop classrooms, facilitates a more collaborative learning environment, Warschauer (2007b) stresses that this does not happen without the

guidance of a teacher. Students are provided greater autonomy through the use of computers and the Internet, but still require the mentorship that a teacher can offer.

While it is challenging to document student growth in the areas of critical thinking and creativity, several studies identify activities in one-to-one environments which enhance these skills (Peck et al., 2009; Shapley et al., 2009; Warschauer, 2006, 2007a, 2011). Activities such as the analysis of data or the validity of information, real-life or authentic tasks, and some research skills are made easier and are more readily available to students who have laptops. The use of multimedia software fosters student creativity as they express themselves with words, photos, videos, and music (Warschauer, 2006, 2011).

Warschauer (2006, 2007a) notes that it is an established fact that students learn better and at greater depth when information is readily available, what is referred to as *just in time learning*. Access to the Internet allows students to quickly search for answers to questions at the moment of interest. Prior to 24/7 access, student questions would often be shelved to the following day so that either the teacher or student had time to research the answer (Warschauer, 2006).

Information, Media, and Technology Skills. One-to-one computing has provided both students and teachers with greater access to information and has increased media and technology skills. The abundance and variety of information has required schools to develop new resources and classes for helping students discern the reliability and validity of sources (Warschauer, 2006). The readily available access to a computer and multimedia software provides the opportunity for students to develop multimodal forms of presenting their work (Warschauer, 2006, 2011).

In addition to learning how to use a computer and specific software, the availability of information via the Internet has required learning new information skills. Information literacy is

considered an important skill for 21st century learners and workers (Grimes & Warschauer, 2008; Partnership for 21st Century Skills, 2016; Warschauer, 2011). Students must be able to "locate, recognize, evaluate, and synthesize information" using the Internet and other technology (Grimes & Warschauer, 2008, p. 317). Increased use of the Internet as a research tool has demanded that schools teach students new skills for citing information and for determining the validity of sources. Grimes and Warschauer (2008) noted that students recall information better when they are able to access it when needed. In a teacher survey they conducted, 82% of those surveyed believed that one-to-one computing increased the amount and depth of research conducted by students.

One-to-one computing programs have also allowed students and teachers to use a variety of forms of media to express their thoughts and ideas (Warschauer, 2007a; Grimes & Warschauer, 2008). The use of presentation software and movies has required that students learn additional presentation skills beyond the traditional verbal and writing skills.

Life and Career Skills. Many business executives have speculated on the skills needed for the 21st century U.S. work force based upon their observations of the current work force. Educators and researchers, such as Tony Wagner and Yong Zhao, have written extensively about the need to transform education in order to better prepare young people for the future (Couros, 2015; Wagner, 2012, 2014; Wagner & Dintersmith, 2015; Zhao, 2009, 2012). Many of the skills needed by American workers in the industrial age are being outsourced to other countries where the compensation for such skills is less than what is demanded in the U.S. Wagner and Zhao believe that success in the global economy will depend upon the innovative and entrepreneurial spirits of individuals. In addition to the 21st century skills previously mentioned, students will need to be self-starters, risk-takers, and team-players.

Proponents of one-to-one computing have long believed that the use of technology in schools could enhance skills needed for innovation and entrepreneurship. Grimes and Warschauer (2008) found that laptop programs increased student autonomy, productivity, and collaboration, as well as enhanced critical thinking skills. Others have found that the move to a more student-centered pedagogy has allowed students to take more ownership for their learning and greater risks (Keengwe et al., 2011; Lowther et al., 2012). In some high schools, students, with the help of technology, are encouraged to develop their own capstone project as the culmination of their secondary education (Wagner, 2014; Warschauer, 2011). While certainly not the only means of enhancing student creativity and curiosity, studies have shown that one-to-one computing programs have provided students with tools to explore and create.

Equity of Technology Access

One of the goals of several large scale one-to-one computing programs was to create educational equity by providing all students with access to a computer and the Internet (Warschauer, Zheng, Niiya, Cotton, & Farkas, 2014). Former Maine Governor Angus King believed that providing all students with access to one-to-one computing would allow each student to have the same opportunities for education and would ultimately enhance the state's economic future (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2012). Warschauer (2011) noted, however, that computer access alone is insufficient for creating educational equity. Social factors, such as having support from peers and family, play a role in fostering how technology can enhance learning (Warschauer, 2007b). Proponents of providing 24/7 student access to a computer and the Internet argued that doing so would also increase computer usage by other family members, creating a greater impact than just the education of one student. Providing school and home access to technology could enhance student learning, but it was not sufficient to

overcome other barriers that low socio-economic students encounter, such as a lack of resources and inferior teachers (Warschauer, 2011). South Carolina Beaufort County School District, a school district in which many students qualified for free or reduced lunch, was one of the pioneer schools of the *Anytime Anywhere Learning* program. An appreciable number of parents, students, and teachers in this school district believed that the laptops had contributed to higher academic performance, especially in the areas of spelling, writing, reading and math (Stevenson, 1998, 1999). Stevenson (1998) noted that although students who had participated in the program for two years significantly outscored non-laptop students on standardized tests, the results may have been skewed because of prior academic differences existing between the two groups.

The One Laptop per Child (OLPC) program developed by Nicholas Negroponte at MIT aimed to provide low-cost laptop computers to students in poor school districts in the U.S. and in impoverished countries (Warschauer & Ames, 2010; Warschauer, Cotton, & Ames, 2012). Inspired by Seymour Papert's vision that a child with access to a computer could learn to use it without any other support, supporters of OLPC provided low-cost laptops to millions of young people (Papert, 1980, 1993). The program has been wrought with difficulties, including the lack of infrastructure, access to the Internet, technology support and professional development for teachers (Warschauer & Ames, 2010; Warschauer et al., 2012). In Birmingham, AL, over 15,000 of these laptops were given to students and teachers. The lack of use in the schools due to the lack of teacher interest and training, as well as technical issues, ultimately led to the city council eliminating funding for the program. Warschauer & Ames noted that the program failed because supporters failed to attend to local context and the curriculum, technical, and professional needs of schools. The lack of success of OLPC supports the belief that successful one-to-one computing programs require much more than hardware.

While one-to-one computing programs may offer access to the Internet and technology to low-socioeconomic status students who lack these resources at home, more than laptops and Internet access are needed to eliminate inequities in skills, knowledge, and attitudes (Zheng et al., 2013). Programs that also provide good teachers, adequate technological support, and curricular that address the specific needs of low-SES students are more likely to be successful than those that simply provide computers (Warschauer & Matuchniak, 2010).

Review of the Literature Summary

A review of the literature indicates that the sustainability of one-to-one computing over time within a school is most likely due to a number of factors. The dissatisfaction and/or apathy towards teaching and learning may lead some school administrators and teachers to embark on one-to-one computing as a possible reform to rejuvenate K-12 education (Fullan, 2013a). A school culture which encourages and develops teacher capacity for change is fundamental to the sustainability of an educational reform (Fullan, 2007, 2016). Whether or not an innovation actually enhances student learning, academic achievement or the development of skills needed for the future, will influence the implementation and longevity of the reform; so, too, will the level of engagement and motivation generated by the innovation. The ability of key stakeholders, such as teachers and students, to adapt an innovation to meet their needs and interests is likely to support sustainability of the innovation. The fact that technology continues to evolve contributes to the adaptation of one-to-one computing to the learning environment. This qualitative case study explored within a school community these many facets in order to understand why the school was able to sustain one-to-one computing for 20 years.

Theoretical Framework

A variety of models or theories exist that attempt to explain the complexities of educational change (Berman & McLaughlin, 1976; Ellsworth, 2000; Ely, 1990; Evans, 1996; Fullan, 2007, 2016; Hall & Hord, 2015; Havelock & Zlotolow, 1995; Reigeluth & Garfinkle, 1994; Rogers, 2003; Zaltman & Duncan, 1977). Each model provides a different lens in which to understand the process of change within an educational setting. Because this study seeks to explore the changes that occurred to an innovation, individuals, and to the organization due to one-to-one computing and how the innovative capacity of the organization was developed and fostered over time, Fullan's Educational Change Model (2007, 2016) provides a framework to guide the research process and methodological design.

Fullan (2016) makes an important distinction between *innovation* and *innovativeness*. "The former concerns the content of a given new program, whereas the latter involves the capacities of an organization to engage in continuous and new improvement" (p. 10). One-to-one computing, as an *innovation,* has been introduced in numerous schools across the United States. In some schools, one-to-one computing has been used as an accelerator to leverage instructional change for educational improvement and continued growth. A school community's capacity to use one-to-one computing in this manner is its *innovativeness.* The success or failure of an educational innovation depends on the innovativeness, the capacity of persons, individually and collectively, to embrace, adapt, and sustain change over a significant period of time.

Fullan's Educational Change Model (2007, 2016) provides two lenses in which to study educational reform, an innovation-focused approach and a capacity-building focus. The first approach seeks to understand what happened over time to the innovation and what factors, including individuals, influenced its success, failure, or adaptation (McLaughlin, 1976; Fullan,

2007, 2016). The second approach is to explore how the innovative capacity of individuals and organizations for continuous improvement is developed and fostered. In order to obtain an understanding of the educational change that occurred in the school studied, it was necessary to look at the changes that occurred to the innovation over time, the individuals involved in the process of change, and the learning environment in which the innovation was introduced.

In studying educational change, a researcher can choose to keep the innovation itself or the organization experiencing change at the center of the study. This study focuses on the organization and its members. However, in order to better understand the nature of educational change that occurred within classrooms and within the school, it is essential to also explore what happened to the innovation over time. The RAND Change-Agent Study (Berman & McLaughlin, 1973, 1977, 1978a, 1978b) determined that successful implementation of educational innovations was characterized by a process of mutual adaptation, that is, both the innovation and the individuals involved in the implementation, changed or adapted over time (McLaughlin, 1976). As Berman and McLaughlin (McLaughlin, 1976) found, not all forms of adaptation lead to successful implementation. Cooptation and non-implementation or lethal adaption can also occur. Berman and McLaughlin described cooptation as the process by which users adapt an innovation, but they and their institution do not change in the process (McLaughlin, 1976). Non-implementation occurs when intended adopters fail to implement an innovation either due to issues with the innovation or resistance on the part of the adopters (McLaughlin, 1976). Lethal adaptation refers to process by which innovations are adopted without fidelity to the original vision or purpose of the innovation. Adopting innovations without fidelity to the original intention of the innovation runs the risk of minimizing the potential impact of the innovation (Fishman, Marx, Blumenfield, & Krajcik, 2004). Because the level of implementation of an

innovation is frequently at the discretion of teachers, it is likely that the implementation of one-to-one computing within a school community may exhibit examples of mutual adaptation, cooptation, non-implementation, and lethal implementation. What is of interest in this study is how one-to-one computing was sustained over a significant period of time despite or because of mutual adaptation, cooptation, non-implementation, and lethal implementation of the innovation.

Fullan's Innovation-Focused Approach

Fullan's (2007, 2016) first approach to understanding educational reform is through an examination of the process of change as an innovation is introduced and sustained through time. Fullan posits that most researchers categorize the process of change into three phases: initiation (adoption), implementation, and institutionalization (sustainability). For the purposes of this study, the terms adoption, implementation, and sustainability will be used. Fullan's model emphasizes that the process of change is not linear, but rather requires constant feedback that allows for adjustments and adaptation as an innovation evolves within the organization. According to Fullan, the process of educational change should be focused on two outcomes: the impact on student learning and the growth of the organization's capacity to embrace future change.

Adoption. The first stage of the process consists of the conversations, information gathering, observations of other schools, etc. that lead up to and include the decision to adopt an innovation (Fullan, 2007, 2016). A variety of factors can influence the decision to move forward with the implementation of an innovation: the existence and quality of the innovation, financial and personnel resources, and support from teachers, administrators, and parents. Strong leadership, especially from the principal, who has typically been the *gatekeeper* of change, is essential to moving an innovation forward within a school (2016, p. 62). Sometimes an

innovation is adopted not because of evidence of its impact, but because key individuals in the school and in the community see the potential that it has to change teaching and learning and "to build capacity and ownership among participants" (p. 60). This case study sought to determine which of these factors contributed to the school's decision to adopt one-to-one computing, and how these factors influenced the sustainability of the innovation over time.

Implementation. According to Fullan (2016), implementation "consists of the process of putting into practice an idea, program, or set of activities and structures new to the people attempting or expected to change" (p. 67). In the classroom setting, signs of implementation might include changes in materials, pedagogical practices, or teacher beliefs and understandings about teaching and learning (Fullan, 2007, 2016). The implementation of an educational innovation can be influenced by the characteristics of the innovation, the local context, and external forces. The characteristics of an innovation to be considered include need, clarity, complexity, and quality/practicality. The local characteristics or context that influence the implementation process include the school district or school board, the community in which the school is situated, the principal, and teachers. External factors that may influence implementation of an innovation may include state departments, federal agencies, or a broader context in which the school situates itself. Societal trends are also an external factor that influences educational reform. For this study, the influence of other independent schools as well as the business climate in which the school is located was considered as potentially influential external factors.

The implementation phase of any educational innovation typically occurs over the course of two to three years, and depending upon the nature of the innovation the actual timing of the phase may be difficult to delineate (Fullan, 2007, 2016). The changing nature of technology makes it more difficult to determine when the implementation phase has ended and the

institutionalization or sustainability phase has begun. For example, wireless capabilities of mobile devices became feasible in schools several years after the first one-to-one programs were implemented. The presence of this new feature may have begun a new implementation phase or extended the original phase. This study considered how the evolution of software and hardware had or had not influenced the implementation and sustainability of one-to-one computing.

Sustainability. Sustainability refers to the decision and commitment to continue an educational innovation. Fullan (2005) defines sustainability as "the capacity of a system to engage in the complexities of continuous improvement consistent with deep values of human purpose" (p. ix). Hargreaves and Fink (2000, 2005) further elaborate on sustainability by insisting that it is more than just whether or not something is maintained; it also includes how an initiative "can be developed without compromising the development of others in the surrounding environment now and in the future" (2000, p. 30). Not all educational innovations are sustained, or even should be, and certainly not all educational innovations have led to continuous improvement.

Many factors can lead to the decision to discontinue an educational reform, ineffective implementation, lack of funding, lack of support by key actors, such as teachers, administrators, and parents, or a change in leadership (Berman, 1977; Fullan, 2007, 2016). Some key factors that influence sustainability include the leadership of the principal, professional development, and observable changes in educational outcomes (Berman, 1977; Fullan, 2016). Huberman and Miles (1984) suggest that the sustainability of innovations depends upon whether or not the innovation becomes embedded into the school, has the time to acquire a sufficient amount of support from administrators and teachers who have embraced the change, and has been allotted the necessary

financial, professional, and personal resources to continue providing support to teachers and administrators.

Using Fullan's change model, this study sought to understand the factors that allowed one-to-one computing to develop and be sustained over 20 years within one school. Through interviews with current and past teachers, administrators, and students, classroom observations, and document analysis, the researcher sought to understand what pedagogical and other educational changes occurred within the school as one-to-one computing developed as a component of the program and what contributes to *innovativeness* of a school.

Fullan's Capacity-Building Focus

As stated earlier, Fullan (2007, 2016) describes the *innovativeness* of individuals or an organization as the capacity to embrace change for continuous educational improvement. In the previous section, issues impacting the adoption, implementation, and sustainability of an innovation were addressed. This section explains Fullan's second approach to understanding educational change through the capacity-building lens. The capacity-building focus considers the individuals involved in the process of change and their *innovativeness*. For the purposes of this study, the roles of teachers, administrators, and students in affecting change were explored. Data collection included interviews and observations with people in these roles as well as interviews of former administrators and teachers and graduates of the school.

Teachers. Most educational change occurs within the classroom with the teacher determining what happens within his or her classroom. The autonomy of teachers with respect to the classroom has led to teachers being viewed as the *gatekeepers* of what occurs in classrooms, suggesting that any significant change in education is mediated by teachers (Cuban, 1993b, 2013a, 2018; Fullan, 2007, 2016; Tyack & Cuban, 1995). Stoll (1999) supports the primacy of

the teacher in school improvement by placing the teacher at the center of any successful educational change. Research indicates that teacher knowledge, confidence, and beliefs are moderating factors in the integration of technology (Ertmer & Ottenbreit-Leftwich, 2010; Inan & Lowther, 2010a, 2010b; Lowther et al., 2012). Ertmer and Ottenbreit-Leftwich (2010) suggest that teacher "self-efficacy may be *more important* than skills and knowledge" in the implementation of technology. An evaluation of Michigan's *Freedom to Learn* one-to-one program noted the correlation between successful technology integration and teacher confidence and readiness (Lowther, Ross, Strahl, Inan, & Pollard, 2005; Lowther et al., 2007).

Several research syntheses have noted that student attitudes towards the use of educational technology can be highly influenced by teacher beliefs and attitudes (Sivin-Kachala & Bialo, 1994; Penuel, 2006). Penuel's (2006) synthesis found a correlation between teacher beliefs in student capabilities and the complexity of the technology introduced in the classroom. Teachers who fundamentally adhere to a teacher-centered pedagogy will direct students to use laptops for tasks such as taking notes, creating Power Point presentations, etc., whereas teachers who are guided by a student-centered pedagogy are more likely to have students use computers for higher-order thinking tasks such as inquiry, analysis and design. Teachers who possess the technological skills and confidence and who view technology as a positive tool for learning are more likely to have their students engage in project-based meaningful learning (Inan, Lowther, Ross, & Strahl, 2010; Lowther et al, 2012; Windschitl & Sahl, 2002). The shift to a more student-centered environment can increase student engagement and create situations in which students feel more control over their learning. Conversely, a teacher's unwillingness to use technology as an educational tool can lead students to use computers for non-educational purposes and to leaving the laptops at home.

These findings are not surprising considering that the "second-order changes," necessary for pedagogical change, require teachers to consider their current practices and beliefs in a learning environment which may result in new instructional practices and roles (Ertmer, 1999). In a study of teacher beliefs and technology integration, researchers found a correlation between the level of technology integration and teachers' beliefs regarding the nature of knowledge and learning and their beliefs about the effective practice of teaching (Kim, Kim, Lee, Spector, & DeMeester, 2013). Kim et al. noted that teacher core beliefs do not happen quickly, that change occurs over time when teachers are provided with continuous opportunities to reflect upon their beliefs and practice of teaching. On-going professional development, technical and personal support and necessary resources, can more rapidly facilitate changes in teacher beliefs and instructional approaches (Cavanaugh et al., 2011; Ertmer, 1999, 2005; Ertmer & Ottenbreit-Leftwich, 2010, 2013). Equally important is focusing on the context in which teachers operate. The influence of peers and the culture of the school can be catalysts for embracing new knowledge, beliefs, and practices (Ertmer & Ottenbreit-Leftwich, 2010; Fullan, 2007, 2016; Wagner, 2003; Windschitl & Sahl, 2002).

Through interviews and observations, the researcher sought to understand how the innovativeness of teachers allowed them, individually and collectively, to sustain one-to-one computing. In addition to understanding, the factors which may have led teachers to either embrace or reject one-to-one computing, the researcher sought to discover how innovativeness or capacity building is fostered and sustained as teachers continue to use one-to-one computing in their classrooms. Information regarding the type and amount of pedagogical and technical professional development provided to faculty, and how individual teachers do or do not develop

their practice of teaching within a technology environment, provided some understanding of how innovativeness is sustained overtime.

Principals. Fullan (2007, 2016) notes that in addition to being the major gatekeeper of change, the principal must also develop leadership in others and be the lead learner within the school. Fullan emphasizes that focusing only on establishing vision, providing resources, and working with individual teachers does not necessarily stimulate ongoing educational improvement. The principal must interact with teachers in a manner that creates an environment of collaboration, shared leadership and learning. The principal must "develop a new culture – modeling the process, establishing a nonthreatening learning climate, focusing on specific pedagogical practices linked to whether and how they produced measurable learning outcomes, monitoring progress, sharing what works, adding technology that supports learning, and so on" (2016, p. 134). To affect educational change for continuous improvement, the principal must develop professional capital, human, social, and decisional, and facilitate an environment that allows for changes to the school culture (Fullan, 2016; Hargreaves & Fullan, 2012; Seller, 2001).

Research indicates that school leadership plays an important role in the implementation and sustainability of one-to-one computing. The school principal is essential in articulating a vision, offering a plan for how the laptops will be used, supporting teachers personally and with professional development, assuring that teachers have the resources and technology support necessary to use the laptops (Allen, Franceschini & Lowther, 2010; Dawson & Rakes, 2003; Levin & Schrum, 2013; Oliver, Mollette, & Corn, 2012; Webb, 2011). Teachers believe that leaders need "to be passionate about the vision and pursue it relentlessly" in pushing forward ubiquitous computing within a school (Levin & Schrum, 2013, p. 37). Principals must lead the learning as to how one-to-one computing can enhance the learning environment.

Through interviews and document analysis, this study explored administrators' beliefs and use of technology to understand how leadership impacted the sustainability of the one-to-one computing. A review of professional development activities sought to discover how leadership has developed the technology skills of teachers and staff and fostered technology leadership among teachers and how these activities shaped teacher beliefs and the culture of the school.

Students. Fullan (2016) believes that "when it comes to the meaning of educational change, nothing could be more crucial than bringing the student forward as a partner in learning" (p. 149). Fullan introduces a model to support student-centered learning that is based upon three factors: (1) student aspirations, which concerns goals and expectations for the future, (2) student learning, which focuses on how the student best learns and creating student agency, and (3) student belonging, which concerns student connectedness to peers, family, and others. Fullan further suggests that in order to achieve the type of student-centered learning he proposes, new structures of learning relationships between and among students, teachers, and communities will be needed. Underlying Fullan's change model is his fundamental belief that school, as it has been traditionally known, has become boring for most teachers and students, and the digital world has become more and more attractive.

One-to-one computing as an innovation can support the type of successful learning that Fullan believes is essential for today's students and teachers. He suggests that learning must 'be irresistibly engaging for students and teachers, elegantly efficient and easy to use, have ubiquitous technology 24/7, and steeped in real life problem solving (Fullan, 2013a; p. 33). One-to-one computing has the potential to facilitate change in student-teacher roles and the learning environment. The promise of one-to-one computing has long supported a more student-centered

learning environment in which the teacher serves more as activator of learning and students guide their own learning.

Observations and student interviews provided the researcher with current data regarding the one-to-one computing program. Classroom observations and student interviews were analyzed to determine what types of pedagogies are most frequently used in classrooms. Several interviews with graduates of the school provided data regarding how technology was used as the program began and evolved. Also of interest were graduates' perspectives on the added value the program gave to their future education and work.

In addition to understanding teacher beliefs as one-to-one computing was sustained within the school, it was necessary to explore the norms and beliefs of the school community to determine what cultural norms and beliefs may have impacted the sustainability of this innovation. Finnan (2000) identified five underlying assumptions that influence the success or failure of educational reform, "assumptions adults hold for students, about leadership and decision-making, about adult roles and responsibilities, about best practices and structures for educating students, and about the value of change" (p. 9). These assumptions helped frame interview questions in order to gain an understanding of individual and cultural norms and beliefs about education and change.

Environment. For the purposes of this study, the conditions for change were considered in two environments, the classroom and the school. The intended environment of most educational change is the classroom in which the teacher is the change agent. However, over time most educational changes also change the overall environment of the school. This study sought to understand what environmental or cultural conditions existed that allowed the school to

embrace one-to-one computing and how the classroom and school environments were changed due to the presence of one-to-one computing.

Researchers of change, such as Ely (1990), have suggested several environmental factors needed for successful change: dissatisfaction with the current situation, knowledge and skills, resources, such has appropriate materials and time, commitment, leadership that both expects and encourages participation (Ellsworth, 2000). Fullan (2016) notes that while most educational change involves materials, pedagogy, and beliefs, real and substantial change occurs when "shared meaning is achieved across a group of people working in concert" (p. 35). For Fullan, shared meaning and program coherence are essential organizational requirements for educational change to occur. Evans (1996) posits that creating a school environment or culture in which members possess a shared vision of achievement and a commitment to each other is necessary for substantial educational change to occur. Beabout and Carr-Chellman (2008) suggest that schools that are aware of changes occurring within the context of their wider environment are more likely "to take those uncomfortable glances in the mirror that often lead to positive change within the institution" (p. 622). It is likely that the emergence of one-to-one computing in schools was the result of the increased use of technology in the workplace. Connections to and the influence of the broader community may have also been an impetus for the implementation and institutionalization of one-to-one computing in the school.

Zheng & Warschauer (2013) note that technology alone does not create changes to the environment; how technology is implemented and used to enhance learning is key to effective change. How teachers use technology and encourage students to engage with technology is an important aspect of realizing the potential of one-to-one computing. Many educators and others have supported the use of one-to-one computing in schools as a means of enhancing student

learning, specifically by creating environments in which students construct their own knowledge, create artifacts, and collaborate with others on authentic projects (Means, 1994). Through classroom observations, this study sought to understand how the classroom environment and the school environment, may or may not have become more constructivist in nature due to the presence of one-to-one computing, and whether or not any changes in the learning environment led to the sustainability of the innovation.

Conclusion: Innovativeness as a Theory of Educational Change

The Project RED study, which researched more than one thousand schools that provided Internet access to every student emphasized that in order for schools to realize significant improvement in academic achievement, programs need to experience "second-order change," rather than only "first-order change" (Greaves et al., 2012). Cuban (1993b, 2008) and Ertmer (1999) describe "first-order change" in schools as incremental changes that occur without fundamentally changing the practice of teaching or learning. Change of the second-order is a radical shift from past practices to new practices that cannot occur without new knowledge and new skills (Cuban, 1993b, 2008; Ertmer, 1999; Greaves et al., 2012). For learning to be significantly impacted by ubiquitous computing, how instruction and learning occur has to be radically different from what has been done in the past. One-to-one computing, unlike many other educational reforms, has the potential to re-engineer schools if the programs are allowed the time and provided the resources necessary to bring about second-order change (Greaves et al., 2012; Weston & Bates, 2010).

Using Fullan's Educational Change Model (2007, 2016) as a theoretical framework, this study explored the innovativeness, ability to embrace change, of a school and its constituents, and the process of change that occurred through 20 years of one-to-one computing. An

exploration of the evolution of one school as it introduced and sustained one-to-one computing will ultimately shed light on how this educational innovation impacted various areas of the school community and provide information for others who which to implement and sustain educational change. The next chapter outlines the process in which the researcher collected, organized, and made sense of data for the purpose of understanding the meaning of educational change that the participants gave to the experience of the adoption, implementation, and sustainability of ubiquitous computing.

Chapter 3: Methodology

Research is a process that allows for the collection, analysis, and interpretation of information to increase understanding of a topic, issue, or experience (Creswell, 2002, 2015). In the field of education, the study of phenomena, events, people, processes, and institutions provides credible material to support educational improvement (McMillan & Schumacher, 2001). Researchers conducting educational research seek to provide trustworthy information about issues, phenomena, or innovations in schools to improve teaching and learning (Gay & Artasian, 2003). Multiple approaches can be employed in educational research, including qualitative, quantitative, or mixed methods (Creswell, 2002, 2015; Gay & Artasian, 2003). Creswell (2015) suggests that researchers "think through the philosophical worldview assumptions that they bring to the study, the research design that is related to this worldview, and the specific methods or procedures of research that translate the approach into practice" (p. 5). This chapter provides the rationale for the qualitative approach chosen as well as an understanding of constructivist philosophical worldview, epistemology of the researcher, and the research design and methods chosen. Using a constructivist orientation, the researcher sought to explore the meaning of educational change that individuals within a school ascribed to their experience of one-to-one computing (Creswell, 2002, 2015). A qualitative approach is chosen because the researcher sought to explore the experiences of individuals within a school over time. The process of data gathering and data analysis is discussed, as well as the means that the researcher took to ensure the trustworthiness of the study.

Qualitative Methodology

Qualitative research allows the researcher to explore and understand a phenomenon within the specific context of an individual or group. This approach allows the researcher to

study the meaning that individuals or groups give to an event, experience, issue, problem, or phenomenon and to form "interpretations of the meaning of the data" (Creswell, 2015, p. 4). In qualitative research, the researcher is the primary instrument in the collection and analysis of data. The role of the researcher is to find and describe with authenticity the meaning found in the experience of others. By collecting a variety of data concerning the adoption, implementation and sustainability of a one-to-one computing program and the experiences of individuals during the 20 years of the program, the researcher sought to identify common themes that support ways to sustain educational change.

Constructivist Epistemology

Constructivists believe that all individuals seek to understand and find meaning in their lives. In doing so, individuals attach varied and subjective meanings to their experiences. While individuals may experience the same event or phenomenon, no two individuals understand or ascribe the same meaning to the event or phenomenon, each constructs his or her reality (Creswell, 2002, 2015; Lincoln & Guba, 1985; Merriam & Tisdell, 2016). According to Crotty (as cited in Creswell, 2014) several assumptions can be made regarding constructivism and constructivist research:

1. Human beings construct meanings as they engage with the world they are interpreting. Qualitative researchers tend to use open-ended questions so that participants can share their views.
2. Humans engage with their world and make sense of it based on their historical and social perspectives – we are all born into a world of meaning bestowed upon us by our culture. Thus, qualitative researchers seek to understand the context or setting of the participants through visiting this context and gathering information

personally. They also interpret what they find, an interpretation shaped by the researcher's own experience and background.

3. The basic generation of meaning is always social, arising in and out of interaction with a human community. The process of qualitative research is largely inductive; the inquirer generates meaning from the data collected in the field (Creswell, 2014, p. 9).

The purpose of this study was to explore one school's capacity to embrace and sustain ubiquitous computing, over a significant amount of time, to leverage educational change. The researcher sought to understand through the views of others the educational changes that occurred within classrooms and within the school environment from the adoption of the innovation until the present. Because the researcher desired to understand and find meaning in the changes that one-to-one computing brought to the members of a school community, individually and collectively, the researcher approached this study from a constructivist world view. As a constructivist, the researcher sought to understand and find meaning in how others perceive and make sense of their experiences. The views, perceptions, and understandings of individuals were essential to the researcher's exploration of the changes that occurred (Creswell, 2014). Creswell suggests that constructivist researchers can only understand the experience of the participants through personal interaction with participants, and preferably in their environment. For this reason, the researcher spent a significant amount of time on the campus of the school studied in an effort to address the research questions of the study.

Research Questions

The guiding research question for this study is: *How and why did a school community experience change as it adopted, implemented, and sustained one-to-one computing over time?*

Sub-questions to this research are:

1. Has teaching and learning changed since the implementation of one-to-one computing, and if so how do participants understand the changes that have occurred?
2. Has one-to-one computing changed over time in this school, and if so, what has changed and why has it changed?
3. How did the organization and individuals within it sustain one-to-one computing over time?

Case Study Design

A qualitative, embedded, single-case design was used for this study. A case study seeks to provide information about the how and why of a contemporary event in which the researcher has no influence (Yin, 2014). According to Yin, there are five rationales for single-case studies based on the nature of the situation to be studied. These include critical, unusual, common, revelatory, and longitudinal cases. Because the researcher sought to understand the implementation and sustainability of one-to-one computing in a school over 20 years a longitudinal case study would be appropriate. In most longitudinal case studies, the researcher studies the case at two or more points in time, collecting information at different points in time (Yin, 2014). According to Yin, the researcher would ideally collect information at stages where the researcher anticipates change would occur. In studying educational innovations, the researcher might collect information at points of adoption, implementation, and sustainability (Fullan, 2007, 2016). For this study, the researcher had to rely on historical and current data, as well as the memories of the experiences of participants, to understand the what, how, and why of one-to-one computing in the school over 20 years.

This study explored educational change that occurred in the school, as well as within the classes of individual teachers. Yin (2014) states that an embedded design, rather than a holistic

design, should be used when there is one or more subunits of analysis within the case. In this study, the school is one unit of analysis and the classroom is a subunit of analysis. Hence, an embedded, single-case design is appropriate for this case study. In an embedded design, the researcher must carefully attend to each unit of analysis to ensure that the nature of the study is not compromised. In this study, extensive analysis of one-to-one computing in the classroom was pertinent to understanding how learning and teaching may have changed due to this innovation. However, to focus only on this subunit of analysis would have been to neglect the organizational aspect of the study which sought to understand the organizational climate that allowed and sustained one-to-one computing over 20 years. Thus, data collection examined both classroom-level activity as well as school-level activity.

Site and Participant Selection

Purposeful sampling occurs when a case is chosen because it has the potential to offer rich informative insights into the phenomenon to be studied (Patton, 2002). Purposeful sampling is used when the researcher seeks in-depth information in order to understand the phenomenon being studied and when generalization to a larger population is not a desired outcome (McMillan & Schumacher, 2001). Because the school has sustained a one-to-one computing environment for 20 years, it had the potential to provide the researcher with a wealth of data for analysis and for the researcher to make inferences.

The sampling was also one of convenience. In convenience sampling, participants and/or a site are chosen by the researcher because the participants are willing and available to be studied and/or the gatekeeper of a site or an organization is willing to provide the researcher access to the organization (Creswell, 2002, 2015). As a former colleague within the international organization of schools in which the school belongs, the researcher had access to administrators, teachers,

students, and graduates of the school and permission to conduct the study from the primary gatekeeper, the head of school.

The site of this study was chosen because the school has a long history of one-to-one computing, having had laptop computers in its middle and upper schools since 1998. Additionally, some members of the faculty and administration have been at the school for the duration of the one-to-one computing program, making them good sources of information regarding the program throughout its history.

Site Selection

In 1996, 52 schools across the United States implemented one-to-one computing programs as a result of the pioneering initiative of the Microsoft and Toshiba *Anytime Anywhere Learning*. In 1997-98, after the first *Anytime Anywhere Learning Summit*, more schools in the United States launched one-to-one computing. It is unknown as to how many schools adopted one-to-one computing in the year following the first summit, but it is known that over 1000 schools had implemented the program by 2002 (Johnstone, 2003). The school studied was one of the schools that implemented one-to-one computing in 1998. The school was invited to send two participants to the first *Anytime Anywhere Learning Summit* in April 1997 because a sister school was among the pioneer schools. As a result of this summit, several schools within this network of sister schools began one-to-one computing programs in the 1997-98 academic year. The school studied has had a one-to-one computing program in Grades 5-12 for 20 years. The school was chosen by the researcher because the school is known for having one of the first fully wireless one-to-one computing programs and has been acknowledged, and the subject of written case studies, by Compaq, Toshiba, and DyKnow (personal communication, April 10, 2018) for its ability to integrate laptops and other technologies into its curriculum. In addition, because of the

school's program, the technology director was asked to serve on advisory boards for Compaq, Toshiba, and Fujitsu (personal communication, April 10, 2018). The location of the school also makes it easily accessible to the researcher for extensive periods of time.

Located in a large urban area, the school is a Catholic, independent, school for girls in Grades PreK -12. The school, which is comprised of three academic divisions, lower school, middle school, and upper school, serves a population of approximately 720 students and employs over 170 faculty, administrators, and staff.

Participants and Data Collection

In a qualitative study, the researcher seeks to find the meaning of events through the experiences of others (Patton, 2002). Participants for the study were administrators, teachers, students, and graduates who had been involved with the one-to-one computing program. From the data collected, the researcher, as the primary research instrument, infers meaning to the phenomenon studied (Lincoln & Guba; 1985; Yin, 2016). The researcher selected three techniques available for obtaining data: interviews, observations, and documents. The collection of data occurred from May 2017 to November 2017, with the researcher making five site visits ranging in duration from two days to two weeks. The researcher spent approximately four weeks on the campus of Sophia Academy with the majority of that time occurring in the 2017-18 academic year. The researcher obtained approval from the IRB to proceed with her research in April, 2017.

Table 1

Administrators, Faculty and Technology Staff Participant Data

Date	Role	Years of Experience	Years at Sophia	Gender	Age
Administrators					
June, 2017	Administrator	43	5	Female	60-69
June, 2017	Administrator	60	31	Female	> 69
June, 2017	Administrator	23	4	Female	40-49
June, 2017	Administrator	21	4	Male	40-49
June, 2017	Administrator	15	5	Male	40-49
August, 2017	Administrator	35	20	Female	> 69
October, 2017	Administrator	40	20	Female	> 69
Faculty					
June, 2017	US English	48	21	Female	> 69
August, 2017	MS Science	38	27	Female	60-69
August, 2017	MS Social Studies	10	4	Female	30-39
August, 2017	MS Computer Science/Tech Staff	24	2	Female	60-69
August, 2017	MS Religion	23	2	Female	50-59
August, 2017	US English	15	15	Female	40-49
August, 2017	US Social Studies	28	20	Female	50-59
August, 2017	US Math	44	24	Male	60-69
August, 2017	US Religion/Foreign Language	18	16	Female	60-69
August, 2017	US Science	5	1	Male	< 29
October, 2017	MS Science	28	19	Female	40-49
October, 2017	MS Religion/Study Skills/ Alum 2005	7	4	Female	30-39
October, 2017	MS Religion	11	11	Female	30-39
October, 2017	MS/US Theatre	3	3	Male	40-49
October, 2017	MS English	3	1	Female	< 29
October, 2017	US Science	13	9	Female	60-69
October, 2017	US Science/Engineering	16	10	Female	30-39
October, 2017	US Science	13	3	Female	30-39
Technology Staff					
October, 2017	Technology Staff	38	1	Female	50-59
October, 2017	Technology Staff/Alum 2004	10	7	Female	30-39

Table 2

Alumnae Participant Data

Date	Class	Years Attended Sophia
Alumnae		
October, 2017	1998	12
October, 2017	2001	14
October, 2017	2001	4
October, 2017	2002	13
October, 2017	2002	7
October, 2017	2003	6
October, 2017	2005	7
October, 2017	2005	7
October, 2017	2007	13
October, 2017	2008	6
October, 2017	2010	8
October, 2017	2013	14
October, 2017	2013	4
October, 2017	2013	14
October, 2017	2014	12

Table 3

Focus Group Participant Data

Date	Type	Participants
Focus Groups		
October, 2017	Middle/Upper School Faculty	6 Faculty
October, 2017	Middle/Upper School Faculty & Staff	6 Faculty & 2 Technology Staff
October, 2017	Middle School Students (Grades 5-8)	7 students
October, 2017	Upper School Students (Grades 9-10)	5 students
October, 2017	CAVE (Help Desk) Students (Grades 10-12)	4 students

Interviews

According to Rubin and Rubin (2012), in-depth qualitative interviews allow the researcher "to explore in detail the experiences, motives, and opinions of others and learn to see the world from perspectives other than their own" (p. 3). Qualitative interviews help to reconstruct the lived experience of participants (Patton, 2002; Rubin & Rubin, 2012). Through approximately 20 open-ended questions, the researcher sought to gain an understanding of each participant's perceptions of one-to-one computing and the educational changes that may have occurred due to its implementation. The researcher developed open-ended questions that while similar in nature, were specific to the four groups of participants to be interviewed. Semi-structured interviews were documented through notetaking and audio recordings. Individual interviews were conducted with seven current and former administrators, 18 current faculty, two technology staff, and 15 graduates from the Class of 1998 to the Class of 2014.

Focus Groups

Focus groups are an interview of a small group of people (Yin, 2014). Focus groups are a valid method for explanatory or exploratory research in which the researcher seeks to understand the feelings and beliefs of a group or individuals regarding a program or an event (Vaughn, Shay Schumm, & Sinagub, 1996). Focus groups, moderated by the researcher, allow for various topics to emerge through the dynamics of the group. The researcher, as moderator of the group, needs to ensure that each individual is able to participate in the discussion (Yin, 2014). Three focus groups with students were conducted. Vaughn et al. recommend that student participants be of similar age in an attempt to minimize any intimidation to speaking that might exist between older and younger students. For this reason, student focus groups were composed of students from the middle school and from the upper school. A third student focus group was composed of upper

school students who serve as computer interns. A focus group of graduates who participated in the one-to-one computing program was scheduled for mid-September, but was cancelled due to a schedule change made by the school. Focus groups can also be a good means of exploring more deeply topics that emerge from individual interviews (Vaughn et al., 1996). For this reason, two focus groups of faculty were conducted after administrator and faculty interviews were mostly completed. The two focus groups of faculty were composed of faculty from across schools and disciplines, librarians, and technology staff.

Gaining access. Prior to the actual collection of data, the researcher visited with the current head of school to explain the purpose of the study and to ensure the head of school confidentiality. As the primary gatekeeper of the school, the head of school has the authority to allow research to occur within the school. The researcher obtained written consent from the head of school to conduct the study, as well as written consent from all participants in the study and parental consent from any participants under age 18. In order to ensure trust and transparency with the head of school, the researcher visited with her several times during the duration of data collection and by phone twice during the analysis of data.

Administrators. In the past 20 years, the school has had two heads of school, three upper school heads, and four middle school heads. While the lower school currently has tablets available to students and Tablet PCs available in the 4th grade, this aspect of the school's technology program did not begin in 1998 and students do not have access to tablets 24/7. Hence, lower school administrators, faculty, and students were not included as participants. The researcher interviewed each of these former and current administrators to gain insights from an administrative perspective as to what had occurred within the school during the duration of the program. Another key administrator is the technology director. The technology director was a

member of the administration for many years; she is no longer considered an administrator. The technology director has been involved with the program since its inception and oversees a number of staff who provide technical and professional development support. Additionally, the technology director was able to help the researcher locate individuals whose experiences provided in-depth knowledge of the one-to-one computing program. The technology director was interviewed once to obtain her perspective of the program and consulted several times to check the validity of other data collected. This administrator was also able to provide the researcher with documents to be studied, such as technology plans, the appropriate use of technology polices, surveys conducted by the school, etc.

Teachers. Individual teachers learned of the research study at a faculty meeting in May where participants were asked to volunteer to be interviewed. Each faculty member received a letter explaining the study, a consent form, and a demographic sheet in his/her mailbox the following day along with a stamped envelope to return the consent form and demographic sheet to the researcher. Eighteen faculty volunteered and all were interviewed. Individuals represented a range of experience with one-to-one computing, from some who had been a part of the program since its inception to others who had been hired in the past 5 years. The teachers who were interviewed also represented various areas of the school. Nine were middle school teachers and nine were upper school teachers. Ten faculty taught some form of humanities (English, social studies, religion or foreign language) and eight taught in the STEM disciplines (science, technology, math, or engineering) Because the researcher was interested in gathering as much information regarding the one-to-one program from inception to present, it was important to have several participants who had been a part of the program since its beginning. Seven of those interviewed had been a part of the program since its inception and two others came the following

year. At least five faculty focus group participants had been a part of the program since 1998. Two faculty members were students at the school when the program was in its initial stages. These individuals were able to provide significant insights into changes that occurred to the school environment as well as to individual classrooms due to one-to-one computing.

Students. Three focus groups of students were conducted, one composed of middle school students chosen by the middle school head, one composed of upper school students chosen by the upper school head, and a group of upper school students who are CAVE interns, that is students who staff the computer help desk. The CAVE students were selected based upon who was free during the last period of the day and willing to be part of the focus group. The researcher also decided to shadow, without their knowledge, two students, one middle and one upper, each for a full academic day in order to get a sense of how much the Tablet PC is typically used during the school day.

Graduates. The researcher emailed alumnae of the school from the Class of 1998 through the Class of 2017 to explain the study and ask for volunteers. As mentioned earlier, the focus group for graduates did not occur due to a schedule change of the Alumnae Weekend by the school. Because of this, the researcher sought permission from her advisor to interview graduates in person or via video conference. Fifteen graduates from ten different graduation years between 1998 and 2014 volunteered to be interviewed.

Observations

Patton (2002) suggests that "to understand fully the complexities of many situations, direct participation in and observation of the phenomenon of interest may be the best research method" (p. 21). Because this study was conducted years after the implementation of one-to-one computing, observational data provided information about the phenomenon as it currently is,

which is important, though insufficient, to answer if and how the innovation has changed over time. Observations of teachers and students provided the researcher with a greater understanding of how the program is currently being used and what teaching and learning look like now that the one-to-one program has been in existence for 20 years.

The researcher observed a variety of middle and upper school classes from various academic disciplines, including the classes of teachers participating in interviews. Eighteen initial class observations were conducted. One faculty member who had been a part of the program for 20 years was on long-term disability and was not able to be observed. When this faculty member was interviewed, the researcher anticipated that he would be teaching in the fall, which was not the case. Another faculty member was not available for a second observation due to maternity leave. The researcher visited each class for at least forty-minutes to observe if and how one-to-one computing was used, and then for an additional visit of similar length to confirm data gathered from the first observation and previous interview. Activities by the teacher, interactions between students and teacher, student-to-student conversations, and inappropriate use of laptop were recorded. The researcher payed close attention to activities that may be classified as teacher-centered or student-centered and to documenting the amount of time and for what activities students and teachers use one-to-one computing.

Documents

An analysis of various documents provided a third source of information. A variety of documents provided the researcher with information that cannot be observed or gained from the perceptions of others (Patton, 2002). In this study, archival documents were a valuable asset in that they provided a lens in which to view historical events associated with ubiquitous computing. Through the school archivist, the technology director, and the head of school, the

researcher obtained access to technology and strategic plans, acceptable use and technology policies, survey data regarding the program, school self-studies and reports of visiting committees of accrediting agencies, newspaper clippings, and other documents that pertained to the one-to-one computing program. These documents provided limited insights into the evolution of the program.

Journaling

Lincoln and Guba (1985) suggest that a reflexive journal be kept by the researcher during the data collection as analysis of the journal can provide insights into the researcher's thinking, perceptions, biases, and assumptions. The researcher maintained a journal of her reflections during the course of the study.

Data Analysis

Interviews were recorded, transcribed, and analyzed for emergent themes using two cycles of coding. According to Saldaña (2016), a code "is most often a word of short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-base or visual data" (p. 4). Since qualitative analysis is primarily inductive and comparative, the constant comparative method, first introduced by Glaser and Strauss in 1967, was an appropriate means of analysis for this case study. Because qualitative research does not seek to test theories or assumptions, but instead seeks to develop an explanation or theory for what occurred, several forms of data were collected in this case study. The constant comparative method in which comparison of codes are made for similarities and differences was used. In the process of comparing, the concepts may emerge which the researcher must attend to knowing that these may lead to new categories or theory (Yin, 2016). Yin suggests that the researcher engage in three processes in analyzing the various forms of data, the making of constant

comparisons, watching for negative instances, and considering rival thinking. Throughout the process of data collection, transcription and analysis, the researcher took care to note where information was similar or different, to consider alternate reasons for occurrences or perceptions that participants had, and to reflect upon how her own bias may be affecting the analysis.

Transcripts, field notes, and documents were initially coded with emergent codes. Prior to data analysis, each transcript was returned to the participant for member checking, to approved, edit, or delete. As each document was coded and analyzed, more concise codes were given to broader categories of groups of codes. The researcher looked for interrelatedness among these broader categories and then used those relationships as well as the broader categories as the basis for creating an outline for reporting the results in Chapter 4. Areas of data that were unclear were checked with technology staff or the technology director for accuracy. However, in each interview, the researcher attempted to clarify questions and/or uncertainties with the participant.

Ethical Considerations

According to McMillan and Schumacher (2001), qualitative researchers need to be keenly aware of ethical issues that may arise due to the research topic and the collection of information through face-to-face interviews and observations. The researcher was aware that administrators and teachers might not feel free to express negative thoughts about the program due to the fear of loss of employment. Teachers, middle level administrators, students, and graduates could have perceived this study as opportunity to express dissatisfaction about a variety of issues and/or people, including the leadership of the school. Prior to conducting any research, the researcher provided and discussed with each participant an informed consent that assured confidentiality. In conversations with participants, the researcher reminded individuals of the focus of the research and the need for confidentiality in order to obtain the most realistic

understanding of individuals' experience of one-to-one computing. In reporting the results of the study, the researcher referred to participants, for example, as a middle school faculty member, a 1998 graduate, etc. The school's identity is not used in the study. Data was stored in a secure area accessible only to the researcher.

Researcher's Role

In a qualitative study, the data about a phenomenon cannot be gathered by external instruments. Interviews, observations, and document analysis allow the researcher to make inferences about the phenomenon studied. For this reason, in a qualitative study, the researcher is the primary research instrument (Yin, 2016). It is important for a qualitative researcher to acknowledge his or her role in the study and to provide information regarding any possible biases that the researcher may have in the case considered.

The researcher in this study has been a faculty member and administrator since 1980 in four sister schools of the school studied. The researcher was the upper school head and one of the primary architects of a one-to-one computing program. Additionally, the researcher served as head of school in another sister school that implemented a one-to-one computing program in its upper school in 2007, the year prior to her appointment as head of school. While the researcher has been in schools with one-to-one computing for 20 years or less, her teaching experience within a one-to-one computing program is limited to having minimally used laptops for data collection in an honors physics class taught for three years in the beginning years of a one-to-one computing program. Because this study sought to understand educational changes that may have occurred due to ubiquitous computing in a school in which the researcher has not worked, the researcher believed that she could conduct this research without bias.

Researcher's Views and Assumptions on One-to-One Computing

The researcher recognizes that her long history with one-to-one computing programs situate her within the context of her own views and assumptions. In the past 20 years, the researcher has observed teachers and students using one-to-one computing in ways that promote a more student-centered environment. She has also observed situations in which one-to-one computing was simply layered upon traditional teacher-centered learning, and she is aware that the initial political enthusiasm that once existed for these programs has waned because of the lack of rigorous empirical studies on the benefits of one-to-one computing. As an educator, the researcher believes that one-to-one computing, under certain conditions, can enhance teaching and learning and can help prepare students for the global society in which they will live. A basic assumption of the researcher is that the teacher, not the tool, creates the context within which learning occurs, whether it is student- or teacher-centered. Hence, simply giving student laptops will not enhance learning. Teachers using one-to-one computing to change the manner in which they teach might do so.

Qualitative researchers attempt to create for participants an environment characterized by cooperation, trust, openness, and acceptance (McMillan & Schumacher, 2001). While the researcher is known as a colleague to some of the faculty, she is unknown to others. In order to establish a relationship with administrators, faculty, and students, the researcher interacted with members of the school community in a variety of other ways while she was present on the campus.

Credibility of the Research

A credible study assures others that the researcher has "properly collected and interpreted data, so that the findings and conclusions accurately reflect and represent the world that was

studied" (Yin, 2016, p. 85). Addressing issues of credibility should occur in the process of creating a research design (2016). Yin suggests several means of ensuring the credibility of a study, trustworthiness, triangulation, validity, and rival thinking.

Trustworthiness. How the researcher approaches his or her study from creating a design to reporting results can build trustworthiness. The trustworthiness of a qualitative study is highly dependent upon the skills and integrity of the researcher (Patton, 2002). Yin (2016) suggests that it is an attitude that the researcher must possess from the beginning of the process. The professional manner and rigor with which the researcher conducts a study can add tremendous credibility to trustworthiness of the study. Providing explanations for site and participant selection as well as the reasons for a particular research design help to create trustworthiness. Demonstrating one's authenticity as one collects data and reports findings is essential to creating an atmosphere in which others trust the researcher's ability to conduct the study (Yin, 2016). Multiple interviews, spending extensive time on site getting to know the school and its members, conducting repeated observations, and checking with participants about the accuracy of the data collected enhanced the trustworthiness of this study. While the researcher is known as a colleague to some on the campus, she spent a significant amount of time interacting with members of the school community during four of the site visits. The researcher conducted interviews and repeated observations. One means of assuring trustworthiness with participants is to have participants check the validity of the transcriptions of interviews. The researcher had each participant check the accuracy of the transcript of his/her interview and periodically checked details of the program with several of the technology staff and the technology director. Most of the participants made no changes to their transcripts. Others made minor changes to the language used or to clarify the intent of their words.

Triangulation. Creswell (2002, 2015) states that triangulation is the process of corroborating evidence from different individuals, types of data, or methods of data collection. Yin (2016) suggests that "the ideal triangulation would not only seek confirmation from three sources but would try to rely on three different kinds of sources" (p. 87). Participants with various roles and perspectives in the school allowed for one form of triangulation. The use of three methods of data collection, interviews, observations, and documents, allowed for corroboration in the present. The lack of observations from the program's inception limited the ability to corroborate historical events. Interviews in which participants recalled what occurred in the past as well as historical documents offered some corroboration of data.

Rival Thinking. In an effort to provide the most authentic reporting of a phenomenon, the researcher was willing to consider rival explanations (Yin, 2016). An attitude of skepticism needs to be present within the researcher so that the researcher can question the validity of events and actions, whether or not participants are being honest and candid, and one's original assumptions about the study (Yin, 2016). The researcher was aware that her previous involvement with two schools with one-to-one computing could sway her ability to collect information which might not support the successful implementation of one-to-one computing. Because the research was focused on educational change as it occurred in this particular school, the researcher did not believe that her former involvement with one-to-one computing was a threat to the credibility of the study. However, in an effort, to ensure that the researcher maintained a willingness to consider rival thinking, the researcher asked a former teacher who had been involved in a one-to-one computing program for a number of years to reflect with the researcher about her findings and frequently discussed her research with a another colleague who had worked in a one-to-one computing school

Conclusion of Methods

This chapter provided a summary of the qualitative, embedded, single case study the researcher used to explore one school's capacity to embrace and sustain ubiquitous computing, over a significant amount of time, to leverage educational change. An embedded, single case study was used to explore what changes may have occurred in one school and to teaching and learning over 20 years due to the implementation of one-to-one computing. Data was collected using interviews, observations, documents, and a reflexive journal. The researcher used a variety of strategies including triangulation, member checking, and peer debriefing in an effort to increase the credibility of the study. The next chapter of the study will provide a discussion of the researcher's interpretation of the data.

Chapter 4: Results

Michael Fullan's Educational Change Model served as the conceptual framework for this case study. Fullan makes a distinction between *innovation* and *innovativeness* (2007, 2015). An educational reform implemented by a school is an innovation, while the school community's capacity to embrace change for educational reform is the innovativeness of the group. This study was primarily focused on the innovativeness of a school community, its capacity to embrace one-to-one computing and sustain it over time. Several themes, the need for a strong educational mission, flexibility in implementation, a risk-taking environment, and interactions with other schools engaged in one-to-one computing emerged as factors contributing to the organization's capacity to embrace and sustain change. These will be discuss in this chapter; however, it is important to understand the innovation, one-to-one computing, and the perceived reasons for why the school decided to implement this educational reform.

Multiple Rationales for One-to-One Computing at Sophia Academy

By the 1990s, many schools had introduced computers into their educational program through computer labs and a handful of desktop computers in some classrooms. Very few schools had seriously considered Seymour Papert's vision of one computer per student (Papert, 1980, 1993). In 1997, Sophia Academy (a pseudonym for the school visited) had two computer labs and was planning to equip classrooms with a few desktop computers, but had not seriously considered bringing laptops into the school. The technology director was actually opposed to taking this step until she and the middle school head were invited to attend a conference focused on one-to-one computing. It was at this conference that they began to see the rationales for moving forward with a one-to-one computing program in the middle and upper schools.

The inspiration for beginning a one-to-one computing program was the 1997 *Anytime, Anywhere Learning (AAL)* Summit. In April 1997, the middle school division head and the technology director attended this summit in which the first schools to implement one-to-one computing presented what they had accomplished and learned during the first year of the program. As the technology director expressed,

> I didn't want to do a laptop program before there was the Microsoft *Anytime Anywhere Learning* program… So I went, and I was just blown away. I mean part of it was the Microsoft presence and I'd never been to anything so big with so many big screens and the music pumping. But, watching people from Harlem and from North Carolina and all these very, very, very poor school districts, watching what their teachers were doing with their kids and how they were able to manage this….I thought ok I've got it. I couldn't wait to come back! (technology director).

Following this meeting, a meeting was held with the head of school who was convinced that the school should move in this direction in order to remain "educationally excellent" (former head of school). A meeting of the board of trustees was held to present the program, and the board decided to dedicate funds for the infrastructure of the program, but felt that the expense of the laptops should be a student expense.

Prior to placing laptops in the hands of students and faculty, the school visited the campuses of three of the pioneer schools to glean all the information that they could about the successes and failures:

> People always say what would you do differently and I don't think we made any mistakes thanks to those people who did it the year before us and made mistakes

and were so willing to share with us what they would do differently (technology director).

Several meetings were held to present and hear concerns of faculty and parents. A member of the board who had a technology background, the head of school, and the technology director facilitated these meetings. Faculty were surveyed regarding their support of the program. The technology director recalled that 88% - 91% of the middle and upper school faculty were in favor of implementing one-to-one computing. Despite the positive support of faculty, there were still resistors to the program. "There were lots of people that were against it and didn't see the point of it, but it was the change factor that made them so nervous….We had some really good teachers that dug their heels in" (former head of school). The resistance to educational reform by teachers was to be expected based upon the findings of researchers, such as Cuban (1993b, 1998, 2007, 2008, 2013a, 2013b, 2018).

The implementation of the program proceeded quickly with the faculty receiving their laptops nine months after the AAL Summit and eight months prior to the first students receiving laptops. The school decided that the 7th, 9th and 10th grades would be the first classes to participate in the program, with additional grades participating the following year. At the time of implementation, the school was one of two independent schools in the urban area to adopt one-to-one computing and the first school in the country to have a completely wireless campus.

Educational change can occur for a variety of reasons, some of which are educationally sound and some of which may simply be a fad. From the research, it is known that schools frequently implement reform after reform, with very little stability

(Cuban, 1993b, 1998, 2007, 2008, 2013a, 2018). For this reason, faculty tend to question any educational change, needing creditable reasons for why they should change or adapt what they are doing. Knowing and understanding the rationales that led Sophia Academy to implement and sustain one-to-one computing for 20 years can be of substantial value to research on educational change and for institutions considering an educational reform.

A variety of reasons were given as to why the school opted to provide one-to-one computing to its students and sustained it for 20 years. Several administrators and faculty indicated that they thought the school decided to go in this direction because the board and the administration wanted to assure that the school's educational program was "cutting edge," that is, they felt that this program would better prepare students for their future roles in society and allow the school to be educationally progressive.

Several individuals who have seen the program change through the years commented that while some of the original goals remain, the rationale for the program has evolved over time:

> In instructional technology, in educational technology, goals are fluid….There are no concrete goals other than doing the best we can do to prepare the girls for the world they are going to encounter outside of these walls (upper school librarian).

The fact that the goals may have evolved as the program evolved could also be a reason for the longevity of the program.

Constructivist Learning

Early years. Early adopters of one-to-one computing at the school believed that this technology would help to promote a more constructivist learning environment. Sophia Academy, like other schools at the time was very textbook driven, but had begun

to implement some student-centered, project-based learning that engaged students collaboratively in solving authentic, real-world problems (Fosnot, 1989; Jonassen, Peck, & Wilson, 1999; Means, Penuel, &, Padilla, 2001; Sandholtz, Ringstaff, & Dwyer, 1997; Solomon & Schrum, 2007; Zhao, Zhang, Lei, & Qiu, 2016). A librarian who has been a part of the program since its implementation as a parent and faculty member commented that the school,

> …has always embraced more of a constructivist attitude toward learning, that learning is not linear. Learning is not you do, you learn how to do this and then you learn how to do this. You explore....We're very project-based and our learning here lends us to do a lot of these things….the technology helped move us even faster and maybe that's one of the things that was missing in the public school [where I was previously]. We didn't have the technology at that time to push the constructivist learning model (upper school librarian).

The fact that the school had some elements of constructivist learning prior to the implementation of one-to-one computing may have benefitted the sustainability of the program; however, many thought that one-to-one computing had allowed more student-centered, project-based, authentic, real-life learning.

One of the results of constructivist learning is that students are more engaged in their learning than in teacher-centered activities, such as lecturing. From the perspective of administrators and faculty, the one-to-one computing program was a tool that helped the school embrace more student-centered learning. A former upper school head who was an advocate for the implementation of one-to-one computing reflected upon what she observed in the first year of the program:

> The students were more engaged in the class. You didn't have a teacher calling on one student. Everybody was hands-on as long as it was being used. People were doing their own work, doing their own investigating, so you had much more engagement….They were…it was not a sit back, listen, take notes. Everybody was involved and so it did become more student-centered from that point, maybe from others, too….I saw kids just take off and you had a flip of the kids, who were kind of nerdy, sort of taking over and you know fixing things in the classroom for the teacher. If something wasn't working, the teacher would call on one of the kids to…'can you get this overhead projector working' or helping out another kid with a problem. So it was very much more an active classroom.

Many faculty embraced one-to-one computing because they saw its potential to provide opportunities for students to construct their own knowledge, be more independent learners as well as collaborators with peers and others. As a former upper school head stated, the school was always student-centered because of its small size, but one-to-one computing offered new and easier means of creating constructivist classes.

Current Program. In the early years of the program, project-based learning was a good means of ensuring that the technology was being used; however, as the program has developed the technology became more of a tool to support a constructivist model of learning. The head of school succinctly described this change: "Our innovation [now] may not be solely about technology; technology will help us innovate." Another administrator commented,

> We've kind of taken the focus off of technology for professional development, and have gone more with [professional development] focused on project-based

> learning….you still need to push it [student-centered learning]…it's not because of technology that they're getting there. It's because we're pushing the student-centered aspect….It's still pretty easy to stand up in front of a classroom and lecture with one-to-one computers! I think that's less of what happens now. So does technology help? Sure. Is it going to drive it? No, no. It's just as Jim Collins says in his book, *Good to Great*, it's just an accelerator. It's not going to be the be-all and end-all for anything (middle school head).

The idea of using technology as an accelerator for achieving a more student-centered learning environment is also advocated by Fullan (2013a; 2016). Technology should not drive educational change, but rather accelerate it (Fullan, 2013a; 2016). Making learning more engaging can be enhanced through "leveraging digital" (Fullan, Quinn, McEachen, 2018). Fullan et al. (2018) believe that leveraging technology, using it "to facilitate, amplify, and accelerate" learning can foster deep learning (p. 81). In "leveraging digital," the focus is on the potential of computing, rather than the devices to create environments which enhance students' ability to control their own learning.

Increased engagement of students is one product of constructivist learning, and it often occurs because students are involved in authentic, real-life activities (Fosnot, 1989; Jonassen, Peck, & Wilson, 1999; Means, Penuel, &, Padilla, 2001; Sandholtz, Ringstaff, & Dwyer, 1997; Solomon & Schrum, 2007; Zhao, Zhang, Lei, & Qiu, 2016) Classroom observations and interviews with current teachers revealed that many teachers, especially at the middle school level, had incorporated more constructivist learning in their classes through the use of authentic, real-life problems. Two upper school science teachers spoke of their recent use of "modeling," a guided inquiry mode of teaching that supports a constructivist environment. A chemistry teacher

described the inquiry mode as experiment-observation-claim and guiding the students through this process to draw conclusions and develop equations (upper school faculty).

An upper school English teacher described how she saw the program supporting a constructivist learning environment: “I may have a degree, but I’m not the specialist. They’re specialists as well. It’s more of that guide by the side learning.” An upper school humanities teacher indicated that moving to one-to-one computing forces a shift in roles for the teacher and the students:

> It’s a change that fundamentally affects how we deal with information… teaching is not about imparting information anymore.....It's about us giving them context and helping them navigate [through the available resources].…classroom time should be about reinforcing, about practicing, about discussing, about what's interesting….we become maybe more mentors than lecturers (upper/middle school faculty).

Interviews and classroom observations support the fact that one of the reasons the program has been sustained is because it supports a constructivist learning environment, and most of the faculty embrace this type of learning for their students.

A good number of teachers who joined the faculty after the implementation of the program were committed to using one-to-one computing as a means of providing their students more autonomy in their education. Interviews with administrators confirmed that in the hiring process, though not the primary factor, consideration was given to teacher use and understanding of technology. Creating a constructivist learning environment was an initial rationale for the program, and is an important driver for the continuation of the program.

Empowerment of Women

Another reason for implementation that was mentioned by participants was the empowerment of women, and the encouragement of women to pursue study in STEM (science, technology, engineering, and math) fields infrequently considered by women. An administrator commented that parents "knew there was a risk [associated with going one-to-one], but you know they understand that and they want their girls to be empowered…." (middle school head). The mission of Sophia Academy has been to empower its students, and in an all girls' school, faculty and administrators believed that this meant providing the knowledge and skills that women would need to compete in careers that had been dominated by men.

Early Years. The technology director stated that one of the initial goals of the program was "to bridge the gap in technological fluency between boys and girls." A humanities teacher commented that it's [technology's] "a field that still really doesn't have a lot of women leaders and what we want is to produce women leaders" (upper school faculty). A student mentioned that the educational mission of the school had its origins in empowering women by providing an education for girls in the 19th century. This student saw the move to one-to-one computing as one way to translate this mission for the 21st Century. For this student, it was an expectation that the school would ensure that women would be taught to use technology because the educational mission has always been about breaking barriers for women. While using technology to further their core education was an important objective, this also included learning a great deal about the technology itself. Early on a decision was made by the school to provide a help desk

for students and faculty that would be primarily staffed by students. A staff member and graduate, who was one of the first students to receive a laptop, commented,

> I just thought it was a cool thing to do and wanted to learn about computers and we were just taking apart computers and fixing them…It never occurred to me that this was not something that everybody did until I left and went to college and saw two girls in an entire engineering program or heard about this stigma that women don't do technology and girls don't do science and math. (technology staff; alumna, 2004).

In addition to providing a means of satisfying a need of the school, the establishment of the Computer Audio/Video Education (CAVE) has allowed more students to gain experience with the operation of digital technology. Since 1998, 295 upper school students have been trained as computer technicians and have completed 25,000 documented repairs (school website).

In the late 1990s, faculty, administrators, and parents knew that many more fields in science, technology, engineering, and math were becoming more available to women. Because the school's mission has always been focused on empowering its students, faculty and administrators readily saw that technological fluency would possibly open new careers for young women, and the one-to-one program was seen as an effective means of preparing them.

Current Program. The rationale of empowering young women for the future remains a goal of the school, and the one-to-one computing, as well as other programs, such as robotics and engineering, are seen as ways to continue accomplishing the school's mission. A member of the technology staff who was a student when the program

was first implemented reflected upon what she perceived to be one of the current goals of the program,

> I think one of our goals is to empower the girls with technology and remove any kind of stigma that may come with females and technology, that they know that they can do whatever they need to do, that they feel empowered to find the tools, to find the resources, to learn how to use the programs that they want to use to accomplish whatever goals, whether it's educational or personal. (technology staff; alumna, 2004).

Alumnae reflecting on the school and the one-to-one computing commented on the school's focus to empower them to pursue their dreams. For some of them, their experiences with the program only enhanced their sense of competency for whatever career they chose. The one-to-one computing program was just one of many ways that the school empowered them.

"I think the CAVE program is amazing, seeing girls, students repairing our computers" (head of school). From the perspective of students, administrators, faculty and graduates, students who have worked in the CAVE have more confidence in their technological abilities, and many of them have pursued careers in STEM related fields. A former upper school head expressed that she believed more students chose STEM careers after the implementation of the one-to-one computing program, but that might have been more about robotics and the programming they used: "I think technology and having the CAVE, having one-to-one and then the robotics which was connected to it, really promoted [STEM careers]...." The one-to-one program has been viewed by many as opening new opportunities for the students to consider. Many recognize the barriers that

have been present to women in the past as women pursued careers in STEM related fields:

> …[technology is] a field that still really doesn't have a lot of women leaders and that's what we want to produce is women leaders…I think the CAVE and the internship that they provide really does a lot for the girls that are in it, but also for the girls who just see it. It just plants the idea in their heads: "Hey, girls could do that and that's not a big deal." It's normal. I think that's important (upper school faculty).

Twenty years later, empowering young women remains a goal. In an engineering class, girls were working with a variety of tools as they learn to design and create (field notes, 10/4/17; 10/21/17). A recent engineering class used a 3D printer to construct a prosthesis for a child's hand, also highlighting the school's and the students' focus to use their learning and skills at the service of the most needy.

Current students are very much aware of the benefit of some of the opportunities afforded them in a girls' school and of the glass ceiling that some women face in work careers:

> …especially because of the environment [of an all girls' school], I feel like really comfortable working as a CAVE girl…I will say it also brings me a lot of benefits, prepares me for future education as well because I know with the ability to use a computer I could do everything easier, faster, and better than many others.... (upper school student).

Another CAVE intern, spoke about a presentation that the Robotics Team gave the upper school in which they explained how few women pursue careers in STEM. "So when schools are bringing in these computers and all this new technology and it's one-on-one,…it's kind of starting

at a young age of teaching people, “it doesn’t matter if you're a boy or a girl, you can use a computer” (upper school student).

The need for young women to feel empowered goes beyond the campus of the school. Another student reflected that when she began at Sophia she was very surprised to see girls repairing computers. She was so impressed by this and about how much these girls knew that she wanted to be a CAVE girl. She shared an experience of the sense of inequity between boys and girls in technology that recently occurred at her community service site:

> Last week, this happened and yesterday, too: one of the girls who is working next to me with two fifth graders, a boy and a girl, we were all using computers to make a presentation for something and the girl is saying ‘Oh I don't know how to do this. He's better at computers.’ So, it definitely still happens. We need to be able to show girls, no matter how old they are, that they can also work on computers and math and science and everything (upper school student).

She further reflected that being in CAVE and on the robotics team has helped her realize the inequity that sometimes exists. At robotics competitions, where 90% of the participants are boys, there is always some boy who expresses amazement that one of the girls can complete a specific task (upper school student). This student is empowered to help society “get to a point where it’s not surprising that a girl knows how to do something related to technology.” As she said, “…because that would be great!” (upper school student). Breaking through the glass ceiling is clearly important to this student.

While faculty and administrators recognize the importance of empowering young women, and view one-to-one computing as a program that helps to accomplish this, students, too, recognize that Sophia Academy provides them opportunities that other young women their

age do not have. Students are keenly aware of the inequities that exist for women, especially in STEM fields, and see their education, supported by one-to-one computing, as preparing them to compete as equals in the work force.

College Preparedness and Future Work

Many constituents of Sophia Academy would agree with the following upper school faculty member's sense of the purpose of the school:

> Everyone has a shared sense of purpose, what is best for the kids. Doesn't matter if it is harder for the teacher or the administrator. The goal is to further learning and make sure students are being successful.

For many students and parents, the idea of furthering learning might manifest itself as acceptance into a prestigious university and being successful in the work force. In fact, 100% of the Class of 2017 was admitted into a four-year university (School Website). The move to one-to-one computing was seen as a means of bettering the educational program and assuring success of Sophia Academy students. Interviews with alumnae revealed that most had been accepted into selective programs and that most had felt very prepared for college. Of those interviewed, many had chosen careers in STEM fields, and some could look back and see the one-to-one computing program as influential in their decision to do so.

Early Years. The educational philosophy that guides Sophia Academy has always recognized the need to adapt programs, methods, and curriculum to meet the needs of the world. Even the educational philosophy has been updated through the years. In a 1975 document of the educational philosophy, there is no mention of technology, but in the 1990 revision, the document addresses the need to teach the responsible and ethical use of technology (school documents). To some, such as a former head of school and a former upper school head, the one-

to-one program was just an extension of the school's mission of preparing young women for the world in which they would live. "I think we always wanted to prepare the girls for the real world, and this was, this is the real world" (former head of school). Many of the faculty and administrators saw the rapid expansion of technology in society and recognized that changes needed to be made to the program if the girls were going to be prepared for the future. "We were encouraging girls to be the best they could be, to develop all of their skills, to use opportunities. So, what better than technology? You provide them a pathway" (a former upper school head). The technology director echoed these same sentiments,

> You saw the world becoming more technologically literate and competitive. ….We wanted to be able to have our students graduate with a proficiency in technology, so that they were equal or above other people's skills. That was a huge selling point….Their computer skills were not growing having one semester course [of computer science] for all of high school (technology director).

Some administrators felt very strongly that the one-to-one computing program was needed if Sophia Academy graduates were going to be prepared for the future.

In 1997, while many schools, including Sophia Academy, had computer labs and required students to take one semester of computer literacy in high school, few were anticipating the impact that technology would have on the work force in the near future and the skills needed for that work force. As a former upper school head reported: "I supported it, not only supported it, but advocated for it. I saw it as the coming, the future for our kids.… We saw it as the future means of communication; that our students would need to have the skills associated with using computers for the rest of their lives…." The introduction of one-to-one computing and the Internet significantly changed how students were doing many of the tasks that they had done

before, and thus, in the minds of the alumnae interviewed placed them at an advantage over their college peers:

> You know, most people did not at my age…have laptops during the school day…. So not as many people were as well-versed in Internet researching and using different types of things other than the library which I thought put us as at an advantage going into college (alumna, 2001).

The ability of one-to-one computing to better prepare students for college and the work force seemed to faculty, administrators, parents, and students as another reason to move forward with the program. Because this, again, was completely in line with the school's educational philosophy, it made it easier for constituents to accept the changes that it would bring.

Current Program. Preparing students for the future continues to remain a primary reason for the one-to-one program. "To prepare them and I'll say for the 21st century and to prepare them for the workforce that they will face when they leave us. It will include integrating technology into what you do." (head of school).

The upper school head expressed a similar goal for students and faculty, to enhance their technological skills to improve performance. Providing students with technological confidence and skills, such as presentation and communication skills that will prepare them for future success is one goal of the program, while for the faculty it is to provide them the tools and skills "to enhance their teaching, to allow them to be more inspirational" (upper school head). Current students concurred with this idea of preparing students for the future. "Using technology, especially in our society today when technology is constantly moving forward, it kind of prepares us for when we get work; we know how to use all the stuff" (middle school student). An

upper school student expressed that she felt Sophia girls were much more prepared for the technological world awaiting them because of the one-to-one program.

Alumnae consistently reflected upon how prepared they were for college and their future work and how they were at an advantage because of having experienced one-to-one computing in high school:

> Sophia definitely prepared me well for college and life beyond. As far as the laptop program, I was definitely more familiar with using computers than a lot of my friends at college and so I think it was helpful. At the beginning, it was an advantage. I think other students quickly caught up so I'm not sure how much of a difference it made, but at the beginning it was definitely helpful so I didn't have to worry about figuring out how to take notes in addition to studying, moving and getting use to a new environment…. (alumna, 2007).

However, the one-to-one computing was only one aspect of their educational experience at Sophia Academy which prepared them. When inquiring as to how influential the one-to-one computing programing had been to choosing a career, an alumna who is currently doing research in computational design for robots at the University of Pennsylvania commented,

> I actually think the most influential part was in my senior year we started a Robotics Club and so that was really the first time that we did any real engineering at school and that was what really got me interested into mechanical engineering and robotics in general. (alumna, 2007).

Consistently, alumnae reflected upon Sophia Academy developing within them the academic qualities needed for success, some of which included using technology effectively in a variety of ways, including how to write and do research.

A primary goal of the school is "to have our girls have access to information, quality scholarly information at their fingertips which is exactly what they need to be prepared to do in college" (upper school librarian). Along with having the information, students are taught research skills, and especially, how to discern a good source from a poor source: "…doing research, I had to decipher what was a legitimate website versus something that somebody might have just put together. Having to figure things out in high school, I think we were all at an advantage" (alumna, 2001). Another alumna shared that her early experience with technology has increased not only her ability to use technology, but also her ability to help others learn new programs. The company in which she is a financial auditor often asks her to teach new software to other employees (alumna, 2001).

Many of the alumnae interviewed recognized that the school was forward thinking in implementing the one-to-one computing program as a means of preparing them for the future:

> I think that they were just moving forward with the times. Computers and technology are more integrated in our day to day lives and that was a next logical step to take… Going out into the workforce….you were expected to know all these basic computer programs…. they just realized that they needed to adapt and give us more of an experience that would be applicable to the real world (alumna, 2014).

Being prepared for college and the work force was a motivating factor in establishing a one-to-one program. As a former head of school shared, the goal has always been to have an excellent educational program. The move to one-to-one computing was seen as one way to accomplish that goal.

Cutting-Edge

Being at an advantage educationally and technologically may also be expressed as being cutting-edge, but being cutting-edge might also mean doing something that other schools are not doing. Hopefully, cutting-edge also means that the school is pursuing the best, current means of educating its students. Both former and current administrators and long-term and newer faculty viewed the program as progressive, and saw that Sophia Academy's early adoption of one-to-one computing gave students and faculty a tool in which they could explore learning in new ways.

Early years. Administrators, faculty, students, and alumna saw the school's early adoption of one-to-one computing in 1997 to be cutting-edge, to be forward thinking in terms of the education of young women. As one of two independent schools in this large urban area to begin the program in 1997, the school definitely chose to be a pioneer:

> It was just a vision that we had. It was cutting-edge. I would think it gave us a boost [in admissions] because we were on the cutting-edge, and we certainly beat our competition in the private Catholic girl school situation in the city….It [to boost admissions] was not the reason for doing it (a former upper school head).

While some saw the one-to-one program as a means of enhancing the educational opportunities for students and perhaps, therefore, would attract more students, others were concerned that parents might choose other schools because of the cost of the program.

Although some feared that the cost of the laptop, which was in addition to tuition, might impact admissions negatively, the opposite actually occurred. However, as indicated by a former upper school head, admissions was not the reason for doing it (a former upper school head). "The technology was moving us forward" (upper school faculty). The program actually was an attractor for faculty. "Part of the reason I came to Sophia was because my impressions of the

one-to-one program were so strong" (technology staff). As far as the parents were concerned, a former upper school head reflected,

> ...they took pride in the fact that we were so advanced…they had a lot of the same fears and questions, but you know they were doing this at their jobs….I think they knew this was a work in progress. I never felt that there was, that people stormed out of the school or raised great expectations" (a former upper school head).

Parents may have supported the program because they saw their children's futures, but they also knew the school to be very discerning in how it moved the program forward. As the middle school head expressed, the school's modus operandi is:

> [to]not necessarily follow the fads, but [to] be very discerning….What's going to work the best for our girls? How is it going to improve engagement? How is it going to improve learning? …if it doesn't, then it's just a shiny object (middle school head).

If the faculty and administration had not anticipated that one-to-one computing would enhance student learning, they would not have moved forward with the program, and if they had and it did not improve learning, its life would have been short-lived.

Alumnae, too, saw the decision to become a one-to-one computing school as forward thinking and progressive. They saw that the school was pursuing the most current and best means of educating them:

> Sophia thinks hard, in general, is very thoughtful about the education and curriculum and growth of women today….fortunately, they were able to see how we were doing in terms of computing and computers and how important that is….they definitely saw that very

> early on… knowing that it's part of an education… [being] successful in today's world is…. (alumna, 2002).

Another graduate of the Class of 2002 suggested that the reason for the program was "to engage students in taking a more proactive approach in their learning instead of just being lectured to every day." An early participant in the program reflected about how being cutting-edge open other opportunities for students at Sophia,

> I guess they were pretty forward. So while I was at Sophia, I think my junior year, we also, we had a robotics team [FIRST Robotics] and NASA had contacted us and they sponsored our team.… My background is in engineering and that's kind of what got me into engineering. I always felt that the school was pretty technology advanced or focused (alumna, 2001).

It was obvious from how participants used the phrase cutting-edge that being cutting-edge meant being progressive, providing students the best and most current pedagogy and curriculum, in how students were being educated and in what they were learning. Experiences such as working with NASA or with FIRST Robotics were enhanced because of the one-to-one program, and in turn, these opportunities provided engaging, authentic and real-life experiences for the students of Sophia Academy.

Not only was the school forward thinking in the use of the computer, it was also forward thinking in how the program might replace the state requirement of one semester of computer literacy in the upper school. The school petitioned the state to do so and was granted permission as long as the school annually submitted documentation of how students were becoming computer literate. "We still consider just having the laptops and using them daily as a technology credit. They received part of their technology credit from that" (upper school faculty). Replacing

the student literacy class with the integration of technology into the teaching and learning was seen as a step forward in creating an environment in which technology was seamless.

Current Program. Whether or not being cutting-edge has continued as a goal of the program was discussed by several people. A math teacher who was at Sophia Academy when the program began, replied to her focus group,

> I think we're still continuing to be on the cutting-edge in terms of software….What's the best, gradebook wise and all the different [administrative and educational programs]….. [the technology director] is always looking at new software that we might want, might be interested in…..We were always on the cutting edge of the software. We were always asking will it, well will it do this and we had to research and find out what could we purchase to move us forward. And then….the students had the computers and we were trying to catch up with what they were doing. So, we [again have] been on that cutting edge, trying to get ourselves in line with what is needed for teaching and helping them [students] move forward….I think just the world around us, the technology and knowing that we're going to have to keep up with technology... kept us going. Our own incentive here to stay on the 'cutting edge' (upper school faculty).

At Sophia Academy, twenty years ago, being cutting-edge meant providing the best education possible for students, but it also meant being one of few schools with one-to-one computing. Today, being cutting-edge is much more about finding how to best meet the diverse needs of students. The school has sustained its one-to-one computing program for 20 years by constantly looking for software and other ways to best use the program to engage students in a variety of ways of learning.

Summary of Sophia Academy's Rationales for One-to-One Computing

In recalling why the school implemented one-to-one computing, participants most frequently cited four reasons: creating constructivist learning environments, empowering women, preparing students for college and the work force, and being cutting-edge. Faculty, administrators, students, and graduates, who were not involved in the early adoption of the program, shared similar thoughts about the rationale for the program today. While most educational change endures for a few years at most, one-to-one computing at Sophia Academy has continued for 20 years. Understanding what allowed the school to sustain this educational reform for so long is informative to the study of educational change. The fact that the current reasons for the program are consistent with the initial reasons provides part of the answer to why the program has been sustained, but a fuller explanation of how and why this program has endured is rooted in the school's ability to embrace educational change, the innovativeness of the school community.

Innovativeness at Sophia Academy

The success of an educational reform is directly related to a school community's capacity to embrace and sustain change. "Understanding change is less about innovation and more about innovativeness" (Fullan, 2001, p. 31). In this case study, several themes emerged as possible contributors to the school community's innovativeness, its capacity to embrace and sustain change. These were: a strong existing culture, flexibility, a safe environment for risk-taking, collegiality, leadership, a collaborative environment, professional development, and providing technology support.

The Existing Culture that Supported Innovativeness

Existing school cultures have the power to allow an innovation to flourish or to meet its end depending on the characteristics of the school culture. Hence, in understanding how and why a school community was able to embrace and sustain change over a substantial period of time, some insight might be gained from the existing school culture that is both shaped by and shapes the intended innovation.

Major changes to schools, such as one-to-one computing can occur due to policymakers deciding to implement the program, or it may happen with input from those who will most be impacted by the change. In other words, the decision to place computers in the hands of students and faculty can be top-down or bottom-up. Fullan (1993, 1999, 2016) notes in many of his works that schools frequently experience *restructuring*, whereas the *reculturing* of schools is a much more difficult task that is seen less frequently. He distinguishes between the two, *restructuring* as what occurs to schools by mandate and *reculturing* as what occurs when teachers question and change their beliefs and practices (2016, p. 23). What occurred at Sophia Academy due to one-to-one computing was the result of teachers changing their beliefs and practices within the parameter of the existing school culture.

At Sophia Academy, the school culture was, and is, rooted in the educational philosophy of the school. Any *reculturing* that occurred happened only because the changes in beliefs and practices were consistent with the educational mission of the school. Interviews, informal conversations, documents, and observations support the influential role of the school's mission in the life of the school and in decisions made by the school, such as the decision to implement one-to-one computing. Administrators,

faculty, students, and graduates frequently referred to one or more of the five tenets of the educational philosophy in discussing their experience of one-to-one computing and how this philosophy supported the school's capacity to embrace change. In the course of this study, three other characteristics emerged as factors shaping the culture and allowing for sustained change: flexibility, a safe-environment for risk-taking, and collegiality.

Connecting Educational Philosophy and an Innovation

Sophia Academy was founded in 1960. Although the school is only 58 years old, its mission is rooted in the educational philosophy of an international network of schools that has been in existence for more than 200 years. The school's educational philosophy has five tenets: faith, intellectual values, service and an awareness of the needs of the global society, community, and the growth of the individual (school website). In describing the culture of the school, faculty and administrators frequently referred to the atmosphere created by the school's mission, "faith-based….high academic standards…a focus towards [students'] well-being….structure, but flexibility within that structure….opportunity to make mistakes" (middle school head). Students, too, spoke of how the one-to-one computing program helped them to grow in the five tenets of the school's mission.

When discussing the one-to-one computing program and the reasons the school chose to be a pioneer in this area and continues to grow the program, participants often referred to the school's commitment to intellectual values and life-long learning, allowing students greater access to social issues and being a part of the solution to these issues, enhancing the sense of community on campus and beyond, and helping the individual to develop life-long skills and values. A guiding principle to the educational philosophy is that this formation to mission occurs for all those associated with the school, students, faculty and staff, parents, and board members:

> We have this foundation that has been set before us, generations ago, and everything we do is motivated and grounded in this foundation and just like many other trends that have come, we've used them based on our founding principles and our [educational philosophy]. But I think technology is one [of the programs] that spans all five [tenets]. Because those two words [growth and freedom] are set in our cement so to say, we have the ability to do what we do (upper school librarian).

The one-to-one computing program was seen by many as a tool that would promote the intellectual and personal growth of every member of the school, build community, and foster an awareness of social issues that require action from committed citizens.

Throughout the interviews with administrators, faculty, students, and graduates and within the documents reviewed, the importance of this educational philosophy in the formation of students and adults and in decision-making was mentioned:

> [The educational philosophy] is obviously the basis of everything we do and it enables us to do all these things, like letting students have their voice, wise freedom, a respect for intellectual values…that motivates us to do the best for the students. The [educational philosophy] is the biggest part of our culture that helps us ground ourselves no matter what we're doing in technology. When we're looking at new innovations, [we ask] how is this reflected in how we're going to teach the kids and how is it going to affect the world around them…. (technology director).

As participants expressed the rationale for one-to-one computing, explained how leadership was exercised and decisions were made, or described the reasons the program has existed for 20 years, the school's mission or a component of it was mentioned frequently as a guiding force in the implementation and sustainability of one-to-one computing. Participants believed that the

program could not have been sustained without individuals seeing the congruency of the program with the educational values of the school. The "buy-in" of faculty, administrators, students, and parents that is so essential to educational change would not have occurred and continued without individuals believing that the program supported the educational mission.

The core of the educational philosophy has not changed since 1800, but adaptations have been made to meet the needs of current students and the times in which they lived. A maxim frequently repeated at Sophia Academy and its sister schools is "times change and so must we." Hence, educational change has been a significant part of the school's heritage and experience. The belief that the school and its programs must adapt to the needs of current students and the world in which they will live has been influential in the school community's ability to embrace and sustain change, including the changes that one-to-one computing brought to education at Sophia Academy. The educational philosophy serves not only as a guide in decisions about the addition or deletion of programs, such as the one-to-one computing, but it also is influential in why the school embraced and sustained educational change. As one participant remarked, the educational foundation is both "the foundation and springboard" (technology staff) for the one-to-one computing program.

Intellectual and Personal Growth. The move to one-to-one computing was viewed by participants as enhancing the school's commitment to the development of intellectual values that promote life-long learning and the use of that knowledge in the service of others (school website). One-to-one computing also allowed the school to focus on two other aspects of its mission, building community and fostering personal growth. An upper school faculty member expressed how the program fostered life-long learning and personal growth:

> absolutely understanding that this intellectual journey is [the student's] undertaking. I'm here as a facilitator. [It's their journey]. [I'm] trying to encourage that academic growth. But what did change…., when I started one-to-one, is I held hands a lot less. It helped the students be more independent and take ownership of their learning (upper school faculty)

The fact that this faculty member could make a direct connection between the educational values of the school with what occurred with the one-to-one computing program allowed her to continue to move forward with the integration of technology into her teaching and student learning.

As with most educational change, some faculty change more slowly than others. While some lecturing remains a part of some teachers' curriculum, project-based learning and guided inquiry are used frequently. "Grades are really important to me, and I like how a deep respect for intellectual values, reminds us that we are learning by doing…not just memorizing" (upper school student, school website). One-to-one computing was a catalyst in moving from a more traditional lecture-base education to a more active, student-centered education. Students and alumnae, also, recognized that the one-to-one computing program was supported by the school's educational mission, but also expressed that the program provided opportunities to live that mission in new ways. One CAVE student explained that sometimes she does not completely understand why something does not work with a computer, but figuring it out is part of the learning. One aspect of the learning that she really appreciated was the feedback that she and others gave Toshiba about things that are not working with the computers:

> We send it to Toshiba and say 'this is what happened, this is how it affected the computer, this is what's going on.' We're also learning, but we're also helping Toshiba and the other companies that we work with learn, too (upper school student).

The students who participated in the different focused groups spoke frequently, like the above student, of something they had learned through the one-to-one program. The CAVE students were very explicit about how their experience developed life skills. Most students, like faculty, embraced the changes due to one-to-one computing because it furthered their intellectual and personal growth.

Another aspect of personal growth that students mentioned over and over again was "wise freedom." For students, the one-to-one computing program provided new opportunities for them to practice wise freedom in that the program required greater responsibility and integrity on their part:

> I feel like wise freedom plays a lot of role in this [one-to-one computing]… If you're working on a project, you have the option to go on and work on something else that's not in that class and if the teacher's not looking at your screen then, you can do that, which could be a big challenge for some people to stay on task with it [one-to-one computing] (middle school student).

Other students spoke about how having the one-to-one program had helped them to be more responsible for the device and for using the technology appropriately. A fifth grade student mentioned how one had to be careful in how one shared notes with other students because simply providing the notes might be a violation of the honor code. Students clearly saw that the one-to-one program required them to exercise wise freedom in new ways and therefore, enhanced their personal growth.

Intellectual and personal growth are not limited to students; faculty, too are expected to grow, and the one-to-one computing presented new ways for that to occur. One faculty member expressed that life-long learning has "definitely become a core thing of mine because I'm still a

practicing artist. I think that idea of continuing to learn and having this program probably necessitates that for some people who might otherwise be kind of locked in" (upper/middle school faculty). The formation of faculty was viewed as essential to the program and hence, a great deal of professional development was offered to encourage and support teachers in integrating technology into their teaching. Professional development will be addressed later in this chapter.

Faculty, too, spoke of wise freedom. A relatively new teacher spoke to his understanding of wise freedom, being willing to try something new and possibly fail in front of students was good modeling:

> wise freedom as well because it really speaks volumes that we are, as educators willing to put ourselves out there. I mean it's really easy to fall back on what we know and just stick with routine because routine is simple, routine is easy and routine is safe, but we're willing to try new things and we're willing to fail in front of our students…it really sends a good message and I think that speaks volumes to how we operate here … and why our programs have been as successful as they are compared to other schools (upper school faculty).

The technology director attributed the longevity of the program to the grassroots, the teachers in the classroom, but she pointed out that it had to do with the wise freedom afforded teachers:

> I think the culture at Sophia…it's the grassroots….I think the reason why we have that grassroots is because of the [educational philosophy]. So, the [educational philosophy] allowed the teachers to have the flexibility to do what they think is the right thing to do, teach what is the right content to teach, wise freedom to use the tools that they want to teach. So, the [educational philosophy] for the students is one thing but the [educational

philosophy] to support the teachers developing what needs to be developed I think is it. (technology director).

The administration allows a great deal of flexibility in how teachers incorporate technology in their classes, a spectrum that goes from minimal use to daily use. Allowing this flexibility, provides the opportunity for faculty to practice wise freedom.

Interviews and focus groups indicated that students and faculty take seriously living the educational mission of the school. The fact that the one-to-one program brought new opportunities for intellectual and personal growth for all members of the school community played a role in the longevity of the program.

Community: Local and Global. Participants commented frequently about how the one-to-one computing program had helped to create community within the school and globally. Increased communication for a variety of reasons and in a variety of ways through the use of technology was seen as a means of building community at school and beyond. Students, administrators, faculty, and alumnae spoke of how the program enhances communication and community:

> I think when communication is enhanced, community also is enhanced…the student-teacher relationship actually gets better because students [can]seek advice from teachers and it instills more of personal relationship with the teachers, which also helps the student learning process because they feel more open with their teachers (upper school student).

Several people saw that the fact that everyone on the campus was learning to use technology together built community. As one upper school teacher stated, "Learning really is a community exercise. Like St. Augustine used to say 'scholarship is community'" (upper school faculty).

Because individuals saw the one-to-one program as expanding and broadening their sense of community, they were able to embrace it.

Not only was the one-to-one computing program seen to enhance community on campus, but participants saw it also enhancing a larger community. Periodically, the school uses its technological capabilities to connect with its sister schools in the United States. In reflecting upon how technology supports the mission of the school, a librarian shared,

> And community! How many events have we had where we are celebrating with our sisters and brothers [at our sister schools] all over the country because of technology! So, when I say every [tenet], I mean every [tenet] (upper school librarian).

The one-to-one computing not only allows greater communication with other sister schools, it also has allowed the organization of sister schools to establish on-line learning in which students and teachers can participate. Being able to connect with sister schools in the United States as well as in other countries allows students and faculty from many schools to interact meaningfully as a global community.

A strong community was of value in implementing and sustaining one-to-one computing according to two administrators: “So if the community is strong and the culture is strong, then those things thrown at you, you embrace” (a former middle school head). Others saw the buy-in of every member of the community, even newer faculty, as one reason for the program’s longevity:

> I think it's the community. I think it’s complete buy-in. I think it's, even though administrations have transitioned over the last 20 years, I think everyone who has come in here sees the benefit of it. I think parents recognize that the tools that the girls are

> getting here are the tools that they need, the parents need right, now in their workforce (upper school head).

Without the buy-in or support of the community, the program might have failed or faded away. Several participants felt that the support of faculty and parents was essential to the sustainability of the program:

> not only does the faculty believe in it,…the parents buy into as well, because they see the effects of what it does to improve the education for the students…we definitely get a really high caliber of education because the computing is a great tool for that (alumna, 2002).

While there were individuals who did not support or see the value of the one-to-one program, a significant number of faculty and parents did. Without a critical mass of support, the program would not have been sustained for 20 years.

Interviews, observations, documents and casual conversations with faculty and administrators supported the fact that the program is what it is today because of a strong community that saw the program as congruent with and as an enhancement to the educational mission. The fact that so many participants mentioned the educational philosophy of the school, either in general or through one of the five tenets, suggests that the members of the school community share a common set of beliefs and values, or at least the school seeks to develop this commonality. According to Fullan (2001, 2007, 2016), having a shared moral purpose is essential for creating the capacity for change. The moral purpose of Sophia Academy, as expressed in its educational philosophy, is the spiritual, intellectual, and moral formation of each member. This moral purpose along with flexibility and collegiality in a safe environment that

encourages risk-taking help to create the culture of Sophia Academy, a culture that was able to embrace and sustain educational change through one-to-one computing.

Flexibility of Implementation

Prior to making the decision to implement one-to-one computing, the faculty were asked for their thoughts concerning the program. The initial process, an example of shared leadership which will be discussed in a later section, reflects the *flexibility* inherent to the program. Once the decision was made to move forward with the one-to-one program, teachers were allowed the flexibility to determine how it would occur in their classrooms. No mandates were given as to how and when one-to-one computing would be used by teachers: "My faculty was a very stubborn, forceful, strong faculty. I never could do that [mandate use] with them about anything and I knew that my success depended upon them. So, we took people where they were in every phase" (a former upper school head). The administration, instead, took an approach of supporting and encouraging teachers as teachers learned and experimented, allowing each the flexibility to move forward at his/her own pace. A long-term humanities faculty member believes that the flexibility that the administration has allowed faculty in how they incorporate technology within their classes has been one reason that the program has lasted:

> I think it was the flexibility. It was the idea of you're still in control of your classroom. [The technology director] never came in and said here's the fiat: you must do this…. So people ran with it… I would say we had complete control of how the laptop was used in our classroom... (upper school faculty).

Other participants who had been a part of the program since the beginning also commented upon the fact that the move to one-to-one computing, while encouraged by the administration, was

gradual and flexible, allowing faculty the freedom to determine what was best for their classes. This flexibility which allowed teachers to remain in control of their teaching was key in having faculty buy-in.

Sometimes necessity demanded flexibility, especially in the early years of the program. The technology did not always function as planned, and teachers had to adapt. The school recently moved from LCD projectors and Smart Boards to large wireless LCD TV screens. In the early weeks of the use of the TV screens, faculty sometimes dealt with the wireless device not functioning properly. A middle school science teacher experienced this on at least two occasions when she had planned to use the technology. On one occasion, she immediately adjusted her lesson to a lab demonstration. She did so with such ease and without allowing the technology to frustrate her that the adjustment appeared to be almost seamless (field notes, 10/21/17; 10/24/17).

Administrators and teachers recognized that one-to-one computing was not always the appropriate means of conducting a lesson. In explaining her expectations of observing teachers, a former upper school head commented,

> And you know, you had to be flexible with that….I tried to be in the classroom a lot and in the literature classes…, reading together aloud Shakespeare,…you don't need technology for that and there was no reason to change that….(a former upper school head).

The flexibility allotted the faculty in determining how and when the computers would be used in their classes has continued. What is important both to faculty and to administrators is that teachers use whatever tools needed to provide the best educational experience for students. A long-term teacher reflected that the longevity of the program

was due to the fact that teachers were able to choose when and how they would use the technology:

> I know in the classroom it's not using technology all the time. It's a variety here and I think that's what makes it powerful and has been around such a long time because it's not just focused on using technology the entire class period (upper school faculty).

Newer teachers to the program also appreciate the flexibility afforded them by the program and administrators. "I love how interactive the girls can be on their laptops during class. We have a lot more flexibility on what we can do in the classroom with those [laptops]" (Upper School Faculty). The fact that administrators did not mandate a certain percentage of time that the laptops were used was seen by one faculty as a reason that faculty have only implemented things that could enhance teaching and learning in their classrooms:

> What I do like is that the administration does not mandate it…. which is really cool. In public schools, they like to put percentages on things, right. You must use the technology 50% of the time, and they use contrived rubrics to grade you on it. So, therefore people implement things that aren't useful, just to implement them (upper school faculty).

Other participants expressed similar comments. This sense of only needing to use the technology if it is useful to the learning is what Fullan et al. (2018) refer to as "leveraging digital," using the technology only if it amplifies or accelerates the learning.

Flexibility was seen as a key factor to the sustainability of the one-to-one program. Teachers appreciated the fact that the administration allowed for a great deal of flexibility in how they chose to use the technology. As Cuban (1993b, 2013a, 2018) noted, teachers are the gatekeepers of what occurs in the classroom. The flexibility that was afforded teachers ensured that teachers were still in control of how they taught and what occurred in their classes. Most of

the students commented upon the fact that the flexibility of the device and the program allowed for greater differentiation in their learning and in how they were assessed. Interviews and observations supported the presence of this type of flexibility.

Safe Environment for Risk-Taking

The ability to take risks was frequently mentioned as administrators, faculty and students spoke about the one-to-one computing program. According to Grant Lichtman (2014), "fear and inertia are often cited as two of the most powerful forces acting to retard organizational innovation." As one participant put it, "schools are very conservative places because they deal with children. Once they get something, if it's working, they're not changing" (technology staff). Success can drive schools to remain status quo, and fear of failure or of being reprimanded can minimize creativity and initiative in educators. The educational philosophy of Sophia Academy supports educational change for the growth of the student. The founder of this international organization of schools expressed in 1832: "It shows weakness of mind to hold too much to the beaten track through fear of innovation" (international organization documents). What emerged from interviews and observations was that Sophia Academy is an environment in which it is not only safe to take risks, but it is also a place in which risk-taking is often encouraged:

> It's one where you can make a mistake and it's not the end of the world. It promotes trying things…. At another school… I pretty much figured out that it was better not to try something new unless it was perfect.... it was just not worth the chance of messing up (technology staff).

Another staff member and graduate of Sophia expressed that it was not just the educational philosophy of the school, but the history of the international organization of schools that supported a culture of "being willing to take risks and go places that nobody's gone before and

do things that might not work out, but knowing that that's okay and it's been ok for a long time. So, I think that contributes as well" (technology staff; alumna, 2004). A teacher who has only been a part of the school community for two years reflected on the freedom he feels to put forth new ideas,

> So, one of the things that I feel has really helped during my time here in terms of technology has been this absolute willingness to accept failure at this school…from our heads. I know that I feel comfortable and that I can grow my program….I can approach them [administrators] with an idea and say 'Hey, I've got this idea!...It's absolutely liberating as an educator to be able to do that because… instead of just planning, going through the monotony of the day, I can actually look forward to tomorrow and start adjusting and trying to see not what we're going to do tomorrow, but how can we grow into tomorrow (upper school faculty).

The middle school head spoke about his role in encouraging faculty to try new things, to take risks: "It's nudging, pushing, giving teachers room to make mistakes and be OK with that" (Middle School Head). He also believes that it is important to model trying to incorporate a program, such as OneNote, and having teachers see that he, too, struggles with some of the technology.

A former middle school head directly attributed the sustainability of the program to this willingness to risk failure in trying new things:

> I think the reason it has sustained itself is because over the years we've allowed ourselves to be vulnerable, to not know everything, to roll with it, to say there's a value in saying, 'I thought this was going to work and it didn't. So, we're going to

> have to go back and figure it out'. I think early in my career as an educator, we weren't willing to do that (a former middle school head).

From the perspective of administrators and faculty, failure and starting over is a valuable form of learning. Hence, people have been encouraged to take risks through the one-to-one computing. They also believe that it is important to model risk-taking and learning through failure to their students.

Several individuals mentioned that because teachers are actually encouraged to take risks, people are more open to change, trying something new, risking failure:

> I think people are very open to change here. But that's, part of that is, because they're encouraged to be open to change and there's no fear of failure….I can get people to try things because they think they have the support and they're not afraid to have it not work (technology staff).

Faculty are not the only ones who take risks. An upper school faculty member spoke of how the current upper school head, who encourages anything innovative or creative, took a risk with "an out-of-the-box" exam he gave and it "flopped". According to this faculty member, the upper school head did not obtain the student results that he had anticipated through the innovativeness of his exam. A follow-up email from the upper school head indicated that for the mid-term exam, he "composed one general question that encompassed the different concepts the [students] had learned throughout the semester." He also allowed them to work in groups of two or three or to work alone. What he discovered was that students used about 45 minutes to give answers that were minimal:

> So while they did well, I needed to frame the question better and ask for more description….So I'm not sure their answers truly reflected everything they

> learned during the course of the semester….it was a great exercise for both of us, so while I feel like it failed, I'm sure they got something out of it. I'm going to try it again this exam period, we'll see what happens.

While this example provided by the upper school head does not directly involve the one-to-one program, it does indicate his willingness to model risk-taking and learning from failure. As several faculty noted, what is important is to learn from failure and try again. Obviously, this is what this administrator tends to do.

The challenge of remaining open to risk-taking should not be left unmentioned. As a college preparatory school, Sophia Academy and its families are concerned about college acceptances to selective universities. Students, too, feel the pressure to succeed (upper school faculty). College acceptances and the need to succeed could easily paralyze the process of change. Many school communities are highly successful because they recognize that success will not continue without growth (Lichtman, 2014). Administrators, faculty, and students realize that there is something to be learned from trying things and having it not work:

> I think it [longevity] absolutely has to do with the fact that we are not afraid to take risks, healthy, appropriate, calculated risks with technology and learn from them. Where we're successful, we build on it; where it fails, we say well let's fix that. I think that that is one aspect of the culture that supports healthy risk-taking with technology (middle school faculty).

A 2001 graduate indicated that the school took a risk being one of the first schools to implement a one-to-one computing program. Taking a risk means risking failure, and not everyone is open to doing so. Another young graduate, a digital marketer, was chosen for a program that celebrates

men and women in their 20s that are making a difference in their industries and communities within the state. In an interview by a local on-line publication, this alumna shared a piece of advice, that she may have learned at Sophia Academy, for individuals seeking to make a difference by innovating, "Fail first….If you really throw yourself into things and know that, yes, you will fail – potentially multiple times – the first to fail at it and then adapt. The result will be a tenacity and fortitude to be successful in whatever life brings." Sophia Academy appears to have a culture which supports risk-taking, even when you fail, because there is something to be learned from the experience.

Faculty and administrators recognized that launching a one-to-one computing program was risky. Those involved in the early implementation were so convinced that the program would enhance the education of their students that they were willing to risk failure. As the technology director shared "I've had failures but the laptop program has not been one of the failures...complete failures but this [no]" (technology director). Newer faculty and administrators also recognize that risk-taking is part of the school culture. Faculty appreciate it and administrators recognize the importance of sustaining it.

Collegiality: Learning from the Outside

Prior to the implementation of one-to-one community, the administrators and faculty had collegial relationships with a variety of others. Much has been written about the role of professional communities in the growth of teachers (Fullan, 2007, 2016; Rust & Freidus, 2001). Most of this research has focused on the learning that occurs through colleagues at one's school. Fullan (2007, 2016) describes these professional communities as collaborative cultures where the interaction is primarily among the members of the school community. The researcher has chosen to distinguish between collegiality and collaboration, using collegiality to refer to the

environment of Sophia Academy prior to one-to-one computing and with other schools and collaboration as what occurred within the school community and beyond because of one-to-one computing.

At the time that Sophia Academy instituted its one-to-one computing another independent school nearby and six sister schools within the United States were also embarking on the same journey. These schools, as well as two pioneer schools, provided collegiality and resources as the programs developed. Prior to the implementation of the program, administrators, faculty, and board members visited several of the pioneer schools to observe how one-to-one computing was being used and to learn from these schools. Frequently, at conferences, such as ISTE (International Society of Technology Educators), representatives from these schools would gather for an evening of conversations about the challenges, successes, and early failures in one-to-one computing (field notes, 10/4/17):

> It's not just been the TCA and the ISTE, but it's been, we've had small group meetings with other one-to-one all-girls schools that were in [our organization of schools] and other one-to-one girls schools, but also the opportunity to even have the listserv [of technology staff and teachers of our [sister schools]. We use that almost every day….We have constant people outside of Sophia to work with and brainstorm with and it is that vision from the [sister schools] that both led us here and I think enabled us to sustain [it] (technology director).

The fact that several schools were implementing one-to-one computing at the same time allowed for consultation with others when contemplating a decision:

> There were times when that [sister schools] was really important… I don't know if it was decisive, but I think it was important to know. When the technology director could go and

> meet with the group....When decisions had to made, there were very few consultants or anything…they [technology staff from sister schools] would talk it over….It was critical, like anything else [it helps] if you have allies…(a former upper school head).

Collegiality also characterizes some faculty's experience of the school community. Later in this chapter, the collaboration that exists among the members of the school community will be discussed.

Members of the technology staff spoke to the willingness of the group to bring new people on and the support that they felt from each other. "So that willingness of those people [tech staff]… just their willingness to bring new people in and share that spirit" (technology staff; alumna, 2004). Another member of the technology staff commented,

> I think that places don't realize, institutions, how important it is in technology for everyone to have what I call a bench. You know like you go to the bench of your sports team when you need something. Well, everybody's got to have someone to back them up, that they can ask the question to because then they can go out and do what they need to do.

A number of faculty spoke about collegiality, the support that they receive from administrators, the technology staff, peers, and students. One faculty mentioned the collegiality of the faculty as being influential in his decision to take a job at Sophia. He also believes that it is the collegiality that allows a program such as the one-to-one program to be sustained: "The faculty is, everyone's really helpful to each other, which I think helps a program like this because for some people it's challenging and other people, it's just in terms of growing it to see what other people are doing" (upper/middle school

faculty). He admiringly spoke of a faculty member who was trying "gaming" in his math classes and this faculty member's willingness to help others experiment.

Collegiality played a significant role in the implementation of the one-to-one program: "I think having an involved group of teachers, students that would drive and help with that buy-in is critical" (technology staff; alumna, 2004). Collegiality also has helped the program grow and has allowed new faculty to adapt more easily to the program.

Summary of Factors Contributing to the Sustainability

Collegiality, flexibility, and a safe-environment in which to take risks, along with the educational philosophy of the school, were viewed by participants as influential in the implementation and continuation of the one-to-one program.

Other Factors that Enabled the Sustainability of the Innovation

Several other factors contributed to the sustainability of the innovation but were not necessarily a part of the culture prior to the implementation. Some of these, such as collaboration, were actually a result of the program and necessary for sustainability. These are: various forms of leadership, the development of a collaborative environment, the necessity of professional development, and various types of technological support.

Various Forms of Leadership

The importance of leadership in successful change is critical. "Leaders should have good ideas and present them well (the authoritative element) while at the same time seeking and listening to doubters (aspects of democratic leadership)" (p. 42, Fullan, 2001). As participants spoke about leadership, it became clear that at Sophia Academy, leadership was exerted in many ways and places by those in leadership positions and others. Faculty appreciated the support that

they received from the administration, especially from the former and current middle and upper school heads. Faculty and administrators also spoke of how they execute leadership and the development of leadership in students. With the one-to-one program, both administrators and faculty believe that the leadership of the technology director and her team, was and is, critical to the program. In discussing the future of the program, the head of school commented that they are "going to have to have visionary leaders that are going to continue to embrace and value the program," if the program is going to be sustained into the future.

The leadership of the program was provided by a number of leaders, rather than a single visionary individual as has been the case in much educational change research (Elmore & Burney, 2001). Faculty and administrators believed that the most significant leadership for the program originated with the faculty and student body who consistently were experimenting with new things and asking for additional software and support. "I think what drives it [the one-to-one program], the faculty and the student body drive it. I think the administration, and the upper school head supports ….they are so extremely supportive of anything creative we want to do" (upper school faculty). A long-term faculty member described how he saw leadership being carried out: "You've got to lead them, you've got to show them wonderful stuff, and if you have a good faculty, and you show them some really cool stuff, lots of them will jump on it" (upper school faculty). For this faculty member, it was important that the administration and the technology department were finding and sharing with faculty new software and devices, but he also saw the role of faculty leadership. As the gatekeepers (Cuban, 1993b, 2013a, 2018; Fullan, 2007, 2016; Tyack & Cuban, 1995) of their classrooms, it was up to them to choose or not choose to implement new software and devices.

While the role of faculty leadership was crucial to the one-to-one program, the support of the administration was also necessary because they are the gatekeepers of any major change in a school (Fullan, 2007, 2016). The technology director was the major advocate for the one-to-one program. She encouraged and supported the faculty in their efforts to integrate the program into their teaching, and she advocated with the administration for the on-going needs of the program. However, what was clear through interviews was that there was a great deal of shared leadership, of all members of the community acting as change agents (Fullan, 2007, 2016).

School Administrators as Coaches. Faculty and staff expressed the importance of the commitment and leadership of the administration to the program. One administrator delayed her retirement in order to assure that the program was operative prior to her departure: "I think that those of us who were involved in the program embraced it, supported it, and as you know, like me, stayed on until they saw that it was working" (a former upper school head). The former head of school commented upon the fact that the continuity of the administration was important; "It did help to have a steady administration." One staff member mentioned that her decision to come to Sophia Academy was influenced by "the way that technology was used in different schools and treated by different administrations which ultimately would trickle down to teachers and eventually student learning" (technology staff; alumna, 2004). Former administrators recognized that they, too, were learning how to improve their use of the technology, specifically the various learning management systems that the school adopted.

A current administrator described his style of leadership in the one-to-one program more as a coach, rather than an authoritarian. He believes that delegating

responsibility allows him to not get caught in the minutia and allows him to focus on the bigger picture:

> Generally speaking, they [the faculty] would go to the CAVE [with an idea or need]….for the most part I trust the CAVE. I trust their thought process. If they say it's good, go for it…. I am not going to micromanage and I don't need to know everything (upper school head).

However, he also believes that it is important that the faculty and technology staff see him as involved and supportive. “I see my role right now as more of a facilitator, encourager, supporter, and in doing so maybe not being the one that's leading the charge but one that's helping the charge, helping support the cause” (upper school head). This same administrator noted that the faculty recognize that he does not have all of the answers; that he, too, is learning.

Another division head described his role as a change agent. He noted that change is hard, but “it energizes me” (middle school head). He envisions his role with one-to-one computing:

> It’s helping drive the program. So, it's supporting teachers through professional development, it’s pushing teachers to think outside their comfort zone….I always have to look back and listen to the people. Is what we're doing best, the best way to do it right now?...so not to push too hard and too fast (middle school head).

The three current administrators that were interviewed have been at the school less than 10 years. The perception of these administrators is that they are supportive of the one-to-one computing program and encourage faculty to be innovative in using it for their teaching.

The faculty believed that the program continues to move forward because of the support of their division heads. “They're incredibly supportive, whether you want to or not, you have to use the computer in some capacity….” (upper school faculty). Faculty described the support and enthusiasm that they often experienced from their division head and the technology staff when bringing forth new ideas and the request for funding for these projects:

> With regard to technology, we have an incredible amount of support here at Sophia, administrative support. Last year when I was just kind of brainstorming and toying with the idea (of using a mapping program for a project), I went to my administrator and his immediate response was ‘what do you need to make that happen?’ (middle school faculty).

The fact that administrators were so receptive of the ideas of the faculty regarding new ways to integrate technology into their classrooms empowered and reduce the level of trepidation of the faculty. Faculty also recognized the commitment and financial support that the administration offered the program through upgrades to software and hardware as well as to professional development:

> I think commitment from the administration to… They're always willing to put in, I guess, it’s dollars to keep us tip top, whatever we need and updates because technology moves at the speed of light and I feel like we do, too. I don't feel like we're behind in any way. So I would say commitment on the part of the staff here and administration (upper school faculty).

While most of the faculty felt that the support of the administration was essential to the program, at least one, faculty member felt that some administrators were coercive about faculty learning a particular software package, such as OneNote. She shared that as

everything went paperless through OneNote, she had to learn the program because it was essential to reviewing documents from her division head (upper/middle school faculty). Her concerns suggested that there were programs, other than the school management system, which faculty were required to use.

In describing his leadership style, one administrator commented on the importance of building relationships with parents, faculty, and students. He also believes that leadership and vision have to come from both the administration and the faculty:

> …there are times that I'll push and say I think you really need to do this, and there are other times that it's so much more effective when it comes from them. So supporting the people who want to be your first followers and then pushing them to the front and letting them be the leaders of it has proven to be an effective method (middle school head).

Not only is leadership essential to moving the faculty and the school forward, but how leaders lead is equally important. The division heads lead through encouragement, example, and offering whatever support faculty need to accomplish their goals.

The technology director also addressed the need for the support and leadership of the administration:

> …we currently have some administrators who are very…pro letting their teachers try things and fail for the sake of being able to use the technology integration and that has helped…and very pro modernizing the curriculum and finding some new tools for students and things like that. So, it cannot happen without the support of division level administration who really work with the teachers to influence them to try things (technology director).

As stated earlier, administrators had the ability to hinder the changes brought about by one-to-one computing. While having fiduciary responsibility for the program, the current and former administrators did not micromanage the program. They delegated leadership to the technology director and the faculty. Administrators were coaches, and not the prime movers of the program.

Technology Director as Leading the Change. This reform effort, while overseen by two heads of school and multiple division heads, benefitted from a technology director who led this program for 20 years and was able to champion the program within the organization. While the technology director spoke about the support and leadership of the administration, almost every administrator, former and current, and faculty spoke of her leadership. In the words of a former administrator, she "was a huge, huge part of the planning. She had the knowledge, the expertise and the enthusiasm. It would never have succeeded without [her]" (a former upper school head). Having someone with her vision, leadership, and skills was one reason for the longevity of the program. The importance of the leadership of the technology director was frequently described in statements such as these:

> To have someone…who has a vision and continues to be forward-thinking…She stays on top of… technology. She's constantly thinking about the next thing…we don't make choices based on fads. We make choices based on what's practical in the classroom…. One thing I will say is consistently asked is how will that impact instruction? What will that look like in the classroom? So just because it's fun, cool, the newest thing out there does not mean we need it (upper school head).

This suggests that other staff appreciated that the technology director was purposeful and discerning about software and hardware decisions, including others in those decisions in order to ensure that the school made the best choices. Rather than simply being an administrative force

behind the program, it appears she considered the classroom-level experiences of students and teachers in her planning and decision making.

The administration, faculty, and technology staff believe that the program would not have moved forward without the commitment and continuity of the technology director:

> If we didn't have someone there pushing us and putting those seeds in and encouraging us to go to places like [conferences] and getting ideas, then we would be dead in the water because the ideas just don't come in our heads. They come from outside, but to have someone as an inspiration to push us forward, I think has been really, really important (technology staff).

The technology director looked for ways to enhance teacher use of technology. She also realized the necessity of teachers experiencing what other schools were doing; hence, she was an advocate for faculty attendance at local and national conferences. She could nudge and encourage faculty only to a point. Sustaining the one-to-one program required that others also find and share ideas with the school community.

The inspiration of the technology director helps to sustain the one-to-one computing program, but how she leads also seems to be important. “[She] is a pretty powerful figure, but she never steps on the middle school or the high school principals' toes, [telling them] 'You're going to do this!' (upper school faculty). Not only was the technology director’s vision and enthusiasm for the program and her manner of leading seen as essential, but so was the fact that she had been a member of the school community for more than 20 years. She had seen the program from its inception until the present: “…the fact that [she] has been here the whole time has made a huge difference because she has made sure that it pulls through, but then also the administration has

supported her, allowed her to hire people to train teachers" (middle school librarian). Several administrators mentioned the importance of the technology director in the planning and implementation of the program. The technology director was essential to the planning process, helping with "figuring out how we were going to get the computers for everyone, how we were going to pay [for them], [how] to provide computers for those kids who could not afford it, how we were going to train the faculty" (a former upper school head). According to one person,

> one of the most important things to have is a person in charge with a vision and I mean, of course, the whole program works because we're all here, but the longevity of the technology director and the vision of pushing it…and encouraging [it have sustained it] (technology staff).

Many members of the adult community concurred with the above statement. The vision, leadership, knowledge and skills of the technology director were frequently mentioned as one of the reasons the program has been successful. The fact that she is strategic, stays abreast of new technologies, and keeps faculty and administrators informed has been invaluable to the program.

While administrators and faculty spoke to the leadership of the technology director, they and the technology director expressed that shared leadership also contributed to the success of the program. A staff member spoke about the technology staff, specifically the technology director and the education technology support manager, that their "championing to make sure we have the best resources is a big part of why our program is successful, why teachers are so integrated into it…they do make it very important to use and make sure that it's always functional" (technology staff). While the leadership of the technology director and the support of

the administration are essential to the program, the program would not have continued without the involvement of the faculty, which required shared leadership.

Promoting Shared Leadership. Throughout the interviews, there was a sense that the leadership for the program was shared by everyone, faculty, staff, administrators, and students. People felt a sense of ownership, and therefore, felt responsible for the program:

> The technology people are the leaders because they get the knowledge first and then they share it, and they nudge you along….I don't think [one-to-one program] would ever have worked, especially with the personalities [here], if the teachers had not embraced it or most of the teachers hadn't embraced it. As they did with everything, because they were very strong people, they wanted to own it. I mean they didn't want to be left behind. Departments could work together to figure out what would work" (a former upper school head).

Broad participation, not only in implementing and sustaining the program, but in decisions about the program were made with input from all constituents:

> I think they've been really smart in constantly getting our feedback. The CAVE or technology director, honestly, but they're, [technology department], they're all very open to feedback and adapting whatever programs we're using to our needs…I think what makes it different is that they actually listen and if we need something, they'll do their best to try to make it happen (upper school faculty).

The fact that the technology staff constantly seeks input and feedback, both informally and formally, encourages the ownership and participation of all members of the school community.

Documents provided by the school revealed that the technology staff frequently surveyed faculty, administrators, and students regarding the one-to-one program. This information was used for addressing perceived needs and necessary changes to the program. Another aspect of the program that illustrates shared leadership is the manner in which decisions are made regarding just about every aspect of the program:

> I also strongly, strongly and I'll say one more time strongly believe that we are successful because of discussion. Decision is made at the grassroots level by the teachers, by the people who are doing, using the tools. Every computer… is chosen by a team…. Every software that we purchase is chosen by a team…. Every screen that is on a wall in this school has been chosen by a group of teachers, technologists and the technology committee. Everything! … this program works because it is directed and massaged and led at this level [grassroots], No decision is ever made down here without input from the teachers who are going to be using it with their students (upper school librarian).

A description of the recent decision to replace Smart Boards with large, wireless LCD TV screens is as an example of how faculty "pilot the new ideas" and provide feedback to the technology committee. Prior to moving to the LCD TV screens, the technology department had several faculty try three different screens and asked for input. The decision for which screen was ultimately made by many after dialogue about what was most appropriate for the classroom.

The technology department sets the tone for the inclusion of everyone in decisions by asking for feedback, for being democratic rather than authoritarian in their leadership. Their approach to decision making is very reflective of Fullan's bottom-up model of change (Fullan, 2001):

> That's where I think it's really important that the CAVE, the tech department, behaves the way that they do. I know that she is the head of technology, but she doesn't tell us what to do. It's the same philosophy as we have with our students. What are some possibilities? What do you want to do? How can we make that happen? (upper school faculty).

Fullan (2001) suggests that leaders should have vision and be able to express that vision well (p. 42); however leaders also need to attend to the thoughts and ideas of those they lead. Significant change does not occur through mandated reforms created by those on top, but rather, organically occurs when all constituents have a role in decision-making. The type of shared leadership modelled by the administration and the technology director helped to create climate in which an innovation, such as one-to-one computing, could be sustained.

Encouraging Student Leadership. Shared leadership does not only exist within the adult community. Students are included in many of the decisions made about the one-to-one program. As a school community, there seems to be a role of leadership for anyone who chooses to exercise it. In the minds of many participants, the students are the ones who best know the technology and know what will work or not work for the one-to-one program. "No one owns the knowledge…or the CAVE [students] might come up with it….It sounds idealistic, but it actually happens here" (upper school faculty). In the earliest stages of implementation, a group of students were involved in the decision: "I think everybody was on board. The technology director was really pushing it and they had a small group of girls that had tested it and it just moved forward very fast" (middle school faculty). Student input is always sought in making decisions about the choice of a

new device, such as moving from one brand of Tablet PC to another, or to have touch screen wireless LCD TVs or not:

> Yes, the students in the CAVE, right, yes and I'm always asking and they'll come tell me, at least. They know that I'm interested. They'll say, 'we're trying out this device and I'll say, 'OK, well, tell me about it. What do you like? What do you not like?' (upper school faculty).

The interaction of this faculty member with students suggests that faculty and administrators are open to the thoughts and opinions of students. It seems that a reciprocal relationship regarding some decisions about the one-to-one program exists. Fullan (2001) believes that in addition to having a moral purpose, strong relationships are needed for change to occur within a school. For change to occur, there must be established relationships in order to create a participative culture. The adult community of Sophia Academy was insightful in realizing that the sustainability of the program was also dependent upon the participation of students in decision-making.

The technology director spoke of how much she and others count on the students who work in the CAVE for feedback about the program and to provide her a pulse on the program:

> Whatever [software or hardware] chosen by a team of teachers and technologists, we also include students in those decisions.…we also have a team of students that give feedback and the CAVE,… they are also free to tell us what's working and what's not working and what we maybe should do differently….whether there's something broken or whether they see a teacher that's struggling or a group of students that are struggling, I think that's just key (technology director).

Not only is the input from students helpful, but their participation in the decision-making process empowers them to take ownership for the program, even to providing input to vendors about computers and programs:

> There's also hardware changes…. It [a particular computer model] didn't have a kickstand in back so you'd open it up and the tablet which was a lot heavier than the keyboard, it would just fall over. We told Toshiba about that and then when we came and we got our computers, it had a kickstand. Toshiba learned this needs to be fixed and I think we helped them to discover that (upper school student).

Students expressed pride in the times in which they were able to provide significant feedback in a decision the school was making or in helping the manufacturer improve a device. Encouraging students to use their "voice" is not only essential to the one-to-one program, but it also encourages the development of leadership in students and helps them understand the importance of shared leadership.

At Sophia Academy, technology staff, administrators, faculty, and students share a common goal of using and integrating technology in the best ways possible. Ownership of the sustainability of the program is encouraged at all levels for the school, from the administration to the students. This focus has helped to create a collaborative environment where working together is a norm.

The Development of a Collaborative Community

When discussing the one-to-one program, almost everyone interviewed spoke about working collaboratively. In suggesting why the program might have been sustained for 20 years, a librarian commented,

> I honestly think though, you have to have a group of people….we have teachers who are invested. We have administrators who are invested. We have parents who are sending their children here because they want them to be part of the program. We have students [who are invested] (upper school librarian).

Participants, generally, felt that there was someone to whom they could turn to solve a problem with the technology or from whom they could learn something new. At the same time, there is some contrived collaboration in that new faculty are assigned mentors or committees are formed purposely. For example, the former head of school said it was "deliberate that the librarians were strategically involved so that they could help the girls know what they were doing [with electronic information]" (former head of school). According to the middle school head, while new faculty are assigned a mentor, the mentor relationship often grows into a more mutual form of collaboration where individuals are sharing ideas and helping each other learn new things and solve problems.

Collaboration is a primary form of learning for the faculty and has contributed to the longevity of the program:

> The success of our program is that it's not the be-all, end-all. It's just another tool that…teachers amongst themselves use collaboratively to make learning better. If somebody has an idea,…we do discuss it….We really do have that open enough of collaborative discussions that they could absolutely bring it forward and say, 'hey I was thinking about this' and maybe push forward (upper school faculty).

This faculty member articulates the most important aspect of any educational change, that is, what is the center of successful educational change is the improvement of learning, not the innovation. This faculty member also recognized that faculty were free to share with

administrators and faculty what was working and what was not working about the program, and to offer suggestions for improvement.

Faculty frequently seek out other faculty who have tried different things to see how they accomplished it. A science teacher mentioned asking the math faculty for help in flipping his classes, a method of recording presentations for students to watch at home prior to the class, because they had successfully done it in their classes. Many participants spoke about who they have sought help from with the OneNote Class Notebook program. Faculty know that the technology staff and the students in the CAVE are available to help, but often another faculty member is a better choice for the support they need. A relatively new teacher described how he received the help he needed:

> I got the kind of a one-on-one with [a faculty member]…and we walked through more of the teacher side of stuff, grade books and how to do attendance and logins and all that good stuff.…And then with the Microsoft OneNote, that was really [the math department chair]. I just heard about OneNote; the kids were using it in their classes. Like the second week of school, I went over to her and I said, 'What is this? How do I use it? (upper school faculty).

As one faculty member expressed, "I rarely feel like there's not someone close by who can help me and is willing to help me" (upper/middle school faculty). Collaboration was also mentioned in terms of adjusting the technology curriculum to best meet the developmental needs of students. Adjustments were made to the 5th grade computer curriculum based upon input from the 4th grade computer teacher.

In discussing who she seeks out for help with the one-to-one program, one faculty member expressed her thoughts about collaboration and leadership in words very similar to those

in the school's educational philosophy, students [and faculty] "learn to deal realistically with their gifts and limitations" ([Educational Philosophy], 2005):

> I see it as a strongly collaborative faculty. When it comes to leadership a healthy ownership of gifts and some limitations and helping each other with that. I think maybe that's where leadership is, in owning my gifts and limitations and seeking help or helping …and that the administration supports (middle school faculty).

It appears that the educational philosophy supports an environment in which individuals feel free to offer help, to share their ideas, but also in which they feel free to recognize their limitations and therefore, seek help. This environment has encouraged faculty to learn, from each other and from students.

The manner in which the students in the CAVE help faculty and students was also given as an example of the one-to-one program contributing to the collaborative environment:

> I think the culture at Sophia in relation to the one-to-one program is just another wing of the collaboration that takes place here. I think the CAVE staff, the CAVE people are phenomenally helpful. They don't look at you strange when I know it's a dumb question. So, you're always welcome to ask anything. So, I would just say we're really collaborative and helpful here, and I think that they really set the tone for that one-to-one program. It wouldn't happen and wouldn't be as successful and easy without them (upper school faculty).

The collaboration that exists between faculty and students is a natural, daily experience. As an upper school faculty member shared "…being open and being able to share is part of our culture…students help faculty and faculty support students." Many of the teachers spoke of learning from their students, of asking them for suggestions as to how to do something.

A collaborative spirit and learning on the part of every member of the school community is fostered. Students learn from teachers, and teachers learn from other teachers and students. There is an expectation that the adult community models and provides opportunity for collaboration with and among students.

The one-to-one computing program and the Internet have enhanced student and faculty interaction with the larger community. While this interaction is a result of the program, it is also appears to be a reason for sustaining the program. Faculty and students value that the program has expanded their access to resources as well as their sense of community. Students and faculty have collaborated with students and faculty at sister schools as well as with experts. Collaboration with others beyond the local school community was viewed as a means of enhancing the learning of faculty and students, and therefore, helped to encourage individuals to move forward with one-to-one computing. The middle school head believes that:

> …part of project-based learning, part of the underlying philosophy of that, is engaging with experts….I think there's a real opportunity for students to get more engaged with the experts, that said, an eighth-grade science teacher has…She brings in engineers who are generally parents, who come in and they work with the girls on their future cities projects, they talk about it and it's very, very meaningful....

According to participants, the availability of the Internet and other forms of technology increased their interaction with each other as well as with the larger community. Faculty and students valued the new ways in which they were learning from their peers, teachers, students, and experts outside of the school. The added value that individuals thought the program offered

helped to generate enthusiasm for new ideas, as well as a commitment to sustaining one-to one computing.

The school's commitment to providing opportunities for faculty to learn how to use technology more effectively for learning may have played a role in furthering the collaboration that participants mentioned. Opportunities to learn with and from each other through professional development may have also helped to create a more collaborative learning environment for both students and the adults of Sophia Academy.

The Necessity of Professional Development

The technology director remembered a great deal of support from the faculty for the implementation of one-to-one computing. In surveying the faculty about their support, concerns, and needs, the administration discovered that there was excitement for the program, but there also was fear. As the technology director noted, teachers "didn't want to fail, didn't want to fail for the students, number one, didn't want to fail asking parents to spend that kind of money." The administration, too, wanted to ensure that the program would not fail. According to the technology director, "The teachers were so excited about it, but we [administrators and technology staff] were also listening" to the concerns that faculty shared about needing to know how to integrate the use of technology into their classes:

> …we really wanted to make this kind of innovation to the program. I think that's when I [found] the wind beneath my wings? That was the energy that I got to make sure that everything was integrated and integrated well and that was when that mission began that we can't just let this slip by because there's a lot of investment going into this, not just financial, but human investment going into this (technology director).

The middle school head also commented upon the need for professional development. "One of the things that the school invested in was professional development, which a lot of schools that go to one-to-one don't do" (middle school head). What the technology director and other administrators recognized was that the one-to-one computing program could not be sustained without significant investment into the professional development of faculty, both individually and collectively.

Providing individuals with the knowledge and skills that they needed to integrate technology into their teaching was an investment in *human capital*. Allowing teachers to learn and grow from each other was an investment into the *social capital* of the school (Hargreaves & Fullan, 2016). According to Fullan (2012), "focusing on human capital does not change culture" (p. 121). In order for substantial change to take root in a community, there must be a focus on *professional capital*, that is, the human, social and decisional capital (the quality of the work done by the group) (Fullan, 2016; Hargreaves & Fullan, 2012). Each year the school has provided professional development that could enhance individuals, faculty, and learning.

For administrators, professional development was the only way to get the faculty on board. A former upper school head recognized that whatever training faculty received had to enhance their teaching and student learning:

> …it has to be the training of the faculty. There's no other way. If you don't have the faculty on board it isn't going to work…. And the program, they've got to use it as a teaching, a learning tool, not just as a fun game thing. It can be fun but it's got to be a learning tool, it's got to be associated with the curriculum.

Another former administrator realized that sending people to different conferences was not enough to bring about substantial change. Those that attended these conferences needed to share what they learned with their colleagues:

> So, it was really professionally developing teachers and saying this … the way we can use this great tool and meet the needs of our kids….They [the faculty] used to go to Austin every year to the big tech conference. They'd seen everything. So, I said I'm not sending you up there to go on vacation. You come here and you teach us, you bring it back….I was more about bringing people onto the campus than us sending people out… (a former middle school head).

The idea of sending one or two teachers to a conference and then having them return and teach other faculty helped to diffuse the use of the one-to-one program throughout the middle and high schools. People felt that if a colleague could do something, so could they.

Over the past 20 years, the school has engaged in a variety of professional development activities, internally and externally. At the beginning the focus was more on how to use the devices and different software. As the program matured, the focus switched to ways in which to better integrate the technology into the curriculum. As the Tablet PC has lost its novelty and students and teachers have begun to see it as a tool for learning, the focus of professional development and how it is done has changed. "We've kind of taken the focus off of technology for professional development. I mean gone more with the project-based learning, differentiation, reading…." (middle school head). The head of school shared a similar thought about the use of professional development: "We're trying to be up to speed with what the technology itself is doing, but then the instructional piece is something else, giving people new ways to do things." As faculty and administrators have become more familiar with the technology, there has been

less need for professional development focused on specific software and more need for professional development on instructional strategies and using technology to enhance teaching and learning.

Early in the program, some professional development was required of all teachers, but as the program has grown, faculty have been allowed to choose how much and what type of professional development. “We have those that are very high on the professional development and wanting as much as they can get and we have those that do maybe less and have grown with it. And everything in between” (head of school). Faculty, in various degrees, have engaged in a variety of programs, including conference and in-services, to enhance their effective use of technology to address the learning needs of students.

Administrators and faculty have attended a variety of conferences focused on the integration of technology in schools. Several people mentioned that attending conferences provides individuals with new ideas that they often share with their colleagues upon return. A staff member commented about the school’s investment in sending faculty and staff to conferences,

> that commitment to going places and learning things and being open to ideas from other people. We regularly go to TCEA and ISTE…. it’s not just the people who are doing technology full-time, but we're also able to take teachers so that they're seeing it from other teachers….It's not coming from necessarily the technology people. We're bringing back some ideas, too and we're getting training for ourselves, but also teachers can see this whole wide world that's out there with all these opportunity that could enhance their students’ education and make it deeper for them (technology staff; alumna, 2004).

In speaking about professional development, a significant number of participants valued the opportunity to learn new things from other educators who had implemented one-to-one programs in their schools. Attendance at conferences allowed both teachers and administrators to interact with personnel from other schools who had one-to-one computing.

While large conferences provided teachers and staff new ideas and allowed them to learn from colleagues at other schools, many saw the benefit of in-house professional development that could be tailored to their specific needs, and just because the programs were in-house did not mean that they necessarily were less innovative. For example, in 2007, the school year began "with an in-service given by Alan November who spoke about creating a culture of teaching and learning that produces students who are self-directed, self-motivated and have the capacity for global collaboration" (ISAS Self Study, 2008). As the head of school pointed out, there are benefits associated with large conferences and with in-services: "We've sent people to conferences. It's morale-boosting when you can go to a big conference. My CFO will tell you she'd prefer to bring people in due to the efficiency of cost" (head of school). From the onset, in-services on how to use specific programs and how to integrate one-to-one computing into teaching, were seen as invaluable to the faculty and administration:

> I think when we first got our… laptops…. The training was done in mass and they learned over the years that we needed smaller groups. It was the open box day and of course, we were all excited. It was the first time we had our individual computers and so in terms of faculty, some of us could kind of follow along, but others needed more help and we didn't have enough staff at that time (upper school faculty).

As the prevalence of technology in society has increased, training on how to use the computer has diminished. New faculty are still required to attend an orientation which

specifically addresses the learning management system of the school. Along with a mentor, these orientations are meant to help new faculty adjust to the attendance and grading programs as well as to the calendar and the use of the school's discussion board.

In addition to these orientation sessions, faculty were exposed to various types of software and ideas of how to effectively incorporate the devices into their teaching. An upper school faculty member recalled that the technology staff was always encouraging faculty to try new things: "I recall there being lots and lots of training for all sorts of different programs that we could use." Professional days, whether a full day or a half day, were incorporated into the annual calendar. These days could consist of outside presenters or faculty sharing something that they had learned:

> …professional days, training…maybe a morning. There would be four or five sessions and you could go to the two that you wanted…. Honestly, I think whenever I go to these professional development sessions, I realize how lucky we are and how [we are] on the front side of the curve….Issues that a lot of the schools are dealing with or the things that are new to them are really not new for us at all" (upper school faculty).

While people found the professional days helpful, they also resented losing time to these days:

> There was always regular faculty training and that was both a blessing and a curse. It was wonderful education, but it was extremely time-consuming. And so, there was some resentment about that and that was true both at the administrative [and faculty] level…. (a former upper school head).

The fact that the administration and technology staff have been willing to adapt the professional development to the needs and desires of faculty has contributed to the

faculty continuing to take advantage of the opportunities. Based upon input from faculty, professional days have been replaced by lunch and after school sessions focused on the particular needs and desires of faculty:

Recognizing that faculty often acquire knowledge and skills from each other, the technology department has also recently added an on-line professional development opportunity in which faculty are encouraged to share a variety of ways in which they have integrated technology into teaching and student learning:

> It's anytime anywhere online faculty PD, challenging them to try things and then capturing what they do and putting it into shared folders where other teachers can then, as if it were the library model, page through and see what other people have done on the campus knowing that they might be able to adapt something for their class or they know where the resources are….

As the program has progressed, the need to individualize professional development has become clearer. While faculty are still encouraged to attend conferences and experts are brought in to offer professional development, a significant amount of professional development is occurring through individuals sharing what they have done and learned and in mini-sessions tailored to the specific needs of faculty.

The amount and type of professional development has changed over the course of 20 years, as would be expected because teaching and technology have evolved:

> …so many good things…we've had more small groups on various topics over the past years that have been nice to either refresh your skills or to learn some new skills. Using it, whether it's been, using it with students or lessons or whether it was just your own ability to enhance that. (upper school faculty).

It is apparent that those responsible for planning professional development recognize that sustainability of the program depends upon exploring new and varied ways of educating the faculty. Regardless of the type of professional development offered, faculty appreciated the school's commitment to their professional development, to encouraging them to grow as teachers. Administrators and faculty saw good and varied professional development as a necessary component of the one-to-one program's longevity. Another offering of the school was also essential to the growth of the program, technology support.

Offering Various Types of Technology Support

Based upon visits to other one-to-one computing schools, the administration knew that one of the biggest issues facing one-to-one computing programs was assuring that the devices and the infrastructure were working and maintained. The pioneer schools had suggested having loaner computers for when someone's laptop needed to be repaired, which required purchasing additional laptops amounting to at least 10% of the number of laptops used by faculty, students, and administrators (AAL Summit, 1997). In addition to providing a replacement laptop when a computer was broken, the school had to determine how to handle repairs and other difficulties that would arise.

The faculty recognized that they could not succeed with the implementation without support, a place that they could go when the computer malfunctioned or they had a question about hardware or software:

> Going back to the very first survey that we did of faculty in the fall of 1997 about one-to-one programs…they were like that is so cool and we should do that for our students, but we have no idea how to do that and we will do that with two requests: 1) the big request

> was that they had support and out of that came a help desk and 2) making sure that our computer teachers at that time only taught computer classes half time and the rest of the time were there to integrate and support…. We are witness that if you don't have that help, you can't sustain it and it doesn't work. The computers become paper weights and note-taking devices. So, that [technology support] is essential in my opinion (technology director).

Technology support at Sophia Academy has evolved through the years, but the main components have been the technology director, technology staff who maintain and support the infrastructure, computer science teachers, an educational technologist, and a help desk. Throughout the interviews and focus groups, faculty and students commented upon the excellent support that they received from the technology staff, but they also mentioned how much they valued the student interns who operate the CAVE.

On the second floor of the upper school is an area referred to by all as the CAVE. CAVE is an acronym for Computer Audio-Visual Education. While there is a physical location called the CAVE, participants used the term most often to refer to technology staff, including the education technologist, or to the student interns who staff the help desk, or to both.

From the beginning of the program, there was a need to have a computer help desk for students and faculty. The technology director and others saw that it would be impossible to staff this help desk throughout the day without eliciting the help of students. As the technology director pointed out, it was a win-win decision. Everyone benefited from the help desk being open throughout the day, and the students who worked in the CAVE became much more knowledgeable about technology. "The very

most important thing was having the CAVE,…where we had not only the support system for the [program], …but the students who manned the CAVE were getting skills, employable skills for a lifetime…" (a former upper school head). Observations of the student interns confirmed this upper school head's thoughts. Girls were dismantling and repairing hardware constantly. In addition, they were also solving other issues, such as Internet issues or wireless issues with the new LCD TV screens (field notes, 11/2/17).

The student interns not only see the CAVE as an educational experience, but they also see themselves being at the service of the community. Administrators, faculty, and students all expressed that the program could not exist without the CAVE and how much they valued the work of the student interns. In addition to the work that the girls perform in the CAVE, they are always counted on when there is an issue with technology in the classroom or as a resource to their peers:

> …So, a student has a problem in class and says, 'Mr…, this isn't working!' and one of the CAVE girls will pipe up and say, 'Oh, just do this!' which is great and then as they learn who the CAVE girls are, they start to go to them in class versus me, and I try to listen in and see what I can pick up (upper school faculty).

The CAVE interns commented that the level of issues that they deal with is broad, from changing printer cartridges to software, hardware or wireless problems. The CAVE program has helped to sustain the one-to-one computing. Many expressed the fact that the program would not be as successful without this program. "The CAVE girl program, without it I think some things would probably have fallen off, just from teacher inability to move it forward" (upper school faculty).

As the technology director expressed, the CAVE has not only served a need for providing technology support for the school, but it has also provided numerous students

the opportunity to obtain skills and knowledge which might be unavailable to the girls without the program. The innovative idea of having students operate the help desk is seen as one of the things that truly sustained the program.

Numerous faculty and administrators spoke about the support that they received from the technology staff. From the very beginning, administrators depended upon these people:

> relying heavily on [upper school librarian and the technology director] who were the ones who were on the cutting edge of seeing, going to the conferences, seeing what was out there and gleaning what was the best and bringing it back, …and then showing the faculty how it was used; advising us on what software we needed. I relied heavily on them (a former upper school head).

While positions have changed and evolved over the years, individuals still depend a great deal on these people and consider the technological support one of the reasons that the program has remained: "…the great support that we get, the technological support. Without that and it's like this is too hard…or it's not working for me so I'm just going to put it aside" (upper school faculty). As the middle school head indicated, the program "is not flawless," and with over 500 computers on campus, the proper support is essential.

Not only are these people the troubleshooters on technology, they are also seen as the visionaries, the people to go to when you want a software program or have an idea but do not exactly know how to implement it. To some administrators, this is an essential component to the program, which allows them to focus on other things. "I think that's the beauty, I think that's one thing, that's great, fantastic about the [technology director] and the beauty of the CAVE [staff]. And that is, they have thoughts, they have ideas, they

have a vision" (upper school head). For this upper school head, it is a gift to have others dealing with the technology for as he expressed it allows him "to deal with bigger picture" ideas. As the program has grown, so have the ideas and needs of faculty and students, requiring the addition of more staff to ensure the sustainability of every component of the program

For some time, the technology department, as well as the faculty, have wanted to hire someone who could work individually and collectively with faculty on the integration of technology into the curriculum. Two years ago, a technology integrationist was hired. "We finally have a dedicated tech integration specialist in the middle school and in upper school, who is dedicated to tech integration" (middle school head). For the technology director and others, this position could only further the growth of the program:

> One of the beauties of the program is that the technology department was able to hire somebody to support the teachers … it allows the teachers to learn how to use whatever software and then explore how they can use it in their projects and learn what works and what doesn't….[faculty] might have an idea but don't know how to implement it. Having that person there to help them [integrate it] is really important. (technology staff).

The technology education specialist has provided in-services for large and small groups and worked with individuals on ways to better integrate the technology into their specific curriculum. As she indicated, she does "whatever is needed to make them be successful in their classroom" from training to modeling teaching for teachers.

Over and over again, individuals remarked on the leadership, vision, and encouragement of the technology director, the technology staff and the technology

committee. Administrators and faculty cannot envision how the program would have survived without these people.

From the beginning, a group of the adults, consisting of the technology director, computer science teachers, and librarians formed the technology committee. Today, this committee also includes the adult staff that maintain the CAVE and infrastructure. The inclusion of the librarians on this committee appears to be a unique model for technology committees:

> That's something that I've had to explain, defend, that it's not an automatic understood thing, why are librarians on the tech committee, why do they need to come to the tech meetings and it's this trifecta that we try to keep of teacher/librarian/technologist because we all see things in a different way and I think for any of this…to work smoothly, because everything digital is information based [we need the librarians] (technology director).

The collaboration between technology staff and librarians was seen as invaluable part of the program. As one technology staff and alumna mentioned, "the librarians are willing to explore things" and share resources with the faculty and the technologists provide the support and training for faculty to implement these resources.

The technology committee is also the locus for recommendations for upgrades to hardware and software, with their recommendations typically approved by the administration. They typically send out information about what is currently offered and suggestions for improvements and changes, and ask for input from faculty and administrators (upper school head). The committee also "plans and offers professional development opportunities and each member supports the community in maintaining

"integrity of technology integration across the curriculum" (2018 ISAS Self-Study). A few years ago, when the school was contemplating moving the one-to-one program into the fifth grade, the technology committee researched and discussed their findings and concerns before a recommendation was made:

> … that was something that we pondered for a longtime: Are they too young to handle it? How can we help them better be prepared for all of their classes? And what we saw was that if they had them in the fifth grade how much more they would be able to move with the sixth grade curriculum…with the component of the computer, one-to-one (middle school faculty).

Like all decisions made concerning the one-to-one program, moving the one-to-one program into the fifth grade required input from various constituencies and the thought and direction of the technology committee.

The technology committee offers support to the faculty and helps to move the program forward. As one of the members of the technology committee commented: "any of the teachers know they can contact any of us in the tech department, library department and they'll get help" (technology staff). To the faculty and administration, the composition of the committee of librarians and technologists seems to be an effective means of sustaining the program.

From the initial conversations regarding the implementation of one-to-one computing program faculty knew and expressed to the administration and technology director what they felt was needed to implement and sustain one-to-one computing at Sophia Academy, professional development and technology support. Good leadership

requires “seeking and listening” to the concerns of those who will be most impacted by the innovation (Fullan, 2001, p. 42).

Educational Change: Did One-to-One Computing Impact Teaching and Learning?

Fullan suggests that educational change depends “on whether educators, students, and other learners find personal meaning in what they are learning and how they are learning” (2016, p. 4). The evidence presented above suggests that many faculty and administrators at the Sophia Academy found tremendous personal meaning in their work with one-to-one computing. This certainly contributed to the sustained implementation that the organization experienced. In implementing a new program, educators often assume that in order for the program to be successful the innovation must be used as it was intended. This faithfulness to the original intent of the innovation is considered the fidelity approach to change (Fullan, 2016). Berman and McLaughlin (1976) found in their RAND study that most innovations are adapted in some form to address the needs of the users. The nature of one-to-one computing, with the device and software improving on a regular basis, impacts the fidelity of implementation. More importantly, the manner in which some schools implemented one-to-one computing fosters more adaptation than fidelity.

The philosophy of implementation of Sophia Academy when beginning the one-to-one program was to place the devices in the hands of faculty and students and provide training and support so that faculty and students would discover the most useful ways of using the device. This “mutual adaptation or evolutionary perspective stresses that change often is (and should be) a result of adaptations and decisions made by users as they work” with the innovation (Fullan, 2016, p. 32). At Sophia Academy, the manner in which one-

to-one computing is used for teaching and learning is dependent upon the teacher. Fullan (2016) suggests that, with most educational innovations, change occurs in three areas, curriculum, behavior, and beliefs. In order to understand what has occurred with one-to-one computing at Sophia Academy since 1997, it is necessary to understand how the program is being used by teachers to teach, and how the program is impacting the learning of students.

Change and the Stability of Teaching at Sophia Academy

In the words of one middle school student, how the computer is used "really depends upon the day" (middle school student). From classroom observations, it was evident that what this student meant was that the level of use was dependent upon the lesson, and hence, ultimately dependent upon the teacher. Many teachers have incorporated more project-based learning and guided inquiry since the program began. However, this varies according to the teacher and the curriculum. In general, middle school teachers more readily use project-based learning either because that has been a part of the middle school curriculum or because the one-to-one computing provided new opportunities for learning. Additionally, the fact that middle school students could collaborate more via the Internet has allowed more group projects. Students and teachers saw the role of the teacher, as a fifth grade student said, "They just help guide us" (middle school student). The teacher as a guide was especially true as students were engaged in project-based learning.

A variety of reasons were provided regarding why teachers chose to adopt and adapt one-to-one computing to their teaching: "It was transformative to the class …for them to have it right at their access" (technology staff). A middle school science teacher

commented that she began using the computers more extensively because she felt that she needed to validate the school's decision and because she wanted to improve her teaching:

> It was the fact that these kids had these very expensive pieces of equipment and I didn't feel I was utilizing it the way I should be…I felt inept and wanted to be better with it…. I think when I first started I covered more curriculum but didn't do all these wonderful neat projects with them which are so much more beneficial, I think. They can get content. They can look up content! Why do they need to memorize anything? (middle school faculty).

For some faculty, such as this one, their initial reasons for implementing the program were not their current reasons for using one-to-one computing in their classes. This teacher realized more of the merits of the program once she had begun to use it with her students. She recognized that she may now cover less content because of project-based learning, but felt that the skills students were gaining through project-based learning were more beneficial. Some of the changes that occurred at Sophia Academy were moves toward a more constructivist learning environment, such as some of the projects and experiments done in the science department. For the most part, faculty had to adapt their teaching to the one-to-one computing program. As a former head of school commented "they just weren't doing the same old thing….[the goal] was to enhance their teaching and I think it did" (former head of school). According to administrators, the program brought creativity and new opportunities which did change teaching and learning in some classrooms. Some changes allowed teachers to adapt their teaching practices, but for others, especially in the early years, the one-to-one computing program was either a hindrance to their teaching or was used only for tasks such as note taking.

From the beginning, most of the faculty saw "possibilities" through one-to-one computing. Whether it was having students take notes, doing research on the Internet, or using email to communicate with parents and students, these early uses were seen by faculty as a means of enhancing the learning environment, but were not necessarily changes to the way teachers taught.

There are many factors that contributed to the level in which one-to-one computing was integrated into the teaching and learning at Sophia Academy: the age level of students, the curriculum, teaching experience, and the number of years one-to-one computing had been used. For example, the curriculum of the middle school was more flexible and made it easier to adapt to project-based learning. As mentioned earlier, one faculty member indicated that prior to the one-to-one computing program, the school had moved to a more project-based curriculum, and that the one-to-one computing program accelerated the progress towards a more constructivist learning environment. For some teachers, the changes due to one-to-one computing were either adaptations to what they had been doing in their classes or were almost non-existent. For others, the one-to-one computing environment allowed them to take positive steps towards a more constructivist learning environment.

Incremental or Fundamental Change. Cuban (1993b, 2008, 2013a, 2018) distinguishes between first-order or incremental changes and second-order fundamental changes within schools. Fundamental or second-order changes are changes to the structure of schooling, such as significant changes in the funding, governance, organization, curriculum, and instruction (Cuban, 2013a, p. 3). Examples of a fundamental change within public schools would be the move to charter schools or to a

voucher system. The fundamental change that proponents of one-to-one computing sought was a move from teacher-centered to student-centered pedagogy. Incremental changes to schooling are adaptations to the current model of schooling that exists in the United States, or as Cuban (2013a) states "amendments to current structures, not deep changes to or removal of core components of schooling" (p. 3). Having students take notes with a computer or using a Smart Board as overhead projector rather than as an interactive device are examples of incremental changes that occurred. At Sophia Academy, changes to teaching and learning due to the one-to-one program covered a broad range, from the layering of computing upon traditional teaching practices to changes in pedagogy, from teacher-centered to student-centered. It should be noted that while some teachers made only incremental changes within their classrooms, other teachers made incremental changes and took steps towards a more constructivist learning environment. There is an inherent complexity that exists in some of the changes that occurred. While a teacher may have made what appears to be an adaptation to her current teaching methods, the changes made may have also been a move towards a student-centered or constructivist environment. A fundamental difference that Cuban (2008) makes between teacher-centered and student-centered environments is based upon who fundamentally has control of what occurs in the classroom, the teacher or the student. In teacher-centered classrooms, the teacher determines the content, the method, and the timing of instruction (p. 132); in student-centered classrooms, students "exercise a substantial degree of responsibility for what is taught, how it is learned, and movement within the classroom" (p. 133). As illustrated in the next sections, in a few cases one-to-one computing did provide students with more control over their learning.

Incremental Change. An upper school English teacher's description of changes that occurred to her classes is a good example of positive incremental change that occurred due to the program. She expressed that from the beginning she knew the one-to-one program would positively influence the research process in upper school English and social studies classes. Before the one-to-one program students had access to the resources at the library of a local university, but they had to be able to go there to find the resources. "[Now,] they can sit at home and search the card catalogs. The only thing they can't do is get physical books out, but they can now, sitting at home, even order articles online and in most cases print them out" (upper school faculty). The manner in which students obtain information changed, but how they used that information did not. Students, too, recognized the benefits that one-to-one computing brought to their ability to access information: "I really like the accessibility of it from other places outside…the classroom or stuff in your backpack" (upper school student). The accessibility of information through technology also impacted student research skills.

> Research…that's another place where we notice that computers actually are a big help….I feel like when we're given this more universal outlet of knowledge and information, we're able to better our thoughts and better our own opinions in the world. I think that's very important in an educational system because then you're more exposed to the world around you, the situation around you, making you a more well-rounded individual (upper school student).

Many graduates also recognized that the one-to-one computing had enhanced their research skills, noting that they had more information readily available to them, and that they had been taught how to discern between good and poor sources: "The breadth of information I was able to

learn was larger in size because I had a laptop, but the way that I learned did not change" (alumna, 2009). One alumna mentioned that:

> …the benefits certainly outweigh any drawbacks….you have access to a lot of information. Sometimes, that's good, sometimes that's bad, but overall, the benefit of learning and being comfortable on a laptop and the power it brings to females certainly outweighs any drawbacks (alumna, 2002).

However, as illustrated through the comments of a 2013 graduate, having one-to-one computing and access to the Internet were not the only reasons her research skills were enhanced. It was having the program and working together with her teacher and the librarian that enhanced her research skills and helped her learn "to identify good and bad sources" on the Internet (alumna, 2013). While the amount of good and bad information available through the Internet has mandated the teaching of new research skills, doing so is an incremental change, an adjustment to a teaching practice.

An upper school math teacher spoke of continually looking for new software to enhance math instruction in the school. She, like some of the graduates interviewed noted the impact that the introduction of the Tablet PC had on her math instruction:

> I use the wireless and carry [the Tablet PC] around the classroom….I send out what are called OneNote Class Notebooks [to every student]…. I don't print anything anymore except for tests; maybe quizzes. Everything is distributed electronically, through the OneNote Class Notebook. I expect them to do their work, so that I can grade it; I can see it real time… They can send me an email, 'please look at this' at night or anytime during the day and I can pull it right up or they send me a screenshot of it. (upper school faculty).

In fact, this math teacher does more than just carry the tablet around the classroom and distribute lessons via OneNote Class Notebook. She projects an image or a problem onto the LCD and then uses the stylus to teach her lesson much like she may have used a marker on a white board in the past. Using the collaborative software program, OneNote Class Notebook, she is able to save her presentation in a place where her students are able to access it for review. Students also submit their homework through OneNote Class Notebook and it is graded on-line using the tablet function. She has also used a screen casting program to create videos of her lectures. She employs a relatively new form of instruction, 'flipping your class,' in which students watch the video the night before class and then come prepared to ask questions and do problems with each other and with her help (field notes, 10/5/17; 10/25/17). Flipping the class changes the manner in which this math teacher is teaching. She is still lecturing, though through video, but by having students watch the lesson prior to class, more time is available for students to work with each other and to inquire of the teacher the fundamentals that are not understood. The manner in which this math teacher has used the program in her classes has radically changed her practice of teaching and has required students to take more responsibility for their learning. In this teacher's classes, there have been incremental changes and glimpses of movement toward a more student-centered environment.

An art teacher's use of flipping her class illustrates that teachers can use the same methods with different types of change occurring:

> I even do a flipped classroom for my Painting II class. One year scheduling was nuts and I was having them come in independently all at different times and I was doing the same demo over and over again …and [a member of the technology

> staff] says video yourself the first time and then just put it up and they can all see it and do it with you. That's been great. I am still using those same videos to teach watercolor techniques that I videoed ten years ago …. (upper school faculty).

This teacher's purpose for using the flipping technique was a practical solution to how to teach the same method of watercolor painting to a number of students at a variety of times. While this changed her method of reaching a variety of students at different times, it was not a change in how she has taught watercolor painting in the past. All that has changed is the medium through which she is teaching, similar to using a movie rather than a book to teach a lesson. While this is a very practical and useful teaching strategy that was accomplished through the use of technology, it did not bring about the type of fundamental change described by Cuban (1993b, 2008, 2013a, 2018).

Another new teaching strategy incorporated by teachers at Sophia Academy has been screen casting which has been possible due to the inclusion of cameras in the Tablet PC. A teacher used screen casting to tape her explanation of a project that she wanted her students to complete while she was absent from school. By doing so, she made the task clearer for students and easier for the substitute teacher. A 2013 graduate commented about another use of screen casting that she found especially helpful:

> [Math teachers] could project their computer and then physically write on their screen a problem. They could have instructions or pictures and write directly on it to the class and they would be able to save that and then send it to students or post it online.

A chemistry teacher had a similar idea last year. Students took screen shots of the work they had completed on the white board or explanations of material and then place them in an on-line gallery that is accessible to all for reviewing at a later date. Students also

submit their homework on-line so that the teacher can review and assess it for what might need to be taught the next class. Again, these are new teaching strategies that are beneficial to student learning, but are not reflective of a more student-centered learning environment.

A Move Towards Fundamental Change. The English teacher who described how students could now access information from a local university library also described how one-to-one computing allowed her to make some other shifts in her teaching, which are moves toward a more student-centered environment. She explained how the technology had changed student understanding of the writing process and the manner in which she provided feedback on their writing:

> They're more conscious of how revision is part of the writing process and that's usually something that a kid only becomes conscious of in college…. But now, [there are] so many different ways that you can have the paper, and we can edit it together. I think they're much more conscious of this is a process, and 'I'm responsible for my own editing. The teacher becomes really an advocate for my [student] being a better editor of my own paper'… they've shown much more consciousness of how they are better editors of their own papers and that the revision is not an onerous thing, but in fact a normal piece of the writing process. (upper school faculty).

This teacher shared that before the one-to-one computing she was unable to give as frequent or thorough feedback on student writing as she is today. Today, she provides them a one to two page single-spaced critique of what they did well and what they did not do, providing them a map for their revisions. Because students are able to easily 'cut and paste" and revise and refine their thoughts, she directs them to not necessarily begin with the first paragraph because it can be the

hardest to write. The fact that students can contact her at any time with questions or electronically send part of a document for her thoughts, in her opinion, has allowed her to be a better teacher and her students far better writers. While the impact of one-to-one computing on the writing process has certainly been a positive one, and some incremental changes were made, it can also be argued that the one-to-one program provided students with more control over their writing. According to this teacher, the adjustments she made to the writing process forced students to take more ownership for their writing, which illustrates a movement towards fundamental change.

Some graduates felt that the one-to-one program had benefitted them more than just academically:

> The greatest benefit is that it taught me self-motivation and researching on my own and also self-discipline because the computer you can go anywhere and sometimes that's a detriment to completing tasks on time, but I think after awhile you sort of self-regulate your activities…. So in college I kind of used my own laptop in the same way that Sophia taught me, just sort of researching….I was very much more proficient at certain applications and Internet researching than some of my other peers who didn't have that program and I think it sort of carries on to work (alumna, 2002).

For this student, the one-to-one computing program, forced her to take more ownership of her learning. She realized that she had to be self-motivated and self-disciplined in her learning. Again, increased student ownership is a move towards a more student-centered environment, even if it is a small move.

The nature of science classes allowed for the opportunity for fundamental changes, changes from a teacher-centered to student-centered environment. Upper school science teachers

spoke of how the program has allowed them to incorporate simulations, virtual labs, and probes into their classes. A science teacher who came to Sophia Academy from a local public school described how her teaching has changed since coming to Sophia. “I've been able to do a lot more stuff online that I wouldn't have been able to do without getting a computer lab reserved [in the public school]…a lot of simulations and virtual labs…that really complement the hands-on labs….” (upper school faculty). A chemistry teacher described an experiment that he has students do at the beginning of the school year in which because of the use of probes they can visualize in real time what is occurring during the collection of data.

> We create a heating curve of water. So they make an ice water bath, put the probe in it, start the data collection….And what's great is they can see it in real time. They don't have to record the temperature. It is right there; they can just watch it. …So when you ask them after the lab what did you have here? Did you have liquid? Solid? Gas? Both? What did you have at this part of the graph? They can tell you (upper school faculty).

According to this faculty member, the fact that students could observe in real-time and compare the analysis of the data [the graph] as it occurred increased their understanding of the phenomenon, what happens when a substance, such as water is heated. This chemistry experiment is a move towards fundamental change, of allowing students to discover for themselves through the experiment what occurs to the heating curve of a substance. The technology that interfaces with the laptops has promoted more inquiry based learning which is a move towards a more constructivist environment.

Project-based learning has the potential to allow students to construct meaning from what they know and from what they are doing to form new learning. One-to-one computing coupled

with project-based learning can provide students more opportunities to construct learning beyond the classroom. One example of this is illustrated from a sixth grade science class.

> Students arrive to class and immediately begin to work on a project that has been assigned. The teacher does not have to tell them to get to work. They unpack their Tablet PCs and set about the work that is to be done. The teacher is projecting on the LCD live activity of the geyser, *Old Faithful*, whose activity they check daily in order to observe an eruption. They are working in small groups planning a virtual trip to Yellowstone National Park. As part of the project, they are to research their travel plans, including air travel, car rental, hotel, and the weather in order to know what items to pack. These tasks are meant to increase student inquiry skills on the computer. At Yellowstone they are to research an assigned geyser, pool, animal, and how to protect themselves from bears. The middle school librarian has brought numerous books on Yellowstone to the classroom, but no one is interested in using them. Everyone is using a computer. Students have divided the project tasks among the members of their small group. A student demonstrates to me how she finds her group's geyser, clicks on a photo, and "snips" it to paste into a Word document. One student who is looking at a map of the park on her computer exclaims to her group, "There are many places to explore!" Students choose the dates they will travel, then find out on-line what the weather will be. One student is at the board, listing the things that her group needs to pack. The teacher is walking around, providing help and encouragement, asking questions and complimenting their work. The teacher reminds them not to use Wikipedia because it is not a reliable source (field notes, 10/5/17).

A few weeks later I returned to this same class to observe the presentations of three of the group projects:

> Each group, in turn, connects a Tablet PC to the wireless LCD TV. Some of the devices will not connect when it is a particular group's turn to present. Students do not flinch when this occurs, but quickly move to another group's computer that has been able to connect and retrieve their presentation which they have posted on-line. Each student presents her section of the PowerPoint, with the last slide including a list of resources the group has used. After each presentation, classmates are free to ask questions. The projects are assessed using a rubric (field notes, 10/24/17).

In reflecting upon the project during an interview, the teacher commented about the level of engagement of her students:

> They really stayed focused for so long on it. It wasn't a project that we really rushed through or anything. We kind of did some material along with it that we were covering in the chapter, but they were so focused and so driven and so excited (middle school faculty).

Project-based learning, such as the Yellowstone trip, can allow for more authentic, real-life learning to occur, such as planning a trip to Yellowstone. It also provides students more autonomy over their learning, and as their teacher indicated, has the potential for deeper engagement.

Several administrators and teachers commented upon a project that some of the middle school students were involved in with NASA. Twice the research project that these students constructed was loaded onto a rocket headed to the International Space Station, and twice the rocket blew up with their work. The teacher responsible for guiding students with the project

believed that the school was selected without an application because NASA knew of the one-to-one computing program at Sophia:

> We were selected….you have this opportunity….So, everyone [students] came up with ideas and we watched a lot of videos. They had to do research on it. Then, we did a lot of the engineering design process and narrowing it down… because …it had to fit in the box. It had to be self-contained and it had to be programmable. So, then I had to teach programming which I don't program. We got these breadboards. There was a lot of training. It basically took over my life. It was the hardest year I had had since my first year of teaching. It was the most time-consuming…. The girls finally came up with [an idea that] at least for me, [was possible]. A fourth grade teacher was doing this with fourth graders, too, and independently we ended up with very similar projects. So, ours was growing pea shoots in different combinations of red and blue light to see which one was the best. The girls had to do all the research, not only the research about the light, but which plant could grow fastest given the amount of time. We didn't want to come up with a watering system because of the space and the problems of water, not only the space limitation but Space. I'm pointing up into the air, of water in the ISS. So luckily, our mentor… had worked with this plant physiologist at [a local university] and he said 'oh there's this stuff called Fido Blend Agar that is great; it has all the nutrients and … he would mix it up for us….Then, trying to come up with the right sized containers which ended up being … 3D printed by our students. It was using the engineering design process and figuring out all this real-life science and then dealing with 'Ok. It exploded. What do we do now?'

So, she explained that they started the project all over when it blew up:

> CASUS gave us another grant and they increased the size of the box because they realized there were a lot of problems with the software and stuff. We worked with [graduate and undergraduate] students at [another local university…and this wonderful professor there. They programmed it all for us and we made several trips up to the [university] taking even some students … with us. It was just really amazing and then it blew up again. The last time [third time] it really was just basically recreating.…(middle school faculty).

Despite the time and energy that this project consumed, the teacher could point to several things that the girls had learned through it: planning, researching, programming, failure, working with experts. As she stated, "we tried to do real science. We really did" (middle school faculty). What the students learned was that real science often does not succeed the first time and requires that you start over with your project. While the teacher guided the students in their construction of this project, it was their responsibility to explore options that would work in the international space station. Certainly, NASA nor the teacher expected the rocket to explode twice, but that only enhanced the authenticity of the project.

Some teachers described ways in which they thought the learning environment had become more student-centered; others described their usage of one-to-one computing that in many ways resembled traditional teaching and learning. Some teachers felt that the one-to-one learning program had allowed for differentiation of learning and for increased creativity. An upper school biology teacher described how she saw the change in her students because of one-to-one computing: "They're able to be more independent….I can give them minimal instructions and they're able to do a simulation that they're in control of, without me doing something or explaining what would have happened if we would have done it [together]" (upper school

faculty). Some teachers believed that greater independence and responsibility enhanced creativity and that these things were illustrative of a move towards more student-centered learning.

The Evolution of Change at Sophia Academy. The examples of incremental and fundamental changes illustrate again that the continuum of changes at Sophia Academy was broad. People, also, had various opinions of what a student-centered environment looked like. Learning that requires greater independence and responsibility and that fostered creativity was viewed as more student-centered.

With the exception of one participant, teachers, students and graduates spoke to various degrees about the benefits of the program. Typically, the longer the program had been in place, the more beneficial graduates and teachers felt the program had been to teaching and learning.

While many teachers and students were positive about the current one-to-one program, graduates and teachers recalled that the program did not make an immediate impact on learning or teaching when it was first implemented. Knowing that the software and hardware have improved over time and that teachers have become more proficient in their use of various programs, it was not surprising to discover that the changes due to one-to-one computing at Sophia Academy have evolved over time.

A graduate from the early years of the program recalled that in the first year, people were learning to use the device: "Obviously, it had just started…it was a new thing…we were all getting used to it" (alumna, 2001). A 2002 graduate reflected,

> I think the first year, they didn't really use it in terms of having some sort of screen that we could interact with …. a lot of our classes were still lecture based so if we were able to take notes during class we could do that on the laptop… I

> can't remember any innovative views to be honest with the laptops in terms of the classroom. There might have been some tests or experiment...an interactive experiment. … I can't recall anything other than that (alumna, 2002).

A 2005 graduate described that when she was a student, some teachers gave PowerPoint presentations sometimes, but other teachers were still lecturing and using overhead projectors. The fact that very little change occurred initially is consistent with what is known about educational change – it takes time. Early adoption years typically demonstrate very little or moderate changes due to the innovation.

Early documents provided by the school also revealed that initially some teachers found it difficult to adapt to one-to-one computing. In a survey conducted in the spring of 1999, a religion teacher wrote:

> I have been hampered in use of the laptop both by personal circumstances and by the subject matter of sophomore theology. It will be interesting to see how the laptop will change the way Bioethics is taught when the class next year has computers. Here is a subject where we can use the Internet and they can find relevant subject matter for research (1999 Faculty Survey).

This teacher's comments suggest that very little change or a lack of adoption occurred in her classes during the first year of the program. Because of the anonymity of the survey, it is not possible to know whether this teacher remained at Sophia Academy or if changes occurred in future years. It is possible to know what currently occurs in the bioethics class. The current bioethics teacher described how students use the Internet to research the various issues discussed in class. Interestingly, she also described how technology has allowed bioethics to become a hybrid class. She explained that she teaches in both the middle and upper schools and because

the schedules are not the same, it has been necessary to allow the older students to meet virtually and review their conversation at a later time. Virtual classes are certainly a new teaching strategy that has evolved due to student and teacher access to technology. While virtual classes have the potential for fundamental change and this class illustrates student ownership for learning, the strategy is an incremental change.

Most of the faculty spoke of some change they made to their teaching through the use of technology. While some changes may have been accomplished without students having their own computer, teachers discovered that the one-to-one program allowed greater variation in meeting the needs of their students. A veteran English teacher described how in one class, in which students were extremely competitive, she used the program, Socrative, to review quotes of Shakespeare which made the learning more fun and engaging:

> They wanted immediate feedback and it made me change my learning, my teaching style…. But I needed to adapt to what they needed to do because they were competitive with each other. So, it broke down some of my resistance, but I needed to do how they needed to learn (upper school faculty).

For many teachers, as they became more familiar with the use of technology and knowledgeable of software and on-line resources, their type of instruction evolved allowing them to better meet the needs of various learners. In some cases it became more constructivist. An English teacher made a distinction between the effective and ineffective use of technology, "…good technology integration just enhances what you already need to do….the emphasis needs to be on the course, not the technology….ineffective technology integration would be…just bringing in some new application just to be doing tech" (upper school faculty).

While the use of the one-to-one computing program has evolved over time, a few teachers have not significantly changed their teaching. A social studies teacher who has been at the school since the inception of the one-to-one computing shared that it worked for him because "taking notes on the laptop seemed like a good idea to me…. My way is lecturing and telling stories" (upper school faculty). He went on to describe how stories have great images and that each week he requires students "to find the best image, the most original best image connected to what we're talking about." He then makes them the "curators of images" that provide visuals for what they are learning. When asked whether or not his teaching had changed because of one-to-one computing, he responded,

> I would say no…. I still do my Victorian lecture as I did before – I look at many teachers who I see have really grabbed it and really changed what they are doing. The one thing that I do, and it's mostly for preparation for the paper, is I videotape myself because I'm saying the same thing over and over and over. 'Here's how you do footnotes'….So to me, what is most important is for them to know their content. So, it's my job to give them the most entertaining, exciting, hopefully something that attracts them to history and to also to deliver the content (upper school faculty).

Unlike this social studies teacher, some faculty thought that it was more important for students to know the skills of finding and using content. This social studies teacher's comments clearly suggest that how the program has been integrated into the curriculum has been dependent upon the teacher, his or her beliefs, and the discipline being taught. What is most interesting is that this teacher supported the program because he saw the program supporting what he currently did with his classes.

Most of the changes that occurred due to the one-to-one computing program were incremental changes to the practice of teaching. Many of these new strategies infused the learning environment with creativity and new opportunities for student learning. Some of the changes indicate that some movement towards fundamental change, towards a constructivist learning environment, has occurred in some classes and areas of the school. There were other changes that occurred due to the program that were not necessarily incremental or fundamental changes.

Unintended changes. Not all changes were positive however. One teacher, in the first year of the program, commented that the dynamics of the class had changed. Students were so busy typing notes, that they seemed less engaged. "In researching, they seem unwilling to use conventional sources, books, periodicals, and now prefer net/websites which may not have the quality of information found in private publications. Quantity and ease seem to be replacing in depth and breadth" (1998 Faculty Survey). While she found that the final products looked great, she had to stipulate the type of resources used in order to maintain the "depth and breadth" to student learning. One teacher shared that sometimes she feels that it is good to put the Tablet PCs away.

> The range of things that I can actually do in the classroom is really great. But just, what I found was that I had to just be a little bit cautious not to go overboard with the technology because I feel that sometimes the girls just need a little bit of a break from it. There are certain things whereby they physically need to go up and write on the wall. …I've always tried to give the girls the opportunity to be able to work in the way that best fits them, their learning style….(upper school faculty).

The fact that this teacher recognized that sometimes the computers were not needed was reflective of the flexible, thoughtful, and discerning culture that characterizes Sophia Academy. As one upper school student mentioned, the one-to-one computing is not always the best solution for every student. She viewed the issues that she had with her first device as detrimental to her education because of the amount of time she was out of class trying to get her Tablet PC repaired. As with this student, difficulties with hardware and software have the potential to sour teachers and students about the benefits of the program.

A current middle school social studies teacher commented that she felt "critical thinking in some ways has decreased" (middle school faculty). She further elaborated,

> I feel like it takes them longer or they're less willing to think about things. Everything is so at their fingertips now…. a lot of kids will just Google something and copy and paste and that has created some really bad habits and they think that they're getting depth, and so that's where I get the critical thinking. We're asking them to do things that are harder, but they don't necessarily have any clue how to get there and it's…the struggle is very real. And I don't think we're preparing them right (middle school faculty).

While this teacher could also see many benefits to the program, such as the fact that it had allowed her to differentiate her teaching, she was concerned that students were not sufficiently prepared to use the technology wisely.

Another unexpected issue that occurred because of the prevalence of technology was the need to teach students to use it ethically and responsibly. The former upper school head spoke of bringing speakers in to provide students and parents with information regarding some of the dangers of inappropriate use of the Internet. A young alumna spoke of how it has become more

relevant for schools to teach students about the appropriate use of technology. “It’s become more relevant….I think, it's even more applicable now to be able to teach students how to use them in an educational atmosphere, how to use them wisely and responsibly” (alumna, 2005). The use of technology in the work force and other areas of life has become so prevalent that it has become necessary for schools to not only teach computer skills, but to also teach the life skills needed to use the technology wisely.

The growth of technology in the lives of individuals during the past 20 years has been exponential. It has brought changes to how people complete tasks, and in some cases, has allowed individuals to have more control over where, when, and how they do their work. The prevalence of technology has brought fundamental changes to society. It remains to be seen as to how much fundamental change one-to-one computing might bring to education.

Changes to One-to-One Computing over Time

Unlike many educational reforms, this innovation and the program have evolved over time. Through interviews and observations, as well as documents, changes to teaching and learning and to the environment of the school were noted. Participants spoke to the evolutionary nature of the program. Additionally, the device and the infrastructure have improved over time allowing for greater variety in the use of technology.

Evolution of the Device and the Program. The computers and the wireless network have become faster and more dependable, allowing for the continuity of instruction. Faculty who have participated in the program for its duration commented about the fact that the tablet has become lighter and its processor has become faster.

The innovation has evolved over 20 years as the device has improved, but more importantly the past 20 years have seen the emergence of new and potentially better

software, as well as the growth of the resources found on the Internet. A middle school teacher expressed how she saw the evolution of the program:

> I think that it (one-to-one computing) just stayed with the times, that it grew as society and technology has grown. It was never like a stagnant thing. It was always, how can we improve it? What did we learn this year? How can we make next year better? …What are the pros? What are the cons? ... I think it was the technology evolved and then how we used it evolved, and then how we needed to use it evolved and then the technology evolved to do that.

A teacher spoke to how in the middle school they gradually build their research skills, from fifth through eighth grade, culminating in a capstone project in eighth grade, "We teach them a few of the tools at a time, building on projects towards [the capstone project], until we get to the end of eighth grade where they're expected to be able to use all of it" (middle school faculty). The evolutionary nature of the device and program has promoted continual growth and change for teachers and students.

A religion and foreign language teacher who has been a part of the program since its third year described her evolution as a teacher:

> …it took me a while to get to this idea of interactive learning. They took notes and I had them do presentations. Then I realized that as I was lecturing, because it was a lot of lecture, many of them….I come to find out…they were planning their weddings [on mywedding.com]! So, then I had to adapt…I've had to sort of figured out how do I really want to handle that particular situation (upper school faculty).

As this teacher discovered and many others referenced, students are experts at finding ways to use the technology for other things than learning. Several people mentioned how quickly in the beginning students were able to find ways to access the Internet outside of the school network via a neighbor's Wi-Fi. As teachers moved forward with the program, they learned that the secret to student distractions was to ensure that they were engaged.

Students, too, spoke to their evolutionary experience with technology. One middle school student who had been at the school since preschool addressed how they are introduced to the use of technology early in their education:

> I think part of the reason it's lasted so long….it's sort of incorporated from a very young age. So, it's not like you're just thrown into middle school and all of a sudden you have all this new stuff and you're sort of overwhelmed by it. They're very gradual with it.

The fact that there has always been something new to learn and the gradual manner in which the use of technology is integrated throughout the school may have been factors in the sustainability of the innovation.

Evolution of Goals. Several people spoke to the evolution of the goals that they had for learning with the one-to-one computing. Initially, the goal was to have them learn how to use the laptop, the Office suite, and email. As one adult shared, "So I think the goals changed along the way from just being, just having access right away, to actually being collaborative" (technology staff). The upper school librarian describe how resources and the process of finding information have evolved in the library:

> [Initially], the goal was how to use a database. It has migrated to how to find and use eBooks. It has grown from 'oh there's a few thousand websites out there that

> might be applicable, here's how you look at them' to 'oh there's a double-digit million websites out there that might be available, how do you determine which ones are good.

While the school remained focus on being more constructivist and progressive, and empowering and preparing young women for college and the work force, having students be able to do more with the technology. One teacher commented that the overall idea, using technology to enhance learning, has not changed. "People have changed, but I don't know that the main idea, I don't think I've felt that it's changed. I mean it's been grown in the kind of offerings and what they present to us, so it hasn't been stagnant..." (upper school faculty). As newer software developed some teachers became more adept at structuring their classes so that students were using the technology collaboratively and for project-based learning.

Evolution of the Use of Technology in Society. As computers and the Internet have become faster and more dependable, the use of technology in the daily lives of individuals has become more prevalent. A senior recognized that the program is in a constant state of flux:

> Even though computer, this program, exists for 20 years, it's also changing over the years. It's not only, it's not the same thing, how it is right now and how it is 20 years ago. It's totally different. There's changes…. It really depends on people's demand and people's demands change every time, so they're willing to change their system to make it better for the society. I think that is why it's always changing and always becoming better for life.

This student's comments suggest that the evolution of the use of technology in society could also have contributed to the school's continuation and growth of the program.

Conclusion of Findings

The words and experiences of administrators, faculty, students, and alumna of the one-to-one computing program over the past 20 years indicate that the program was an accelerator of educational change. Teaching and learning were impacted by the decision to become a one-to-one computing school. Several factors, including the culture of the school, support, the manner in which leadership is exercised, and the collaborative environment that exists were also influential in sustaining this educational reform over 20 years. Around the country, there have been examples of schools and school systems that have adopted some form of one-to-one computing, only to dispense with it within a few years. What allows one school community to embrace change with one-to-one computing over time, while other schools abandon initial programs? This study was conducted to provide some insight into this question. The next chapter discusses these factors, various forms of adoption, and what can be learned from this case study about embracing and sustaining change to enhance student learning over time.

Chapter 5: Discussion

This chapter provides an analysis of the findings of this case study of one school's experience of embracing and sustaining educational change. The study sought to provide insights about the adoption, implementation, and sustainability of one-to-one computing in a school community. The findings illustrated four reasons for the adoption of the program: creating a constructivist learning environment, empowering young women, preparing students for college and work, and maintaining a progressive educational program. The data suggested that there were some key factors that allowed for the adoption, implementation, and sustainability of one-to-one computing over time. These factors were a strong educational philosophy, the flexibility of implementation, a safe environment for risk-taking, leadership from various levels, professional and technology support, and relationships within and outside the school community that foster collegiality, collaboration, and ownership. Teaching and learning changed both incrementally and fundamentally. Some classrooms reflected incremental changes, changes to the current structures, while others reflected some fundamental changes to the fundamentals of learning and teaching (Cuban, 1993b, 2013a, 2018). Changes to teaching and learning might occurred on a continuum, from little or no change to highly visible fundamental change. A more accurate description of the change that occurred at Sophia Academy might be that there was movement, sometimes great, sometimes small, toward fundamental change.

Fullan's Educational Change Model (Fullan, 2001, 2007, 2016) provides two lenses through which to view educational change, *innovation* and *innovativeness.* This case study predominantly focused on the *innovativeness*, the individual and collective capacity of a school community to embrace and sustain change for school improvement (Fullan, 2001, 2007, 2016). However, in order to fully understand why faculty and students at Sophia Academy were able to

sustain one-to-one computing, the innovation must be considered. Thus, the first section below summarizes the findings on the innovation and the various ways in which it was adopted within the school. Consistent with the findings of the RAND Change Agent Study, one-to-one computing was adopted by teachers in a variety of ways, as well as not adopted by some (Berman & McLaughlin, 1976). Berman and McLaughlin suggests that educational innovations are typically adapted in some form by teachers to meet their needs. Several ways in which teachers adapted one-to-one computing are discussed in this chapter using the model suggested by Berman and McLauglin and further developed by others. The second section summarizes the findings on the innovativeness, the capacity of individuals, both individually and collectively, to embrace and sustain change over a period of time. The final section discusses the implications this case study may have on the study and practice of educational change.

Innovation and Change

One-to-one computing is a practice in which faculty and students have ubiquitous access to computing for the purpose of educational improvement. As was seen in this study, the success and the sustainability of the program are dependent upon the integration of technology into the way teachers teach and students learn. The RAND Change Agent Study found that "planned-change efforts, it seemed, needed to be sufficient in scope to challenge teachers and kindle interest, but not so ambitious that they required too much too soon from the implementing system" (McLaughlin, 1990, p. 12). Fullan (2013a) is in agreement when he suggests that for the integration of technology and pedagogy to be successful in educational reform, it must "be irresistibly engaging and elegantly efficient" (p. 33). He further states the integration must be "technologically ubiquitous and steeped in real-life problem solving" (p. 33). The sustainability

of an innovation not only depends upon the capacity of a group of people to embrace change, but also upon whether or not individuals find the innovation useful and applicable.

The manner in which an educational reform is adopted is a significant factor in the sustainability of that reform (McLaughlin, 1990). The following sections summarize the following aspects of this long-running reform: 1) the process by which adoption took place and, 2) its evolution and adaptation which included cooptation, lethal adaptation, and mutual adaptation and the resistance to change.

Adoption

The study revealed that there were several reasons for the adoption of one-to-one computing: aspirations for more constructivist learning, the empowerment of women, college and future preparedness, and being cutting-edge. As the technology director shared, administrators, faculty and others were exposed to the possibilities of the program through videos and through site visits. The current head of school believes that "a really enthusiastic group of educators and early adopters" found the program "interesting and the next thing we knew, it's a strong program." Based upon information provided, it is known that the majority of faculty was in support of adopting the program and there was minimal resistance from parents. Interviews also revealed that some faculty were quicker to move with implementation, and, in fact, there were some faculty who saw no reason for the program. For the early adopters, the innovation was "irresistibly engaging and elegantly efficient" (Fullan, 2013a) or at least sufficiently so to motivate them to explore using it.

These early adopters also took on the role of mentoring other faculty. They were seen as the "go-to" people for help, ideas, and encouragement. The fact that some of these early adopters are still in the school and are continuing to be leaders has helped to sustain the program.

The growing prevalence of technology in society and especially in the lives of young people, who have been exposed to technological devices and the Internet all of their lives has also pushed teachers to use the technology more in their classrooms. It might be said that the ongoing digital revolution in society helped focus faculty on the utility of one-to-one computing, giving the adoption process more support. A veteran middle school teacher reflected that she did not think that at the beginning, "it was utilized as much one-to-one as it is now. Now, it's [Tablet PC] an extension of the tool" (middle school faculty).

The fact that the technology has become more seamless to some faculty, that is, a tool used frequently for teaching and other tasks, can be attributed to a growing focus on the computer as a tool for learning and a diminishing focus on the need to be assured that the computer is used in every class. At the beginning, according to this middle school teacher, the computer and technology integration was "a lot more teacher-centered than student-centered….it was very foreign to us. It's great, but I know, at the beginning I did not utilize it nearly the way I should have" (middle school faculty). The comments of this teacher indicate that initially the innovation may not have been widely or thoroughly adopted due to a lack of knowledge and skill on the part of some faculty.

The recent adoption of OneNote Class Notebook illustrates how implementation of a program occurs at Sophia Academy. The technology department explored the program and realized that it could offer some new ways of collaboration between students and teachers. The technology staff and early adopters assumed the role of change agent, of bringing the innovation to others in some form. The staff offered and continues to offer in-service on the program, but many faculty have learned to use it through colleagues

who were early adopters. The process by which OneNote Class Notebook, and most of the technology use at Sophia Academy, has occurred through diffusion (Rogers, 2003). As individuals speak of the positive aspects of one-to-one computing and how they are using it in their classrooms, others become interested in the possibilities for teaching and learning. The innovation, almost without any coercion by change agents, diffuses itself into the school. This suggests that one method of sustaining an innovation may be to always seek out early adopters to model the innovation.

While one-to-one computing may have been "irresistibly engaging and elegantly efficient" (Fullan, 2013a) for both students and teachers, those attributes were not sufficient for the sustainability of the program, nor were they enough to truly make the program ubiquitous. A danger exists in thinking that giving students and teachers their own laptops or Tablet PCs is the ubiquitous use of technology. Doing so only makes the device ubiquitous. Proponents of one-to-one computing in schools sought to make the use of technology ubiquitous in the fabric of 21st century schooling (Papert, 1980, 1993). The achievement of this goal is dependent upon how the innovation is adapted over time, and the leeway given, in which adopters are free to determine the manner and timing of the implementation.

Adaptation

Observations and conversations with faculty indicated that the level of integration of technology varied among faculty. Consistent with earlier change studies, the variations of implementation existed across a broad spectrum from adoption to rejection, with most examples falling within these two boundaries. In addition to students taking notes with a Tablet PC instead of with pen and paper, some other adaptations that occurred were the

use of electronic resources for research, accessing a university library from school or home, and using video or PowerPoint, in addition to reports, as means of presenting work. Rogers (2003) noted that most adopters believe that re-invention or adaptation of an innovation is necessary for successful implementation. The RAND Change Agent Study found that in most successful adoption situations the innovation and its adopter and/or environment changed during implementation (Berman & McLaughlin, 1976; McLaughlin, 1990). Teachers tend to make changes to an innovation in an effort to allow the innovation to best meet their needs and the needs of their students. Adaptation seems to be a common characteristic to most educational reforms (Fullan, 2016; Berman & McLaughlin, 1976). The grammar of schooling fundamentally contributes to the phenomenon of adaptation due to the transitory nature of administrators, teachers, and students, as well as changes mandated by external entities, such as state departments of education. Additionally, "the local expertise, organizational routines, and resources available to support planned-change efforts generate fundamental differences in the ability of practitioners to plan, execute, or sustain an innovative effort" (McLaughlin, 1990, p. 13). The fact that no two schools are exactly the same, nor are the adopters the same from one year to next, makes adaptation an almost named prerequisite for the successful implementation of an educational reform. Hence, most administrators and teachers are very adept at adaptation, which may occur in a variety of ways, even within one school community.

Cooptation. *Cooptation* refers to the practice of modifying an innovation to conform to traditional practices of teaching either because of resistance to change or lack of skill on the part of implementers (McLaughlin, 1976). A relatively inexperienced teacher described how her

students only use their Tablet PCs in her class for writing essays and doing research. This limited use of the computer appeared to be the norm of this middle school teacher's classes. In essence, she was using the technology to have students complete the same cognitive tasks they would have without the technology. This is the essence of cooptation. At the beginning, this may have been due to resistance to change, but it is evident from this teacher's remarks, that the cooptation occurring in her classes is due more to her lack of skill at integrating technology into the curriculum. Her division head and the technology staff have obviously tried to encourage her to try new things. In describing a professional development experience, the teacher indicated that she had not availed herself of any of the opportunities offered on campus other than the one that was required to learn how to use the learning management system, nor had she attended any conferences or other workshops that addressed technology integration. The manner in which technology is being used by this teacher's students reflects that cooptation has occurred in some situations. This teacher further expressed concerns she had about every student having access to her notes, and then said "I push back a little bit against sort of streamlining the technology practice in the classroom" (middle school faculty). The latter statement seems to indicate that cooptation may be also be occurring due to resistance.

Lethal Adaptation. *Lethal adaptation* is a term used to describe an alteration to an innovation that undermines the expected benefits of the innovation (Beabout & Carr-Chellman, 2008; McLaughlin & Mitra, 2001). Considering the reasons for why one-to-one computing was implemented at Sophia Academy, some of the usages by faculty and students, especially in the early years of the program indicated that lethal adaptation occurred in some classrooms. A former middle school head spoke of how, in the beginning, some teachers used the computer and electronic white boards to simply

display a worksheet that they had been using for years. In her words, the devices became "a glorified overhead projector." This is an example of lethal adaptation because these teachers failed to incorporate the intended purpose of the combination of these devices, which is to allow students to interact with the projected material.

Teachers and graduates who were participants of the one-to-one computing program in its early years often spoke of using the laptop only for the purpose of taking notes. While current students may use their Tablet PCs for a variety of reasons, observations and interviews indicated that lecture is still a method used by some teachers sometimes. As the current head of school noted, "Oh yes, there are still those teachers that lecture. I believe that's just because they have not grown up with the computer and are still learning."

While many students and graduates spoke positively about being able to "get everything down" that the teacher was saying, being able to do so undermines students ability to discern the importance of what is being said by the teacher. This, too, indicates that lethal adaptation occurred in some situations. As the middle school head said, "It's still pretty easy to stand up in front of a classroom and lecture with kids with one-to-one computers." One veteran upper school teacher firmly believes that this form of teaching is his best method of conveying history, that story-telling and student discussions do not require a computer.

This same teacher also limits the use of computers in his classes because he feels that the Tablet PC is a distraction for many kids. He described how the really smart students "listen to me with one ear and follow along with the other," but he goes on to say, "But that's not normal. I really feel like other kids are shopping online. They're not

so excited" (upper school faculty). Later in our conversation, this teacher described how he employs flipping your class when he is preparing students for the research paper. He films himself explaining aspects of the research paper, like creating footnotes, so that students can review this lecture as often as they would like.

Some form of lethal adaptation may exist in some classes at some time. What is clear from interviews and observations is that the amount of lethal adaptation has significantly declined as teachers learned how to adapt the technology to serve them and their students. Also significant is that certain types of lethal adaptation have never become the institutionalized norm. While there are low-level technology users, there are also plenty of examples of highly-integrated technology use. While the innovation may be lethally adapted in that classroom to the point that it serves no educational benefit, a student can participate in a well-integrated project only an hour later. Thus, lethal adaptation may have occurred at the level of the classroom, but not at the level of the school.

Mutual Adaptation. *Mutual adaptation* refers to the process by which an innovation and its adopter and/or environment change during implementation (Beabout & Carr-Chellman, 2008; Berman & McLaughlin, 1976). From interviews and observations, it is evident that teachers' adoption of one-to-one computing over the past 20 years at Sophia Academy has reflected greater mutual adaptation over the course of time. According to many who have studied change, mutual adaptation or re-invention is what occurs in most successful adoptions of an innovation (Beabout & Carr-Chellman, 2008; Berman & McLaughlin, 1976; Fullan, 2007, 2016; Rogers, 2003).

As stated earlier, the manner in which the administration and technology staff allowed teachers to adopt the use of one-to-one computing allowed for this. Faculty were encouraged to use the technology, but initially, no specific mandate was given as to how and how much it had to be used. Division heads and technology staff trusted that with continual professional development, faculty would implement one-to-one computing and that early adopters would have an impact on more hesitant faculty. To some extent, this has been true. Based on interviews with some faculty, there is reason to believe that the current administration requires faculty to use the computer in some form.

Addressing Barriers to Change

Several researchers have addressed barriers to the use of technology in education and have offered suggestions as to how to overcome these barriers (Ertmer, P.A., 1999, Ertmer & Ottenbreit-Leftwich, 2010, Fullan, 2007, 2016). In his doctoral dissertation, Brickner (1995) extended the concepts of first- and second-order to change (Cuban, 1993b, 2008, 2013a, 2018) to describe the barriers to the use of technology integration in secondary math education. First-order change describes incremental changes or changes to current teaching practices, while second-order change refers to fundamental changes to the essence of teaching and learning. Fundamental change challenges the fundamental beliefs about teaching and learning (Cuban, 1993b, 2008, 2013a, 2018; Ertmer, 1999). First-order barriers to change are used to "the extrinsic and intrinsic factors that affect a teacher's innovation implementation efforts" (Brickner, 1995, p. xvii). Administrators, technology staff, and faculty at Sophia Academy encountered both first- and second-order barriers and implemented practices to address these barriers.

First-Order Barriers. Extrinsic barriers to change typically are associated with a lack of resources, physical and personal (Ertmer, 1999). Examples of first-order barriers include deficits

in materials, functioning equipment, knowledge and skills, support, and time. At the time that Sophia Academy considered adopting one-to-one computing, faculty realized that they could not implement this change without professional development and technological support. The administration and technology director addressed this concern through extensive professional development on the use of the computers and various software and a student-run help desk that was capable of maintaining the computers as well as offering technical assistance. Additionally, the school provided the time and the opportunity for faculty to attend conferences and to learn from each other about different software. Because Sophia Academy invested and continues to invest resources, both financial and personnel, into the one-to-one computing, first-order barriers have been minimized. Improvements to computer and other devices, Wi-Fi, and software have also contributed to reducing a lack of change due to first-order barriers. Addressing first-order barriers initially allowed for the implementation of one-to-one computing and minimized teacher resistance to change. This allowed the school to focus more on second-order barriers as the program evolved.

Second-Order Barriers. Second-order barriers typically impede movement towards fundamental changes in teaching and learning. Ertmer (1999) suggests that removing these barriers requires a shift in teacher beliefs about teaching and learning. These beliefs may encompass teacher understanding of traditional teaching practices including pedagogy, means of assessment, and the organization and management of the classroom (Ertmer, 1999). While the minimization of first-order barriers may have allowed the school to focus more on second-order barriers, it should be noted that this alone would not have produced movement towards fundamental change. Participant interviews revealed that during the 20 years of one-to-one computing at Sophia Academy, professional development has shifted from a focus on the use of

the device and software to a focus on changing traditional teaching practices. Additionally, the school hired an educational technology integrationist who works with teachers in small groups or one-on-one in how to implement teaching practices that are more constructivist. The shift in professional development and the work of the educational technology integrationist indicate that the school has made a commitment to working with teachers in changing their underlying beliefs and assumptions about teaching and learning.

Conclusion. The removal of first-order barriers occurs more easily and more quickly than the removal of second-order beliefs as extrinsic change is easier to accomplish than intrinsic change. Intrinsic change ultimately requires a change in culture (Fullan, 2007, 2016). Professional development that addresses both first- and second-order change helps to increase the self-efficacy of teachers (Ertmer & Ottenbreit-Leftwich, 2010) which has the potential decrease the fear of change; thus, allowing for greater experimentation and implementation among teachers. The culture of Sophia Academy, which encourages risk-taking, fosters greater self-efficacy on the part of faculty and students. This has contributed to sustainability of one-to-one computing and the capacity of teachers and students to embrace change.

Resistance to Change

While one-to-one computing has existed at Sophia Academy, there has been resistance to change, especially in the early years with teachers who were considering retirement. The resistance was handled in a variety of ways, encouragement, mentoring, and individuals departing. The administration has been more thoughtful as the program has grown to hire individuals who express comfort with technology and are willing to embrace the program. However, as was observed, how a teacher embraces the program varies from teacher to teacher.

Change does not occur quickly in schools. “Schools are very conservative places because they deal with children. Once they get something, if it’s working, they're not changing” (technology staff). Teachers who are comfortable, secure, and successful with what they are doing often resist change. Inertia can be from fear of the unknown, a sense of ineptness, lack of understanding, or comfortability with the status quo. The head of school reflected upon resistance to change in schools: “Invoking change, change no matter what the platform, be it technology, be it instruction, be it a mindset of innovation in any institution. Change is difficult and it takes time for it to occur.” She went on to explain that with time most people change, but that there are always individuals who will wait for the innovation to disappear.

Although the majority of faculty supported the move to one-to-one computing, there were faculty who resisted. The former head of school believed that the initial resistance to one-to-one computing was because of fear – not knowing how to use it and having to find ways to adapt. Ertmer and Ottenbreit-Leftwich (2010) noted that self-efficacy, confidence in being able to change and learn, is essential to teachers’ embracing an educational innovation. Another administrator viewed resistance as a good thing. She felt that people were not necessarily resisting out of unwillingness to adapt, but more because they wanted to be good teachers and were not initially comfortable with using the technology.

Two veteran upper school faculty recounted their experience of the resistance of some faculty twenty years ago, “…there were a few that just said 'we're not technology oriented’ or ‘you know we’re not that interested,’ said, ‘this is just new and it's too much for me to be there’.” A middle school faculty member spoke about the fact that “you can’t stay in education without

progressing with the time and still be effective." This faculty member believed that about 30% of the faculty resisted the move to one-to-one. She noted that they are not at the school anymore. Despite the resistance of some faculty, the program moved forward due to the persistence of some, such as the technology director, and to those, such as a former upper school head, who realized that technology was going to change the lives of students.

The level of resistance to one-to-one computing has decreased over time. On-going professional development, the influence of colleagues, purposeful hiring, changes to hardware and mutual adaptation have allowed one-to-one computing at Sophia Academy to evolve.

Co-evolution as a Factor in Sustainability

Fullan (2016) states "that it is very difficult to define once and for all exactly what the objective dimensions of change are with respect to materials, teaching approach, and beliefs, because they may get transformed, further developed, otherwise altered during implementation" (p. 30). Although schools are conservative places and difficult to change, change occurs daily in teachers' classrooms. Hopefully, children and teachers are engaged in a learning process that leaves neither unchanged. One should also assume that scaffolding is occurring in the lives of students, that is, each day they are building their understanding and knowledge based upon previous knowledge.

By its very nature, the innovation of one-to-one computing is an evolving entity. Developments in technology occur on such a rapid basis that it is almost too difficult to keep up with every change. The coupling of laptops or Tablet PCs with the process of learning for students and teachers creates an evolutionary system, one in which some form of change should be expected.

Innovativeness: Creating and Sustaining a Culture of Change

Educational Mission

Administration, faculty, students, and graduates rooted the discussion of one-to-one computing within the bigger picture of the mission of the school. They frequently spoke of how they saw this program as being aligned with one or more of the five tenets of the school's educational philosophy. The five tenets of the school's mission are the moral purpose (Fullan, 2001) of the school, and to this most are committed. Hargreaves and Shirley (2009) state that "A compelling and inclusive moral purpose steers a system, binds it together, and draws the best people to work in it" (p. 76). They further continue by saying all children need roots, something that "grounds them in their own traditions while opening their hearts and minds to other cultures around them" (p. 77). As individuals spoke of the school and its culture, they frequently referred to the tradition of education that has shaped and grounded them as educators within an international organization which has been in existence for over two centuries.

Many of the interviews, observations, and documents used in this study clearly point to an educational foundation that guides the school, unites generations of people, and attracts and maintains competent adults who are committed to the education of young women in the tradition of Sophia Academy. Having shared beliefs about the education of young women, a shared educational mission, helped to sustain one-to-one computing. Researchers have noted the importance of teachers' beliefs and attitudes to successful technology integration (Ertmer, 1999; Evans, 1996; Kim et al., 2012). Because many teachers saw the move to one-to-one computing as supporting the schools educational mission, as well as shared beliefs about the education of young women, they were able to implement and sustain the program. One of the ways that the school orients new faculty to the school's educational philosophy is through a summer workshop

held for all new faculty of sister schools in the United States. With the roots of a vibrant educational mission, the school was given the wings that it needed to launch one-to-one computing when few schools in the United States were doing so. In explaining the program to its constituents 20 years ago and today, its educational mission is the *raison d'etre* for the program.

The leadership of the school and the technology staff offered a vision of teaching and learning that would be impacted by the use of technology. They did not see this educational reform as a dichotomy, an either/or, but rather saw the educational change supported by one-to-one computing as a continuum, a process of growth for which there is no known end product. One-to-one computing was not something to implement once, it was something to sustain in a process of continual growth and change, an evolutionary process, as long as it remained a vehicle for achieving their shared educational philosophy.

Many researchers have written about the role of culture in educational reform (Fullan, 2001, 2007, 2016; Hargreaves, 1997; Hinde; 2004; Sarason, 1996). The school's mission formed the basis of the school culture, and it was within this culture, flexibility, risk-taking, and collegiality shaped the school culture and allowed one-to-one computing to be sustained for 20 years. Thomas and Brown (2011) offer a unique image of culture that is illustrative of what occurred at Sophia Academy. They make a distinction between two types of cultures. The first type of culture is "an existing entity that changes and evolves over long periods of time" (p. 36). When new people join this type of culture, they either adapt to its customs and conventions or they choose to leave (p. 36). The other type of culture is the type that one finds in a research or medical lab in which a bacteria or virus is placed in a Petri dish with agar and allowed to grow. As the culture grows, it becomes something new, it evolves as changes are introduced. "This emerging culture responds to its surroundings organically. It does not adapt. Rather, it *thrives* on

change, integrating it into its process as one of its environmental values" (p. 37). The agar, the school's educational philosophy, as well as other factors, such as flexibility, risk-taking, and collegiality, became a part of the school's culture prior to one-to-one computing. As one-to-one computing was introduced and sustained at Sophia Academy, a new culture of teaching and learning continued to emerge.

Flexibility

Before one-to-one computing was introduced at Sophia Academy, it appeared that flexibility, risk-taking, and collegiality were a part of the school culture. The fact that administrators were flexible, and continue to be with how the program was implemented and sustained, has encouraged its growth. Each faculty member has had the freedom to chart his or her own course of the integration of technology and pedagogy. The flexibility of implementation appears to have allowed mutual adaptation to occur in many teachers' classrooms (Berman & McLaughlin, 1976; Fullan, 2007, 2016) Faculty have been allowed to maintain control of the "black box" of their teaching, that is individual practices, beliefs, and traditions (Cuban, 2013a; McLaughlin, 1990) while being encouraged and nudged forward into the unknown by administrators, the technology department, and in some ways, students.

Risk-Taking

Risk-taking has not been a characteristic that typically portrays schools (Lichtman, 2014). Indeed, the system of measuring academic achievement by grades and standardized test scores is not a culture that sees failure as an opportunity to learn. While Sophia Academy remains traditional in its final assessment practices, it has made progress in encouraging both faculty and students to take risks. Although being able and encouraging others to take risks was likely a part of the culture of Sophia Academy prior to the one-to-one computing, the adoption of one-to-one

computing magnified risk-taking because in essence, faculty and students were asked to try to teach and learn in new ways. Faculty and students alike spoke of how wonderful it was to be encouraged to take a risk, even if they failed.

The modeling of risk-taking by administrators was considered essential to the implementation and continuation of the program. Individuals saw that the school's bold move to introduce one-to-one computing in 1997, when few schools had done so, was a risk. Many recognized that it could fail, but the majority of administrators, faculty, and staff did not want it to fail creating ownership for the success of the program. This attitude of risk-taking in an atmosphere where failure is accepted enhanced the willingness of individuals to admit that they might not have all of the answers and to seek out the help of colleagues. This was not a program that belonged to the administration or to the technology department, this was a program owned by all of the constituents of the school, including parents and students.

Community: Collegiality, Collaboration, and Ownership

A shared moral purpose, the school's educational mission fosters the building of community as a common value. Community creates collegiality, collaboration, and ownership and in turn, the exercising of these things builds community. Fullan (2016) notes that "educational change, above all, is a people-related phenomenon for each and every individual" (p. 138). The relational nature of education is fostered through the school's focus on the building of community. While teachers maintained control of their "black box," a term used by Cuban (2013a) to describe a teacher's domain, their educational practice was influenced by the interaction with colleagues and students. Diffusion of one-to-one computing occurred not simply because individuals could see the usefulness and efficiency of the device, but because of collegiality, collaboration, and ownership.

Collegiality. In launching and continuing the one-to-one program, the school benefitted from having a network of colleagues who shared a similar experience. The value of having relationships is only second to having shared educational vision (Fullan, 2001). As a former upper school head noted it was important to have "allies," people that she, the technology director, or others could consult when making a decision or planning for the future. Several member schools of the international organization of which Sophia Academy is also a member played a significant role in diffusion of one-to-one computing. Technology staff were able to participate in an on-going listserv where questions and solutions were shared by staff of sister schools. Annual meetings of staff and faculty from these schools also increased collegiality and contributed to the overall success of one-to-one computing in a number of schools. While these types of meetings were new to technology staff, they were not new entities for administrators and faculty. The organization had had numerous meetings that gathered various administrators, faculty, and board members. Making site visits of three of the pioneer schools provided data on what had worked and what had failed in these schools during the first year of their programs. As the technology director pointed out, their program did not fail because they had so much good and relevant advice from the pioneer schools. As the program has grown, Sophia Academy has become a resource of information for many other schools embarking on one-to-one computing.

Another form or source of collegiality that Sophia Academy has developed is a network of outside resources, including engineers and research scientists. Participation in local, state, and national competitions (e.g. FIRST Robotics) has also created collegial relationships with students and faculty in other schools. The long relationship that the school has had with the library at a local university provides students and faculty with many more resources than those available on the campus. Administrators and faculty recently visited this university's engineering program to

see what research and design projects undergraduates were conducting and to find out more about how this program fosters innovation (technology director).

The collegial relationships that existed prior to the implementation of one-to-one computing, such as sister schools that were also implementing the program, provided a level of support and a place to consult as Sophia Academy ventured into this uncharted territory. The school also had established a significant number of relationships with universities and organizations within their local community that provided resources and access to experts for some of the projects initiated through one-to-one computing.

While these pre-existing external supports were beneficial to the sustainability of the program, the collaborative culture that emerged at Sophia Academy due to the one-to-one computing was equally important. Because the one-to-one computing was new for everyone, it required that individuals learn from each other, which supported the development of a collaborative culture that was essential to the sustainability of the program.

Collaboration. Much has been written about the importance of collaborative cultures in today's schools. Fullan, Quinn, and McEachen (2018) state that:

> Of all the conditions that fuel deep learning, collaboration is at the heart of them….If teachers are to make a rapid shift to using new pedagogies, they need support from working with others to identify effective practices in their repertoire and to push new thinking and innovative practices (p. 97).

Collaboration is encouraged and valued at Sophia Academy. Faculty spoke of learning something new from another faculty member or from students. New faculty are provided a mentor for learning fundamentals of the one-to-one program, but often these mentorships lead to collaborative relationships and projects. Veteran faculty have shared their knowledge and

experience of integrating technology and pedagogy with other faculty. Students and faculty spoke of working together and with outside experts on projects. The implementation of one-to-one computing has allowed greater online collaboration between students, faculty and students, and students and experts. A focus on project-based learning has also furthered the collaborative environment of Sophia Academy. In listening to individuals describe their experiences of one-to-one computing, it was obvious that a collaborative culture has helped to diffuse and grow the program.

Ownership. A sense of belonging to a community helps to create ownership, which has been essential in driving the one-to-one program forward. The importance of the five tenets in the minds of those interviewed is indicative of the level of ownership each has for the mission of the school. One upper school faculty member spoke about students being invested, that they know that when something is wrong, the ownership is on them to fix it. As she insinuated, "that's just how things are." Gruenert and Whitaker (2015) distinguish between culture and climate. Culture is the personality of a school, while climate is its attitude. They go on to say that culture will always support "the way we do things around here" (p. 104). The sense of investment that this faculty member describes has been nurtured by a culture that fosters ownership (Wheatley, 2006). Conversations with students and graduates indicated that these young people recognize their responsibility in their own learning. They also recognized that they had a role in the shaping one-to-one computing.

As the technology director indicated, the establishment of the CAVE, the student help desk, was a win-win situation. The school was able to service the computers and solve issues for participants more quickly than a vendor, and student interns gained invaluable knowledge. While

staff members supervise the interns, it was evident that the student interns take ownership for the CAVE.

The consultative behavior of the technology department when decisions are to be made about new devices and new programs encourages ownership for the program by faculty and students. Faculty and students took pride in describing how these decisions are made and how they sometimes make recommendations to software and hardware companies.

The school's mission stresses the importance of community, and in turn, this emphasis creates and is sustained by collegiality, collaboration, and ownership. This is particularly important, for as Fullan (2016) comments, it is "only when schooling operates in a way that connects students relationally in a relevant, engaging, and worthwhile experience that substantial learning will occur" (p. 139). What this study revealed was that the students were not the only ones learning, so were the faculty, staff, and administration, and one-to-one computing was an accelerator in this collective learning process.

Leadership

Fullan (2016) stresses the importance of leadership at various levels. The leadership of the technology director and her team was considered to be a prime driver in the implementation and sustainability of the one-to-one program. What was evident from interviews and documents (e.g. self-studies) it was most important that someone was leading with a vision. Gruenert and Whitaker (2015) state that "a vision of the future is not simply a generic statement of positivity – it reflects a capacity to imagine a new reality and to understand all the components necessary to achieve and maintain it" (p. 49). The on-going envisioning and leadership of the technology department has been essential in sustaining the one-to-one computing program. As a faculty member mentioned these people come to the faculty with ideas and suggest that they try it. They

also welcome ideas from faculty and students and then determine how and what is needed to implement those ideas. Their leadership has been a powerful force in the sustainability of the one-to-one computing program.

As stated earlier, the manner in which decisions are made about the program has also been a factor in the sustainability of the program. “Both leadership and innovation are vastly more effective and rapid in distributed, not hierarchical organizations” (Lichtman, 2014). Not only has the process of decision making created ownership, it has also created a sense of shared leadership or distributed leadership among administrators, faculty, and students.

While shared or distributed leadership prevailed in the execution of the one-to-one program, a hierarchical structure similar to most schools still exists. The technology director as well as faculty recognized that the program would not have moved forward, nor would it have continued, without the support of the board of trustees and the head of school. It is significant that the program had the same head of school for the first 15 years of the program, and the same upper school head, as a faculty member for a year and then as division head for 15 years. This continuity will be discussed further in the section on the implications for the study and practice of educational change.

Support

While the support of the board and administration were essential for starting and continuing the program, other more concrete forms of support were needed if the program was to achieve some of the goals that were mentioned as reasons for implementing the program. Educational and technical support were instrumental in the evolution of one-to-one computing at Sophia Academy.

Prior to the implementation of the program, faculty expressed the need for a help desk and training. The help desk was necessary because it would eliminate the frequency and amount of time that faculty and students might be without a laptop due to hardware and software issues. In addition, the help desk would set up loaner laptops or Tablet PCs for individuals whose device needed to be sent off for repair. Everyone realized that the help desk would minimize disruption to the program.

The other need expressed by the faculty was training. The technology department recognized that this training needed to be more than orientation to how to use the device, but needed to be on-going and provide means for faculty to move towards more constructivist learning. Through the course of 20 years, professional development has occurred frequently either through conferences where faculty and staff gleaned ideas from presenters and other schools, or in-services on campus that had an outside presenter or were conducted by the technology department or faculty who had explored something new. Two years ago, the school hired an educational technologist whose sole purpose is to work with faculty in integrating technology and pedagogy. As many on the technology committee expressed, the hiring of this person was long awaited and the lunch time in-services that she has conducted and the work she has done with individual teachers has pushed the program further towards project-based learning, guided inquiry and modeling, forms of constructivist learning.

Another form of support has come through the technology committee which is composed of technology staff and librarians from across the school, including the lower school. Not only do these people meet regularly to discuss what is needed and how they continue to push the program forward, but they are all at the service of faculty and students in an effort to make one-to-one computing as seamless as possible.

Implications for Practice: Building the Capacity for Educational Change

While this study focused on what allowed a school community to implement and sustain change through one-to-one computing over a period of time, there are some findings which are applicable to educational practitioners and leaders as they contemplate educational change in their institutions. What follows are the broad generalizations gleaned from this study that may be of benefit to other school communities as they attempt to implement and sustain change for more than a few years.

Culture First, then Change

Every organization has some form of culture. Fullan (2001) suggests that the type of culture that is needed is a culture of change, one that is constantly evolving in order to better achieve its moral purpose. Without such a culture, the work of the members of the organization and its leaders is about re-culturing, moving the organization beyond 'this is the way it has always been done' to 'what do we need to do to better achieve our moral purpose?'

Having a strong educational mission, a moral purpose, creates a *raison d'etre* for change. Without a clear sense of mission, "organizations get tossed and turned by shifts in their environment" (Wheatley, 2006, p. 39). If the individuals within an organization believe that the changes that are proposed will help to achieve the goal(s) of their mission, they are more likely to embrace change. Sophia Academy has a clear moral purpose that is stated in the five tenets of its educational philosophy. Administrators, faculty, and students articulated how they saw the move to one-to-on computing as being aligned with the school's educational philosophy and history. People spoke of how decisions and everything done at the school was done with these tenets in mind. What this case study revealed was that educational change may be more likely to

occur and be sustained if the members of a school or organization are able to articulate the change's congruence with the mission or moral purpose of the school or organization.

It can be argued that it is necessary to have a strong culture prior to implementing change, that leaders and others should begin to develop such a culture in the absence of one prior to suggesting a major shift in the manner in which teachers teach and students learn. This study revealed several characteristics of a school community that can help to develop a culture open to change. Being flexible about how change occurs and the timeline for change, providing a safe environment for risk-taking, encouraging risk-taking, allowing failure to be a form of learning, and collegiality that supports collaboration can help to foster change within an institution. Change will more likely occur in a culture characterized by these attributes.

A collaborative environment in which faculty and students share ideas and in which the majority of people feel ownership for leadership and the educational reform will more than likely encourage and sustain change among the organization's members. Collaborative cultures "provide the mutual learning and moral support that stimulate teachers and sustain them through the difficulties of change" (Hargreaves & Shirley, 2009, p. 92). Teachers continue to guide what occurs in their classrooms, but with informal and formal input from colleagues and students. Change is more likely to be sustained in a culture in which silos are not the prominent form of dwelling.

Identify Change Agents and Find Leadership

Fullan (2007, 2016) recognizes that there are many agents of change within a school, the principal, faculty, students, parents, and the community beyond the school. The ownership for leadership and the one-to-one computing program was assumed by many people, administrators, technology staff, faculty, students, and board. As indicated by the technology director, no one

wanted it to fail. Sufficient buy-in by numerous constituents was essential. While it can be argued that the technology director played a primary role in the change efforts that occurred at Sophia Academy, there were others "who were also leading the charge." This sense of shared leadership meant that no one person owned the success or failure of the educational reform, that the majority of constituents shared in the efforts to change teaching and learning through the integration of technology and pedagogy.

At the time of implementation, the administration exercised leadership through delegation and support. This form of leadership has continued to some extent with changes in leadership of the head of school and middle managers. Continuity has been provided by the technology director and some key faculty. While some administrators have seen their role as that of nudging people forward, "believing the only way to motivate others was pushing and prodding them into action, overcoming their entropy by the sheer force of their own energy," (Wheatley, 2006, p. 77), others have recognized the evolutionary nature of change. In recent years, the study of leadership has focused more on its relational aspects and "the complexity of relationships that contribute to a leader's effectiveness" (Wheatley, 2006, p. 13). School leaders that ensure opportunities for shared expertise are more likely to see positive educational change occur within their schools (Fullan, 2001). Early adopters at Sophia Academy were encouraged to formally and informally share their knowledge and skills with colleagues. Wheatley (2006) notes that it is more important to foster relationships than it is to impart information and skills. At every level, individuals spoke of mutual learning. Such mutual learning can only occur in relational environments characterized by trust and mutual respect. Whether intentionally or not, the relationships at Sophia Academy nurtured the growth and development of one-to-one computing.

As Berman and McLaughlin (1976) found in their RAND Study, the most successful educational reforms are those in which both the innovation and those implementing it have been allowed to mutually adapt for educational improvement. This study of educational change due to one-to-one computing demonstrates the same finding. In the classrooms in which the most constructivist learning seemed to be occurring, teachers had adapted the innovation and their style of teaching to best meet the needs of their students. As was mentioned earlier, forms of cooptation and lethal adaptation were also observed, leaving one to suggest that future growth and sustainability might be hindered by these forms of adaptation. For this reason, efforts of changing how teachers teach in a one-to-one computing program or any other educational reform need to be sustained and further developed through professional development activities. Schools, hoping to sustain change, may also need to be more purposeful in creating collaborative environments; that is, not leaving collaboration completely up to teachers. Mentoring and professional learning communities across disciplines and the schools are two means that might support greater collaboration among faculty.

While the school was intentional in its decision to implement one-to-one computing, it is unknown if the behaviors of administrators and the technology director were completely intentional. What was observed and learned through interviews was that these individuals were more encouraging than dictating. The behavior of administrators and the technology staff allowed the innovation to diffuse in an evolutionary environment. Their behavior allowed a natural progression of the innovation into the teaching and learning at Sophia Academy. The fact that mutual adaptation was the predominant manner in which the innovation was implemented and sustained also supports the nature of an evolutionary environment. While the innovation evolved, so did all of the participants in the program. This study provides an example of

organizational behavior that supports morphism rather than coercion. The skills, knowledge and support needed for sustaining one-to-one computing were provided on a regular basis in an effort to keep the environment supportive of the life and growth of the innovation. While a strong educational mission may ensure that this environment continues to be life-giving for one-to-one computing, for constructivist learning, for continual educational change for improvement, other factors could prove to be destructive forces. One such factor is the continuity of the technology director and several key faculty.

This study presents the question of the importance of continuity. What role did the continuity of the technology director and key faculty, as well as the longevity of the head of school and the upper school head in the first 15 years of the program play in sustaining one-to-one computing over a long period of time? While it was noted by the technology director that the school now has two division heads who push for change and experimentation in their respective divisions, it is difficult to determine what effect the retirement of the technology director and/or key faculty members will have on the program. The division heads spoke of being purposeful in their hiring of new faculty with a focus on the potential of new faculty to integrate technology and pedagogy; however, the researcher found with several newer faculty either very limited use of technology or skepticism regarding the impact that such integration can have on learning. Without a purposeful, inclusive focus that encourages ownership at all levels, any educational change is subject to a loss of momentum over time. Hence, if this educational reform is to continue to evolve over time, those most responsible for it will need to continue to develop the capacity of all constituents for change through leadership, support and resources so that the students of Sophia Academy are prepared as empowered young women for future study and the 21st century work force. However, given the world today and the students' very natural use of

technology, perhaps going forward, students will almost force the on-going development of this educational change, pressing teachers and their classmates to continue to grow.

Suggestions for Future Research

Future research might include a follow-up study of the site after the current leadership has been in place for 10 or more years and/or after the technology director and some other key faculty have retired. Such a study could provide insight as to whether or not, the level of educational change would have occurred with different change agents. Clearly, because of the limitations of case study research, a study of a larger public school which has sustained one-to-one computing or some other educational reform for a significant amount of time could produce new and valid insights, especially on the development of shared beliefs and school culture. Additionally, a comparative case study of the other sister schools that began one-to-one computing at the same time as Sophia Academy might illustrate striking differences regarding how the educational reform was instituted and sustained. In a similar manner, a study of a school that has more recently implemented one-to-one computing might illustrate some differences, but could also provide information regarding how the school was able to move one-to-one computing forward in a small amount of time, and even more interesting would be the insights gained about the school culture that led the school to wait a number of years before implementing one-to-one computing.

Conclusion

In any study, it is imperative to remember that schools are dynamic institutions, constantly subjected to the forces of change. At the same time they can be resistant to change. In this situation, the diffusion of the innovation, one-to-one computing was more organic and evolutionary than most changes introduced into schools. For this reason, the image of the culture

within the Petri dish, suggested by Thomas and Brown (2011), and further elaborated upon in this study, is a good image for educational change. A moral purpose, educational philosophy, is the agar in which the culture grows and changes based upon added catalysts, such as the attributes of flexibility, risk-taking, and collegiality. It was into this culture that one-to-one computing was introduced and sustained, eventually, becoming part of an ever evolving school culture. The value of a study, such as this one, is that it illustrates that some educational changes need time to evolve, and unfortunately, because of the need for immediate results, schools and educators are not always willing to allow a reform the time needed for change.

References

Abell Foundation. (2008). One-to-one computing in public schools: Lessons from "laptops for all" programs. Baltimore, MD: Author. Retrieved from http://www.abell.org/sites/default/files/publications/ed_onetoone_908.pdf

Allen, L.E, Franceschini, L. & Lowther, D. (2010). The role of school leadership in a large-scale student laptop implementation. *Proceedings of Informing Science & IT Education Conference (InSITE) 2010. pp. 631-644. Retrieved from http://proceedings.informingscience.org/InSITE2010/InSITE10p631-645Allen872.pdf*

Anyon, J. (1995). Race, social class, and educational reform in an inner-city school. *Teachers College Record 97*(1). doi: 0161-4681-95/9701/069$1.50/0

Beabout, B., & Carr-Chellman, A. A. (2008). Change agentry. *Handbook of research on educational communications and technology*, 619-632. Retrieved from http://www.aect.org/edtech/edition3/ER5849x_C046.fm.pdf

Bebell, D. (2005). *Technology promoting student excellence: An investigation of the first year of 1:1 computing in New Hampshire middle schools.* Boston, MA: Technology and Assessment Study Collaborative. Retrieved from www.intasc.org.

Bebell, D. & Kay, R. (2010). One to one computing: A summary of the quantitative results from the Berkshire Wireless Learning Initiative. *The Journal of Technology, Learning, and Assess*ment 9*(2). Retrieved from www.ejournals.bc.edu.

Bebell, D. & O'Dwyer, L.M. (2010). Educational outcomes and research from 1:1 Computing settings. *The Journal of Technology, Learning, and Assessment, 9*(1), 1-15. Retrieved from http://www.jtla.org

Berliner, D. C., & Biddle, B. J. (1995). *The manufactured crisis: Myth, fraud, and the attack on America's public schools*. Longman Publishers, USA.

Berman, P. (1977). Federal programs supporting educational change, Vol. VII: Factors affecting implementation and continuation. Santa Monica, CA: Rand. Retrieved from https://files.eric.ed.gov/fulltext/ED140432.pdf

Berman, P., & McLaughlin, M. W. (1973). Implementing innovations: Revisions for an agenda for a study of change agent programs in education. Study of Change Agent Programs: A Working Note. Santa Monica, CA: Rand. Retrieved from http://files.eric.ed.gov/fulltext/ED352720.pdf

Berman, P. & McLaughlin, M.W. (1976). Implementation of educational innovation. *The Educational Forum 40*(3), 345-370. doi: 10.1080/00131727609336469

Berman, P., & McLaughlin, M. W. (1978a). Federal programs supporting educational change, Vol. VIII: Implementing and sustaining innovations. Santa Monica, CA: Rand. Retrieved from http://www.rand.org/content/dam/rand/pubs/reports/2006/R1589.8.pdf

Berman, P., & McLaughlin, M. (1978b). Rethinking the Federal Role in Education. Santa Monica, CA: Rand. Retrieved from http://files.eric.ed.gov/fulltext/ED162421.pdf

Brickner, D.L. (1995). *The effects of first and second order barriers to change on the degree and nature of computer usage of secondary mathematics teachers: A case study* (Doctoral dissertation). Retrieved from https://media.proquest.com/media/pq/classic/doc/740913081/fmt/ai/rep/SPDF?_s=l0TcU8LS%2BPTjiNqgogNyAvocHWQ%3D

Brooks, J.G. & Brooks, M.G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: ASCD.

Cavanaugh, C., Dawson, K., & Ritzhaupt, A. (2011). An evaluation of the conditions, processes, and consequences of laptop computing in K-12 classrooms. *Journal of Educational Computing Research*, *45*(3), 359-378. doi: http://dx.doi.org/10.2190/EC.45.3.f

Charles, C.M. & Mertler, C.A. (2002). *Introduction to educational research* (4th ed). Boston: Ally and Bacon.

Christensen, C.M. (1997). *The innovator's dilemma: The revolutionary book that will change the way you do business*. Cambridge, MA: Harvard Business School Press.

Christensen, C. M., & Eyring, H. J. (2011). *The innovative university: Changing the DNA of higher education from the inside out*. New York: John Wiley & Sons.

Christensen, C.M., Horn, M.B., & Johnson, C.W. (2011). *Disrupting class: How disruptive innovation will change the way the world learns* (2nd ed). New York: McGraw Hill.

Collins, A., Morrison, D., & Newman, D. (1994). Putting technology to work for school reform. In C.M. Reigeluth & R.J. Garfinkle (Eds.), *Systemic change in education* (pp. 71-82). Englewood Cliffs, NJ: Educational Technology Publications.

Corn, J.O., Tagsold, J.T., & Patel, R.K. (2011). The tech-savvy teacher: Instruction in a 1:1 Learning Environment. *Journal of Educational Research & Practice 1*(1), 1-22.

Couros, G. (2015). *The Innovator's Mindset: Empower Learning, Unleash Talent, and Lead a Culture of Creativity*. Dave Burgess Consulting, Incorporated.

Creswell, J.W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative Research.* Upper Saddle River, NJ: Merrill Prentice-Hall.

Creswell, J.W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Los Angeles: Sage.

Creswell, J.W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative Research* (5th ed.). Upper Saddle River, NJ: Merrill Prentice-Hall.

Crook, S.J., Sharma, M.D. & Wilson, R. (2015). An evaluation of the impact of 1:1 laptops on student attainment in senior high school sciences. *International Journal of Science Education, 37*(2), 272-293. doi: 10.1080/09500693.2014.982229

Cuban, L. (1986). *Teachers and machines: The Classroom use of technology since 1920.* New York: Teachers College Press.

Cuban, L. (1993a). Computers meet classroom: Classroom wins. *Teachers College Record*, *95*(2), 185. Retrieved from http://www.tcrecord.org/content.asp?contentid=82

Cuban, L. (1993b). *How teachers taught: Constancy and change in American classrooms 1880-1990* (2nd ed.). New York: Teachers College Press.

Cuban, L. (1998). How schools change reforms: Redefining reform success and failure. *Teachers College Record 99*(3), 453-477. doi: 0161-4681-98/9903/453$1.50/0

Cuban, L. (2001). *Oversold & underused*. Cambridge, MA: Harvard University Press.

Cuban, L. (2007). Hugging the middle: Teaching in an era of testing and accountability, 1980-2005. *Education Policy Analysis Archives, 15*(1). Retrieved from http://files.eric.ed.gov/fulltext/EJ800818.pdf

Cuban, L. (2008). *Frogs into princes: Writings on school reform.* New York: Teachers College Press.

Cuban, L. (2009a). *Hugging the middle: How teachers teach in an era of testing and accountability.* New York: Teachers College Press.

Cuban, L. (2009b). *The blackboard and the bottom line.* Cambridge, MA: Harvard University Press.

Cuban, L. (2013a). *Inside the black box: Change without reform in American education.* Cambridge, MA: Harvard Education Press.

Cuban, L. (2013b). Why so many structural changes in schools and so little reform in teaching practice. Journal of Educational Administration 51(2). 109-125. doi: 10.1108/09578231311304661

Cuban, L. (2018). *The flight of a butterfly or the path of a bullet? Using technology to transform teaching and learning.* Cambridge, MA: Harvard Education Press.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal 38*(4), 813-834. doi: 10.3102/00028312038004813

Culp, K.M., Honey, M. & Mandinach, E. (2005). A retrospective on twenty years of educational technology policy. *Journal of Educational Computing Research, 32*(3), 279-307.

David, J. L. (1994). Realizing the promise of technology: The need for systemic education reform. *Systemic reform: Perspectives on personalizing education*, 137-154. Retrieved from http://files.eric.ed.gov/fulltext/ED376557.pdf#page=139

David, J. & Cuban, L. (2010). Cutting through the hype: The essential guide to school reform. Cambridge, MA: Harvard Education Press.

Dawson, K., Cavanaugh, C, & Ritzhaupt, A.D. (2008). Florida's EETT leveraging laptops initiative and its impact on teaching practices. *Journal of Research on Technology in Education 41*(2), 143-159. Retrieved from http://files.eric.ed.gov/fulltext/EJ826090.pdf

Dawson, C. & Rakes, G.C. (2003). The influence of principals' technology training on the integration of technology into schools. *Journal of Research on Technology in Education 36*(1), 29-49.

Dede, C. (2010). Comparing Frameworks for 21st Century Skills. In J. Bellanca and R. Brandt's *21st Century Skills.* Bloomington, IN: Solution Tree Press.

Dede, C., Honan, J. P., & Peters, L. C. (2005). *Scaling up success: Lessons learned from technology-based educational improvement*. Indianapolis, IN: Jossey-Bass.

DiMaggio, P.J. & Powell, W.W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*(2), 147-160.

Dixon, B. & Einhorn, S. (2014). A policy agenda for 21st-century education. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2460703

Dixon, B. & Einhorn, S. (2016). *#Anytime anywhere learners: A blueprint for transforming where, when, and how young people learn.* Anytime Anywhere Learning Foundation.

Donovan, L. & Green, T. (2010). One-to-one computing in teacher education: Faculty concerns and implications for teacher educators. *Journal of Digital Learning in Teacher Education, 26*(4), 140-148.

Donvan, L., Hartley, K., & Strudler, N. (2007). Teacher concerns during initial implementation of a one-to-one laptop initiative at the middle school level. *Journal of Research on Technology in Education, 39*(3), 263-286.

Downes, J.M. & Bishop, P.A. (2015). The intersection between 1:1 laptop implementation and the characteristics of effective middle level schools. *Research in Middle Level Education Online, 38*(7), 1-16. Retrieved from http://files.eric.ed.gov/fulltext/EJ1059737.pdf

Drayton, B., Falk, J.K., Stroud, R., Hobbs, K., Hammerman, J. (2010). After installation: Ubiquitous computing and high school science in three experienced, high-technology schools. *The Journal of Technology, Learning, and Assessment, 9*(3), 5-56. Retrieved from www.ejournals.bc.edu

Dunleavy, M., Dexter, S. & Heinecke, W.F. (2007). What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning? *Journal of Computer Assisted Learning, 23*(5), 440-452. doi: 10.1111/j.1365-2729.2007.00227.x

Ellsworth, J. B. (2000). *Surviving Change: A Survey of Educational Change Models*. Syracuse, NY: ERIC Clearinghouse on Information & Technology.

Elmore, R.F. (2004). *School reform from the inside out: Policy, practice, and performance.* Cambridge, MA: Harvard Education Press.

Elmore, R.F. & Burney, D. (1997). *Investing in teacher learning: Staff development and instructional improvement in Community School District #2, New York City*. National Commission on Teaching & America's Future, Box 117, Teachers College, Columbia University, New York, NY 10027

Ely, D.P. (1990). Conditions that facilitate the implementation of educational technology innovations. *Journal of Research on Computing in Education, 23*(2), 293-305. doi: 10.180/08886504.1990.10781963

Ertmer, P. A. (1999). Addressing first-and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, *47*(4), 47-61.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration?. *Educational technology research and development*, *53*(4), 25-39. Retrieved from http://galleries.lakeheadu.ca/uploads/4/0/5/9/4059357/pedagogical_beliefs_psts_technology.pdf

Ertmer, P.A. & Ottenbreit-Leftwich, A. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255-284.

Ertmer, P.A. & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education 64*, 175-182. doi: 10.1016/j.compedu2012.10.008

Evans, R. (1996). *The Human Side of School Change*. San Francisco: Jossey-Bass.

Finnan, C. (2000). *Implementing School Reform Models: Why Is It So Hard for Some Schools and Easy for Others?* Paper presented at the meeting of the American Educational Research Association, New Orleans. Retrieved from iles.eric.ed.gov/fulltext/ED446356.pdf

Fishman, B., Marx, R. W., Blumenfeld, P., Krajcik, J., & Soloway, E. (2004). Creating a framework for research on systemic technology innovations. *The Journal of the Learning Sciences*, *13*(1), 43-76.

Fosnot, C.T. (1989). *Enquiring teachers, enquiring learners: A constructivist approach for teaching.* New York: Teachers College Press.

Fosnot, C.T. (1993). Preface. In J.G. Brooks & M.G. Brooks, *In search of understanding:The case for constructivist classrooms* (pp. vii-viii). Alexandria, VA: ASCD.

Frank, K.A., Zhao, Y., Penuel, W.R., Ellefson, N., & Porter, S. (2011). Focus, fiddle, and friends; Experiences that transform knowledge for the implementation of innovations. *Sociology of Education, 84*(2), 137-156.

Fullan, M. (1993). *Change forces: Probing the depths of educational reform.* London, England: Falmer Press.

Fullan, M. (1999). *Change forces: The sequel.* London, England: Falmer Press.

Fullan, M. (2001). *Leading in a culture of change.* San Francisco, CA: Jossey-Bass.

Fullan, M. (2005). *Leadership & sustainability: System thinkers in action*. Thousand Oaks, CA: Corwin Press.

Fullan, M. (2007). *The new meaning of educational change* (3rd ed.). New York: Teachers College Press.

Fullan, M. (2013a). *Stratosphere: Integrating technology, pedagogy, and change knowledge.* Don Mills, ON: Pearson Canada, Inc.

Fullan, M. (2013b). The new pedagogy: Students and teachers as learning partners. *LEARNING Landscapes 6*(2), 23-29.

Fullan, M. (2013c). Great to excellent: Launching the next stage of Ontario's education agenda. Retrieved from https://www.edu.gov.on.ca/eng/document/reports/FullanReport_EN_07.pdf

Fullan, M. (2016). *The new meaning of educational change* (5th ed.). New York: Teachers College Press.

Fullan, M. & Langworthy, M. (2014). *A rich seam: How new pedagogies find deep meaning.* London: Pearson.

Fullan, M., Quinn, J. & McEachen, J. (2018). *Deep learning: Engage the world change the world.* Thousand Oaks, CA: Corwin.

Gay, L.R. & Airasian, P. (2003). *Educational research: Competencies for analysis and applications* (7th ed). Upper Saddle River, NJ: Pearson Education, Inc.

Greaves, T. W., & Hayes, J. (2008). *America's digital schools 2008: The six trends to watch*. The Greaves Group.

Greaves, T.W., Hayes, J., Wilson, L., Gielniak, M., & Peterson, E.L. (2012). *Revolutionizing education through technology: The project RED roadmap for Transformation.* Eugene, OR: ISTE.

Gredler, M.E. (2005). *Learning and instruction: Theory into Practice.* Upper Saddle River, NJ: Pearson.

Grimes, D. & Warschauer, M. (2008). Learning with laptops: A multi-method case study. *Journal of Educational Computing Research, 38*(3), 305-332.

Gruenert, S. & Whitaker, T. (2015). *School culture rewired: How to define, assess, and transform it.* Alexandria, VA: ASCD.

Gulek, J. C. & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *The Journal of Technology, Learning, and Assessment, 3*(2), 1-28. Retrieved from www.ejournals.bc.edu.

Guthrie, J. W., & Springer, M. G. (2004). A *Nation at Risk* revisited: Did "wrong" reasoning result in "right" results? At what cost?. *Peabody Journal of Education*, *79*(1), 7-35.

Hall, G.E. & Hord, S.M. (2015). *Implementing change: Patterns, principles, and potholes* (4th ed). Boston, MA: Pearson.

Hargreaves, A. (1997). Cultures of teaching and educational change. In M. Fullan (Ed.), *The challenge of school change: A collection of articles* (pp. 57-84). Arlington Heights, IL: Skylight Training and Publishing, Inc.

Hargreaves, A. (2003). *Teaching in the knowledge society: Education in the age of insecurity.* New York: Teachers College Press.

Hargreaves, A., & Fink, D. (2000). The Three Dimensions of Reform. *Educational leadership*, *57*(7), 30-33.

Hargreaves, A. & Fink, D. (2005). *Sustainable leadership.* San Francisco, CA: Jossey-Bass.

Hargreaves, A. & Fullan, M. (2012). *Professional capital: Transforming teaching in every school.* New York: Teachers College Press.

Hargreaves, A. & Goodson, I. (2006). Educational change over time? The sustainability and nonsustainability of three decades of secondary school change and continuity. *Educational Administration Quarterly 42*(1), 3-41. doi: 10.1177/0013161X05277975

Hargreaves, A. & Shirley, D. (2009). *The fourth way: The inspiring future for educational change.* Thousand Oaks, CA: Corwin.

Harris, A. (2001). Building the capacity for school improvement. *School Leadership & Management*, *21*(3), 261-270. Retrieved from http://files.eric.ed.gov/fulltext/ED466034.pdf

Harris, A. (2011). System improvement through collective capacity building. *Journal of Educational Administration*, *49*(6), 624-636. doi: 10.1108/09578231111174785

Havelock, R.G., & Zlotolow, S. (1995). *The change agent's guide*. Englewoods, NJ: Educational Technology.

Hayes, W. (2004). *Are we still a nation at risk two decades later?* Lanham, MD: Scarecrow Education.

Hinde, E.R. (2004). School culture and change: An examination of the effects of school culture on the process of change. *Essays in Education*,*12*(3). Retrieved from https://www.researchgate.net/profile/Elizabeth_Hinde/publication/251297989_School_Culture_and_Change_An_Examination_of_the_Effects_of_School_Culture_on_the_Process_of_Change/links/0deec5323677ab9bb3000000.pdf

Holcomb, L.B. (2009). Results & lessons learned from 1:1 laptop initiatives: A collective review. *TechTrends 53*(6), 49-55. doi: 10.1007/s11528-009-0343-1

Hu, W. (2007, May 4). Seeing no progress, some schools drop laptops. *The New York Times.* Retrieved from http://www.nytimes.com/2007/05/04/education/04laptop.html?_r=0

Huberman, M. & Miles, M. (1984). *Innovation up close.* New York: Plenum.

Huffington, A. (2012). Technology in schools: Poll finds K-12 teachers and parents support greater digital use in the classroom. *Huffington post.* Retrieved from http://www.huffingtonpost.com/2012/09/10/poll-finds-k-12-teachers-_n_1871017.html

Inan, F.A. & Lowther, D.L. (2010a). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137-154.

Inan, F.A. & Lowther, D.L. (2010b). Laptops in the K-12 classrooms: Exploring factors impacting instructional use. *Computers & Education 55*, 937-944. doi: 10.10.1016/j.compedu.2010.04.004.

Inan, F. A., Lowther, D. L., Ross, S. M., & Strahl, D. (2010). Pattern of classroom activities during students' use of computers: Relations between instructional strategies and computer applications. *Teaching and Teacher Education*, *26*(3), 540-546.

International Society for Technology in Education (ISTE). (2016). *National educational standards for students.*

Islam, M.S. & Gronlund, A. (2016). An international literature review of 1:1 computing in schools. *Journal of Educational Change, 17*(1), 191-222. doi: 10.1007/s10833-016-9271-y

Johnson, K., Hays, C., Center, H., & Daley, C. (2004). Building capacity and sustainable prevention innovations: A sustainability planning model. *Evaluation and Program Planning*, *27*(2), 135-149. Retrieved from http://resources.prev.org/documents/BuildingCapacityandSustainablePrevention.pdf

Johnstone, B. (2003). *Never mind the laptops: Kids, computers, and the transformation of learning.* Lincoln, NE: iUniverse.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). Learning with technology: A constructivist perspective. Upper Saddle River, NJ: Prentice Hall.

Kay, K. (2010). Forward: 21st century skills: Why they matter, what they are, and how we get there. In J. Bellanca & R. Brandt (Eds.), *21st century skills: Rethinking how students learn (pp. xiii-xxxi).* Bloomington, IN: Solution Tree Press.

Keengwe, J., Onchwari, G., & Onchwari, J. (2009). Technology and student learning: Toward a learner-centered teaching model. *Association for the Advancement of Computing in Education Journal, 17*(1), 11-22. Retrieved from http://www.editlib.org/p/26258/article_26258.pdf

Keengwe, J., Schnellbert, G., & Mills, C. (2011). Laptop initiative: Impact on instructional technology integration and student learning. *Education and Information Technologies, 17*(2), 137-146. doi: 10.1007/s10639-010-9150-8

Kelly, F. S., McCain, T., & Jukes, I. (Eds.). (2008). *Teaching the digital generation: No more cookie-cutter high schools*. Corwin Press.

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, *29*, 76-85. Retrieved from http://media.dropr.com/pdf/WEvqzmQRL2n2yxgXHBVTGHGG0tLjpzc1.pdf

Labaree, D.F. (2010). *Someone has to fail: The zero-sum game of public schooling.* Cambridge, MA: Harvard University Press.

Lei, J. (2010a). Conditions for ubiquitous computing: What can be learned from a longitudinal study. *Computers in the Schools 27*(1), 35-53. doi: 10.1080/07380560903536364

Lei, J. (2010b). Quantity versus quality: A new approach to examine the relationship between technology use and student outcomes. *British Journal of Educational Technology 41*(3), 455-472. doi: 10.1111/j.1467-8535.2009.00961.x

Lei, J., Conway, P.F., & Zhao, Y. (2008). *The digital pencil: One-to-one computing for children*. New York: Taylor & Francis Group.

Lei, J. & Zhao, Y. (2008). One-to-one computing: What does it bring to schools? *The Journal of Educational Computing Research, 39*(2), 97-122. Retrieved from http://inspiringed.com:8082/rid=1MQ6QYNH7-G3FZK2-1M8/Lei%20and%20Zhao%20One%20to%20One%20Research.pdf

Levin, B.B. & Schrum, L. (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), 29-51.

Lichtman, G. (2014). *#EdJourney: A roadmap to the future of education.* San-Francisco, CA: Jossey-Bass

Lincoln, Y.S. & Guba, E.G. (1985). *Naturalistic inquiry*. London: Sage Publications.

Little, J.W. (2001). Professional development in pursuit of school reform. In A. Lieberman & L. Miller (Eds.), *Teachers caught in action* (pp. 23-44). New York: Teachers College Press.

Livingston, P. (2006). *1-to-1 learning: Laptop programs that work*. Eugene, OR: International Society for Technology in Education (ISTE).

Lowther, D.L., Inan, F.A., Ross, S.M., & Strahl, J.D. (2012). Do one-to-one initiatives bridge the way to 21st century knowledge and skills? *Journal of Educational Computing, 46*(1), 1-30.

Lowther, D.L., Ross, S.M., & Morrison, G.M. (2003). When each one has one: The influences of teaching strategies and student achievement of using laptops in the classroom. *Educational Technology Research and Development, 51*(3), 23-44. doi: 10.1007/BF02504551

Lowther, D.L., Ross, S.M., Strahl, J.D., Inan, F.A., & Pollard, D. (2005). *Evaluation of Michigan's freedom to learn program: Evaluation brief.* Center for Research in Educational PolicyPartnership. Retrieved from http://wireless.mivu.org/upload_3/FTL%20Year%201%20Evaluation%20Report%20FINAL%20cr.pdf

Lowther, D. L., Strahl, J. D., Inan, F. A., & Bates, J. (2007). *Freedom to learn program: Michigan 2005-2006 evaluation report*. Memphis, TN: Center for Research in Educational Policy. Retrieved from http://www.memphis.edu/crep/pdfs/michighan_freedom_to_learn_laptop_program.pdf.

Maninger, R.M. & Holden, M.E. (2009). Put the textbooks away: Preparation and support for a middle school one-to-one laptop initiative. *American Secondary Education, 38*(1), 5-33.

Mayes, T. & de Freitas, S. (2013). Technology-enhanced learning: The role of theory. In H. Beetham & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age: Designing 21st century learning* (pp. 17-30). New York: Routledge.

McLaughlin, M.W. (1976). Implementation as mutual adaptation: Change in classroom organization. *Teachers College Record 77*(3), 339-351. Retrieved from http://www.tcrecord.org.

McLauglin, M.W. (1990). The rand change agent study revisited: Macro perspectives and micro realities. *Educational Researcher, 19*(9), 11-16.

McLaughlin, M. W., & Mitra, D. (2001). Theory-based change and change-based theory: Going deeper, going broader. *Journal of Educational Change*, *2*(4), 301-323.

MCH Strategic Data. (2012). MCH Survey results: technology use in nation's school districts. Retrieved from http://mchdata.com/mch-survey-results-technology-use-in-nations-school-districts/

McLester, S. (2011). Lessons learned from one-to-one. *District Administration 47*(6), 34-39. Retrieved from http://www.districtadministration.com/article/special-technology-report-lessons-learned-one-one.

McMillan, J.H. & Schumacher, S. (2001). *Research in education: A conceptual introduction.* New York: Addison Wesley Longman.Means, B. (1994). Introduction: Using technology to advance educational goals. In B. Means (Ed.), *Technology and education reform: The reality behind the promise* (pp. 1-21). San Francisco: Jossey-Bass.

Means, B. (1994). Introduction: Using technology to advance educational goals. In B. Means (Ed.), *Technology and education reform: The reality behind the promise* (pp. 1-21). San Francisco: Jossey-Bass.

Means, B., Penuel, W. R., & Padilla, C. (2001). *The connected school: Technology and learning in high school*. San Francisco: Jossey-Bass.

Mehan, H.U., Datnow, A.M., & Hubbard, L. (2003). Why educational reforms sustain or fail: Lessons for educational leaders. *Handbook of educational leadership and management*, 460-477.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation*. San Francisco: Jossey-Bass.

Morrison, G. R., Ross, S. M., & Lowther, D. L. (2009). Technology as a change agent in the classroom. In *Learning and instructional technologies for the 21st century*, 1-23. Springer US. doi: 10.1007/978-0-387-09667-4_9

National Commission on Excellence in Education. (1983). A nation at risk: The imperative for educational reform. *The Elementary School Journal*, *84*(2), 113-130.

Oliver, K.M., Mollette, M., Corn, J. (2012). Administrative Perspectives on the Implementation of One-to-One Computing. *Journal of Information Technology and Application in Education 1*(4), 125-142. Retrieved from http://www.sagefoxgroup.com/_articles/Administrative_perspectives_on_computing.pdf

Papert, S. (1980). *Mindstorms, children, computers, and powerful ideas.* New York: Basic Books.

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer*. New York: Basic Books.

Partnership for 21st Century Skills. (2010). Framework for 21st century learning. Retrieved from http://www.p21.org.

Partnership for 21st Century Skills. (2016). Framework for 21st century learning. Retrieved from http://www.p21.org.

Patton, M.Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Payne, C.M, (2008). *So much reform, so little change: The persistence of failure in urban schools.* Cambridge, MA: Harvard Education Press.

Peck, K., Clausen, R., Vilberg, J. Meidl, C., & Murray, O. (2009). Classrooms for the future: Year three evaluation report. Obtained from K. Peck.

Penuel, W.R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*(3), 329-348.

Potter, S. L., & Rockinson-Szapkiw, A. J. (2012). Technology integration for instructional improvement: The impact of professional development. *Performance Improvement,* 51(2), 22-27.

Ravitch, D. (2010). The death and life of the great American school system: How testing and choice are undermining education. New York: Basic Books.

Reigeluth, C.M. (1994). Introduction: The imperative for systemic change. In C.M. Reigeluth & R.J. Garfinkle (Eds.), *Systemic change in education* (pp. 3-11). Englewood Cliffs, NJ: Educational Technology Publications.

Reigeluth, C. M., & Garfinkle, R. J. (1994). *Systemic change in education*. Englewood Cliffs, NJ: Educational Technology Publications.

Rockman et al. (1997). Report of a laptop program pilot. Retrieved from http://rockman.com/predndx.htm

Rockman et al. (1998). Powerful tools for schooling: Second year study of the laptop program. Retrieved from http://rockman.com/predndx.htm

Rockman et al. (2000). A more complex picture: laptop use and impact in the context of changing home and school access. Retrieved from http://rockman.com/predndx.htm

Rockman, S. (2003). Learning from laptops. *Treshold.* Retrieved from http://rockman.com/articles.htm

Rogers, E.M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.

Rogers, Y. & Price, S. (2007). Using ubiquitous computing to extend and enhance learning experiences. In M. van't Hoof & K. Swan (Eds.), *Ubiquitous computing in education: Invisible technology, invisible impact* (PP. 329-347). Mahwah, NJ: Lawrence Erlbaum Associates.

Rosen, Y. & Beck-Hill, D. (2012). Interwining digital content and a one-to-one laptop environment in teaching and learning: Lessons from the time to know program. *Journal of Research on Technology in Education, 44*(3), 225-241. Retrieved from http://files.eric.ed.gov/fulltext/EJ976467.pdf

Ross, S. M., Lowther, D. L., Wilson-Relyea, B., Wang, W. & Morrison, G. R. (2003). Anytime, anywhere learning final evaluation report of the laptop program: Year 3. *Memphis, TN: The University of Memphis.* Retrieved from http://www.memphis.edu/crep/pdfs/walled_lake_anywhere_anytime_laptop_program.pdf

Rothstein, R., Jacobsen, R., & Wilder, T. (2008). Grading Education: getting accountability right. Washington, DC: Economic Policy Institute & New York: Teachers College Press.

Rubin, H.J. & Rubin, I.S. (2012). *Qualitative interviewing: The art of hearing data* (3rd ed.). Los Angeles, CA: Sage.

Russell, M., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research, 30*(4), 313-330. doi: 10.2190/6E7K-F57M-6UY6-QAJJ.

Rust, F. O. C., & Freidus, H. (Eds.). (2001). *Guiding school change: The role and work of change agents*. New York: Teachers College Press.

Saldaña, J. (2016). *The coding manual for qualitative researchers* (3rd ed). Los Angeles, CA: Sage.

Sandholtz, J.H., Ringstaff, C. & Dwyer, D.C. (1997). *Teaching with technology*. New York: Teachers College Press.

Sarason, S. B. (1996). *Revisiting "The culture of the school and the problem of change"*. New York: Teachers College Press.

Schrum, L. & Levin, B.B. (2009). *Leading 21st century schools: Harnessing technology for engagement and achievement.* Thousand Oaks, CA: Corwin.

Seller, W. (2001). Introduction: Reforming schools: Building the capacity for change. *School Leadership & Management, 21*(3), 225-259. doi: 10.1080/13632430120074428

Senge, P. M. (2006). *The fifth discipline: The art and practice of the learning organization*. Broadway Business.

Shapley, K., Sheehan, D. Maloney, C. Caranikas-Walker, F. (2009). *Evaluation of the Texas technology immersion pilot: Final outcomes for a four-year study (2004-05 to 2007-08)*. Austin, TX: Texas Center for Educational Research. Retrieved from http://eric.ed.gov/?id=ED536296

Shapley, K.S., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2010). Evaluating the Implementation Fidelity of Technology Immersion and its Relationship with Student Achievement. Journal of Technology, Learning, and Assessment, 9(4). Retrieved [date] from http://www.jtla.org

Sheninger, E. (2014). *Digital leadership: Changing paradigms for changing times.* Thousand Oaks, CA: Corwin.

Silvernail, D. L. (2005). Does Maine's Middle School Laptop Program Improve Learning? A Review of Evidence to Date. Occasional Brief. *Center for Education Policy, Applied Research, and Evaluation*. Retrieved from http://digitalcommons.usm.maine.edu/cgi/viewcontent.cgi?article=1019&context=cepare_technology

Silvernail, D.L. & Gritter, A.K. (2007). Research brief. Maine's middle school laptop program: Creating better writers. Maine Education Policy Research Institute, University of Southern Maine Office. Retrieved from file:///F:/Silvernail%20and%20Gritter%20Maine%20Mathematics.pdf

Silvernail, D.L. & Harris, W. J. (2003). *The Maine learning technology initiative: Teacher, student, and school perspectives mid-year evaluation report.* Maine Education Policy Research Institute, University of Southern Maine Office, Maine. Retrieved from http://www.usm.maine.edu/cepare/pdf/ts/mlti.pdf

Silvernail, D.L. & Lane, D.M. (2004). *The impact of Maine's one-to-one laptop program on middle school teachers and students: Phase one summary evidence. (Research Report #1)* Maine Education Policy Research Institute, University of Southern Maine Office. Retrieved from https://usm.maine.edu/sites/default/files/cepare/19MLTI_Report1_2004.pdf

Sivin-Kachala, J., & Bialo, E. R. (1994). Report on the Effectiveness of Technology in Schools, 1990-1994. Retrieved from http://files.eric.ed.gov/fulltext/ED371726.pdf

Solomon, G., & Schrum, L. (2007). *Web 2.0: New tools, new schools*. Eugene, OR: International Society for Technology in Education (ISTE).

Stake, R. (1998). Some comments on assessment in U.S. education. *Education Policy Analysis Archives, 6*(14). Retrieved from http://epaa.asu.edu/ojs/index.php/epaa/article/view/581

Stallard, C. K., & Cocker, J. (2015). *Education technology and the failure of American schools*. Lanham, MD: Rowman & Littlefield.

Stedman, L. C., & Smith, M. S. (1983). Recent reform proposals for American education. *Contemporary Education Review*, *2*(2), 85-104.

Stevenson, K.R. (1998). *Evaluation report – year 2* (report). Beaufort County: Department of Educational Leadership and Policies, University of South Carolina. Retrieved from http://www.beaufort.k12.sc.us/district/evalreport2.htm

Stevenson, K.R. (1999). *Evaluation report – year 3* (report). Beaufort County: Department of Educational Leadership and Policies, University of South Carolina. Retrieved from http://www.beaufort.k12.sc.us/district/evalreport3.htm

Stoll, L. (1999). Realising our potential: Understanding and developing capacity for lasting improvement. *School effectiveness and school improvement*, *10*(4), 503-532. Retrieved from http://www.highreliabilityschools.co.uk/_resources/files/downloads/school-improvement/ls1999.pdf

Stoll, L. (2009). Capacity building for school improvement or creating capacity for learning? A changing landscape. *Journal of educational change*, *10*(2-3), 115-127. Retrieved from http://eprints.ioe.ac.uk/2934/1/Stoll2009Capacity115.pdf

Suhr, K. A., Hernandez, D. A., Grimes, D., & Warschauer, M. (2010). Laptops and fourth grade literacy: Assisting the jump over the fourth-grade slump. *The Journal of Technology, Learning and Assessment*, *9*(5).

Thomas, D. & Brown, J.S. (2011). *A new culture of learning: Cultivating imagination for a world of constant change.* Lexington, KY: CreateSpace.

Tucker, C., Wycoff, T., & Green, J.T. (2017). *Blended learning in action: A practical guide toward sustainable change.* Thousand Oaks, CA: Corwin.

Tyack, D. & Cuban, L. (1995) *Tinkering toward utopia: A century of public school reform.* Cambridge, MA: Harvard University Press.

Valiente, O. (2010). 1-1 in education: Current practice, international comparative research evidence and policy implications. OECD Education Working Papers, No. 44, OECD Publishing. doi: 10.1787/5kmjzwfl9vr2-en

Vaughn, S., Schumm, J. S., & Sinagub, J. M. (1996). *Focus group interviews in education and psychology*. Thousand Oaks, CA: Sage Publications.

Vik, P. (1984). A response to "A Nation at Risk": More looking and less leaping. *NASSP Bulletin*, *68*(470), 53-59.

Vinovskis, M. A. (2003). Missed opportunities: Why the federal response to A Nation At Risk was inadequate. *A nation reformed: American education 20 years after A Nation At Risk,* 115-130.

Wagner, T. (2003). *Making the grade: Reinventing America's schools.* New York: RoutledgeFalmer.

Wagner, T. (2012). *Creating innovators: The making of young people who will change the world.* New York: Scribner.

Wagner, T. (2014). *The global achievement gap: Why even our best schools don't teach the new survival skills our children need – and what we can do about it.* New York: Basic Books.

Wagner, T. & Dintersmith, T. (2015). *Most likely to succeed: Preparing our kids for the innovation era.* New York: Scribner.

Warschauer, M. (2006). *Laptops and information literacy: Learning in the wireless classroom.* New York: Teachers College Press.

Warschauer, M. (2007a). Information literacy in the laptop classroom. Teachers College Record 109(11), 2511-2540.

Warschauer, M. (2007b). The paradoxical future of digital learning. *Learning Inquiry*, *1*(1), 41-49. doi: 10.1007/s11519-007-0001-5

Warschauer, M. (2011). *Learning in the cloud: How (and why) to transform schools with digital media.* New York: Teachers College Press.

Warschauer, M., & Ames, M. (2010). Can One Laptop per Child save the world's poor?. *Journal of international affairs*, 33-51.

Warschauer, M., Cotten, S. R., & Ames, M. G. (2012). One laptop per child Birmingham: Case study of a radical experiment. *International Journal of Learning and Media, 3*(2), 61-76 doi: 10.1162/IJLM_a_00069

Warschauer, M. & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. Review of Research in Education 34, 179-225. doi: 10.3102/0091732X09349791

Warschauer, M., Zheng, B., Niiya, M., Cotten, S., & Farkas, G. (2014). Balancing the one-to-one equation: Equity and access in three laptop programs. *Equity & Excellence in Education*, *47*(1), 46-62. doi: 10.1080/10665684.2014.866871

Webb, L (2011). Supporting technology integration: The school administrator's role. *National Forum of Educational Administration & Supervision Journal, 28*(4), 1-7. Retrieved from http://www.nationalforum.com/Electronic%20Journal%20Volumes/Webb,%20Lorie%20Supporting%20Technology%20Integration%20NFEASJ%20V28%20N4%202011.pdf.

Weiser, M. (1991). The computer for the 21st century. *Scientific American 265*, 94-105. doi:10.1038/scientificamerican0991-94.

Wenglinsky, H. (2005). *Using technology wisely: The keys to success in schools.* New York: Teachers College Press.

West, D.M. (2012). *Digital schools: How technology can transform education.* Washington, D.C.: Brookings Institution Press.

Weston, M.E. & Bates, A. (2010). The end of the techno-critique: The naked truth about 1:1 laptop initiatives and educational change. *The Journal of Technology, Learning, and Assessment 9*(6), 1-25. Retrieved from http://www.jtla.org

Wheatley, M.J. (2006). *Leadership and the new science: Learning about organization from an orderly universe* (3rd ed.). San Francisco, CA: Berrett-Koehler Publishers, Inc.

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American educational research journal*, *39*(1), 165-205. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.465.4221&rep=rep1&type=pdf

Wiske, M.S. & Perkins, D. (2005). Dewey goes digital: Scaling up constructivist pedagogies and the promise of new technologies. In C. Dede, J.P. Honan, & L.C. Peters (Eds.), *Scaling up success: Lessons learned from technology-based educational improvement* (pp. 27-47). San Francisco: Jossey-Bass.

Yin, R.K. (2014). *Case study research: Design and methods* (5th ed.). Los Angeles, CA: Sage.

Yin, R.K. (2016). *Qualitative research from start to finish* (2nd ed.). New York: Guilford Press.

Zaltman, G. & Duncan, R. (1977). *Strategies for planned change.* New York: John Wiley and Sons.

Zemelman, S., Daniels, H., & Hyde, A. (1998). *Best practice: New standards for teaching and learning in America's schools* (2nd ed.). Portsmith, NH: Heinemann.

Zhao, Y. (2009). *Catching up or leading the way: American education in the age of globalization.* Alexandra, VA: ASCD.

Zhao, Y. (2012). *World class learners: Educating creative and entrepreneurial students.* Thousand Oaks, CA: Corwin.

Zhao, Y., Zhang, G., Lei, J., & Qiu, W. (2016). *Never send a human to do a machine's job: Correcting the top 5 edtech mistakes.* Thousand Oaks, CA: Corwin Press.

Zheng, B. & Warschauer, M. (2013, April). *Teaching and learning in one-to-one laptop environments: A research synthesis*. Paper presented at the American Educational Research Association Annual Meeting, San Francisco. Retrieved from email from authors on November 30, 2015.

Zheng, B. & Warschauer, M. (2015). Participation, interaction, and academic achievement in an online discussion environment. Computers & Education 84, 78-89. doi: 10.1016/j.compedu.2015.01.008

Zheng, B., Warschauer, M. & Farkas, G. (2013). Digital writing and diversity: The effects of school laptop programs on literacy processes and outcomes. *Journal of Educational Computing Research 48*(3), 267-299. doi: 10.2190/EC.48.3.a

Zheng, B., Warschauer, M., Lin, C.-H. & Chang, C. (2016). Learning in one-to-one laptop environments: A meta-analysis and research synthesis. *Review of Educational Research*. doi: 10.3102/0034654316628645

Appendices

Appendix A

Cover Letter for Informed Consent Form for Administrators

Lynne Lieux, RSCJ
Graduate Student and Candidate for Doctoral Degree in Educational Leadership
llieux@uno.edu or llieux@rscj.org

Department of Educational Leadership, Counseling and Foundations
University of New Orleans
2000 Lakeshore Drive
New Orleans, LA 70148

[Date]

[Name]
[School]
[Address]
[City, State, Zip Code]

Dear [Name],

I am graduate student in the Department of Educational Leadership, Counseling and Foundations at the University of New Orleans.

I am conducting a research study under the direction of Dr. Brian Beabout. My research study seeks to understand what, if any, educational changes have occurred within a school and within individual classrooms due to one-to-one computing. I am requesting your participation in one or two one-to-one interviews. Your participation in this study is voluntary. You are free to choose not to participate or to withdraw from the study at any time. Real names will not be used in the study. Instead, participants will be given pseudo names. Confidentiality will be held throughout the study.

I have attached an informed consent form that provides further information regarding this study. If you should choose to participate in this study, please sign the consent form and return to me.

Sincerely,

Lynne Lieux, RSCJ

Appendix B

Cover Letter for Informed Consent Form for Faculty

Lynne Lieux, RSCJ
Graduate Student and Candidate for Doctoral Degree in Educational Leadership
llieux@uno.edu or llieux@rscj.org

Department of Educational Leadership, Counseling and Foundations
University of New Orleans
2000 Lakeshore Drive
New Orleans, LA 70148

[Date]

[Name]
[School]
[Address]
[City, State, Zip Code]

Dear [Name],

I am graduate student in the Department of Educational Leadership, Counseling and Foundations at the University of New Orleans.

I am conducting a research study under the direction of Dr. Brian Beabout. My research study seeks to understand what, if any, educational changes have occurred within a school and within individual classrooms due to one-to-one computing. I am requesting your participation in one or two one-to-one interviews, one or two classroom observations, or a focus group. Most faculty participants in this study will only participate in a focus group, but you may be selected to participate in an interview and to allow me to observe one of your classes. Your participation in this study is voluntary. You are free to choose not to participate or to withdraw from the study at any time. Real names will not be used in the study. Instead, participants will be given pseudo names. Confidentiality will be held throughout the study.

I have attached an informed consent form that provides further information regarding this study. If you should choose to participate in this study, please sign the consent form and return to me.

Sincerely,

Lynne Lieux, RSCJ

Appendix C

Cover Letter for Informed Consent Form for Graduates

Lynne Lieux, RSCJ
Graduate Student and Candidate for Doctoral Degree in Educational Leadership
llieux@uno.edu or llieux@rscj.org

Department of Educational Leadership, Counseling and Foundations
University of New Orleans
2000 Lakeshore Drive
New Orleans, LA 70148

[Date]

[Name]
[School]
[Address]
[City, State, Zip Code]

Dear [Name],

I am graduate student in the Department of Educational Leadership, Counseling and Foundations at the University of New Orleans.

I am conducting a research study under the direction of Dr. Brian Beabout. My research study seeks to understand what, if any, educational changes have occurred within a school and within individual classrooms due to one-to-one computing. I am requesting your participation in an interview as graduate who was present at specific time in the program. Your participation in this study is voluntary. You are free to choose not to participate or to withdraw from the study at any time. Real names will not be used in the study. Instead, participants will be given pseudo names. Confidentiality will be held throughout the study.

I have attached an informed consent form that provides further information regarding this study. If you should choose to participate in this study, please sign the consent form and return to me.

Sincerely,

Lynne Lieux, RSCJ

Appendix D

Cover Letter for Informed Consent Form for Parents of Student Participants

Lynne Lieux, RSCJ
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llieux@uno.edu or llieux@rscj.org

Department of Educational Leadership, Counseling and Foundations
University of New Orleans
2000 Lakeshore Drive
New Orleans, LA 70148

[Date]

[Name]
[School]
[Address]
[City, State, Zip Code]

Dear [Name],

I am graduate student in the Department of Educational Leadership, Counseling and Foundations at the University of New Orleans.

I am conducting a research study under the direction of Dr. Brian Beabout. My research study seeks to understand what, if any, educational changes have occurred within a school and within individual classrooms due to one-to-one computing. I have randomly chosen a group of students for participation in this study. I am requesting your daughter's participation in a focus group interview. Her participation in this study is voluntary. You and she are free to choose not to participate or to withdraw from the study at any time. Real names will not be used in the study. Instead, participants will be given pseudo names. Confidentiality will be held throughout the study.

I have attached an informed consent form that provides further information regarding this study. If you should choose to allow your daughter to participate in this study, please sign the consent form, have your daughter sign the form, and return to me.

Sincerely,

Lynne Lieux, RSCJ

Appendix E

Administrator Consent Form

Consent Form – Adult

Title of Study: Innovativeness: One School's Experience of Sustaining Educational Change

Introduction

The purpose of this form is to provide you, as prospective participant in this study, information about the study which allows you to make an informed decision about whether or not you will participate in this study.

Purpose of Study

The purpose of this research is to explore the capacity of the school and individuals to embrace change for educational improvement through the use of one-to-one computing.

Procedures

The researcher plans to interview several administrators who were or are a part of one-to-one computing within your school. If you choose to participate in this study, you will be asked to participate in a one-hour interview, and possibly a brief follow-up interview. Your interview will be audio-recorded and transcribed. You will have the opportunity to review the transcription for accuracy. Electronic data will be kept in a password-protected file and all written data will be kept in a locked file at my personal residence. All data collected will be destroyed three years after the publication of the study. Each participant will be given a pseudonym. Real names will be known only to myself. Confidentiality will be retained at all times.

Expected Duration

The researcher intends to spend a significant amount of time on campus from May through October, 2017. Participant commitment will be 1-2 one hour interviews. Interviews will be conducted at the White House Community on campus, or if necessary, through the use of video conferencing. After each interview has been transcribed, you will be asked to review the transcript for accuracy.

Risks of Participation

There are no anticipated risks associated with this study.

Benefits of Study

There is no direct benefit received for your participation in this study. However, your participation in this study will help the researcher understand how and why a school community embraces change for educational improvement and what occurred in this school as a result of one-to-one computing. The results of this research could provide significant information to other schools considering implementing one-to-one computing programs, or other educational reforms.

Confidentiality of Records

Every effort will be made to maintain the confidentiality of all records of this study. Audio recordings will be conducted for interviews and observations. The data collected will be stored, secured, and only accessible to the researcher. Interview and observation data will be used for educational and publication purposes. Every participant will have an assigned pseudo name. No identifiers connecting you to this study will be included in any publication related to the study.

Financial Compensation

There is no financial compensation to be offered for participation in this study.

Contact Information for Questions or Problems

If you have any questions during the course of this study about the research or any related problem, you may contact the researcher at 504-382-0782 or by email at llieux@rscj.org. Dr. Brian Beabout at the University of New Orleans is the researcher's committee chair. He can be contacted at bbeabout@uno.edu. The Head of School has graciously given her approval for this study to occur. You may also contact her with any questions or concerns.

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, please contact Dr. Ann O'Hanlon at the University of New Orleans, (504)280-3990.

Signature

Your signature below acknowledges your voluntary participation in this research project. The purpose of this study, procedures to be followed, and explanation of risks or benefits have been explained to you. You have been allowed to ask questions and your questions have been answered to your satisfaction. You are free to withdraw your consent at any time by contacting the researcher. You will be given a copy of the consent form for your records.

Signature of Participant: _____ **Date:** _____

Printed Name: _____

Signature of Person Obtaining Consent: _____ **Date:** _____

Printed Name: _____

Appendix F

Faculty Consent Form

Consent Form – Adult

Title of Study: Innovativeness: One School's Experience of Sustaining Educational Change

Introduction

The purpose of this form is to provide you, as prospective participant in this study, information about the study which allows you to make an informed decision about whether or not you will participate in this study.

Purpose of Study

The purpose of this research is to explore the capacity of the school and individuals to embrace change for educational improvement through the use of one-to-one computing.

Procedures

The researcher plans to elicit faculty participation for one-to-one interviews, focus groups, and/or classroom observations. Participants will be selected from faculty who have been a part of one-to-one computing program since its inception and those who have been a part of the program for 10 years or less. If you choose to participate in this study, you may be asked to participate in a one-hour interview, a focus group, and/or a classroom observation. Interviews and focus group sessions will be audio-recorded and transcribed. The researcher will keep field notes of classroom observations. You will have the opportunity to review transcriptions of interviews for accuracy. Electronic data will be kept in a password-protected file and all written data will be kept in a locked file at my personal residence. All data collected will be destroyed three years after the publication of the study. Each participant will be given a pseudonym. Real names will be known only to myself. Confidentiality will be retained at all times.

Expected Duration

The researcher intends to spend a significant amount of time on campus from May through October, 2017. Participant commitment will be 1-2 one hour interviews. Interviews and focus groups will be conducted at the White House Community on campus, or if necessary, through the use of video conferencing. After each interview has been transcribed, you will be asked to review the transcript for accuracy.

Risks of Participation

There are no anticipated risks associated with this study.

Benefits of Study

There is no direct benefit received for your participation in this study. However, your participation in this study will help the researcher understand how and why a school community embraces change for educational improvement and what occurred in this school as a result of one-to-one computing. The results of this research could provide significant information to other schools considering implementing one-to-one computing programs, or other educational reforms.

Confidentiality of Records

Every effort will be made to maintain the confidentiality of all records of this study. Audio recordings will be conducted for interviews and observations. The data collected will be stored, secured, and only accessible to the researcher. Interview and observation data will be used for educational and publication purposes. Every participant will have an assigned pseudo name. No identifiers connecting you to this study will be included in any publication related to the study.

Financial Compensation

There is no financial compensation to be offered for participation in this study.

Contact Information for Questions or Problems

If you have any questions during the course of this study about the research or any related problem, you may contact the researcher at 504-382-0782 or by email at llieux@rscj.org. Dr. Brian Beabout at the University of New Orleans is the researcher's committee chair. He can be contacted at bbeabout@uno.edu. The Head of School has graciously given her approval for this study to occur. You may also contact her with any questions or concerns.

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, please contact Dr. Ann O'Hanlon at the University of New Orleans, (504)280-3990.

Signature

Your signature below acknowledges your voluntary participation in this research project. The purpose of this study, procedures to be followed, and explanation of risks or benefits have been explained to you. You have been allowed to ask questions and your questions have been answered to your satisfaction. You are free to withdraw your consent at any time by contacting the researcher. You will be given a copy of the consent form for your records.

Signature of Participant: _____ **Date:** _____

Printed Name: _____

Signature of Person Obtaining Consent: _____ **Date:** _____

Printed Name: _____

Appendix G

Graduate Consent Form

Consent Form – Adult

Title of Study: Innovativeness: One School's Experience of Sustaining Educational Change

Introduction

The purpose of this form is to provide you, as prospective participant in this study, information about the study which allows you to make an informed decision about whether or not you will participate in this study.

Purpose of Study

The purpose of this research is to explore the capacity of the school and individuals to embrace change for educational improvement through the use of one-to-one computing.

Procedures

The researcher plans to conduct interviews with graduates who were a part of one-to-one computing at different transitional times within the school. If you choose to participate in this study, you will be asked to participate in a 30minute interview, and possibly a brief follow-up interview. Interviews will be audio-recorded and transcribed. You will have the opportunity to review the transcription of the interview for accuracy. Electronic data will be kept in a password-protected file and all written data will be kept in a locked file at my personal residence. All data collected will be destroyed three years after the publication of the study. Each participant will be given a pseudonym. Real names will be known only to myself. Confidentiality will be retained at all times.

Expected Duration

The researcher intends to spend a significant amount of time on campus from May through October, 2017. Participant commitment will be 30 minute interviews. Interviews will be conducted at the White House Community on campus, or if necessary, through the use of video conferencing. After each interview has been transcribed, you will be asked to review the transcript for accuracy.

Risks of Participation

There are no anticipated risks associated with this study.

Benefits of Study

There is no direct benefit received for your participation in this study. However, your participation in this study will help the researcher understand how and why a school community embraces change for educational improvement and what occurred in this school as a result of one-to-one computing. The results of this research could provide significant information to other schools considering implementing one-to-one computing programs, or other educational reforms.

Confidentiality of Records

Every effort will be made to maintain the confidentiality of all records of this study. Audio recordings will be conducted for interviews and observations. The data collected will be stored, secured, and only accessible to the researcher. Interview data will be used for educational and publication purposes. Every participant will have an assigned pseudo name. No identifiers connecting you to this study will be included in any publication related to the study.

Financial Compensation

There is no financial compensation to be offered for participation in this study.

Contact Information for Questions or Problems

If you have any questions during the course of this study about the research or any related problem, you may contact the researcher at 504-382-0782 or by email at llieux@rscj.org. Dr. Brian Beabout at the University of New Orleans is the researcher's committee chair. He can be contacted at bbeabout@uno.edu. The Head of School has graciously given her approval for this study to occur. You may also contact her with any questions or concerns.

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, please contact Dr. Ann O'Hanlon at the University of New Orleans, (504)280-3990.

Signature

Your signature below acknowledges your voluntary participation in this research project. The purpose of this study, procedures to be followed, and explanation of risks or benefits have been explained to you. You have been allowed to ask questions and your questions have been answered to your satisfaction. You are free to withdraw your consent at any time by contacting the researcher. You will be given a copy of the consent form for your records.

Signature of Participant: _____ **Date:** _____

Printed Name: _____

Signature of Person Obtaining Consent: _____ **Date:** _____

Printed Name: _____

Appendix H

Student Consent Form

Consent Form – Student

Title of Study: Innovativeness: One School's Experience of Sustaining Educational Change

Introduction

The purpose of this form is to provide you, as prospective participant in this study, and your parents, information about the study which allows you to make an informed decision about whether or not you will participate in this study.

Purpose of Study

The purpose of this research is to explore the capacity of the school and individuals to embrace change for educational improvement through the use of one-to-one computing.

Procedures

The researcher plans to conduct focus group interviews with two groups of students who have been a part of the Tablet PC program for at least 3 years. If you choose to participate in this study, you will be asked to participate in a 60-90 minute focus group interview. Focus groups interviews will be audio-recorded and transcribed. Electronic data will be kept in a password-protected file and all written data will be kept in a locked file at my personal residence. All data collected will be destroyed three years after the publication of the study. Each participant will be given a pseudonym. Real names will be known only to myself. Confidentiality will be retained at all times.

Expected Duration

The researcher intends to spend a significant amount of time on campus from May through October 2017. Participant commitment will be approximately 60minutes. Focus Groups will be conducted in one of the conference rooms on campus.

Risks of Participation

There are no anticipated risks associated with this study.

Benefits of Study

There is no direct benefit received for your participation in this study. However, your participation in this study will help the researcher understand how and why a school community embraces change for educational improvement and what occurred in this school as a result of one-to-one computing. The results of this research could provide significant information to other schools considering implementing one-to-one computing programs.

Confidentiality of Records

Every effort will be made to maintain the confidentiality of all records of this study. Audio recordings will be conducted for interviews and observations. The data collected will be stored, secured, and only accessible to the researcher. Interview data will be used for educational and publication purposes. Every participant will have an assigned pseudo name. No identifiers connecting you to this study will be included in any publication related to the study.

Financial Compensation

There is no financial compensation to be offered for participation in this study.

Contact Information for Questions or Problems

If you or your parents have any questions during the course of this study about the research or any related problem, you may contact the researcher at 504-382-0782 or by email at llieux@rscj.org. Dr. Brian Beabout at the University of New Orleans is the researcher's committee chair. He can be contacted at bbeabout@uno.edu. The Head of School has graciously given her approval for this study to occur. You may also contact her with any questions or concerns.

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, please contact Dr. Ann O'Hanlon at the University of New Orleans, (504)280-3990.

Signature

Your signature and your parent's signature below acknowledge your voluntary participation in this research project and your parent's consent to your participation in this study. The purpose of this study, procedures to be followed, and explanation of risks or benefits have been explained to you and your parents. You have been allowed to ask questions and your questions have been answered to your satisfaction. You are free to withdraw your consent at any time by contacting the researcher. You will be given a copy of the consent form for your records.

Signature of Participant: _____ **Date:** _____

Printed Name: _____

Signature of Parent: _____ **Date:** _____

Printed Name: _____

Signature of Person Obtaining Consent: _____ **Date:** _____

Printed Name: _____

Appendix I

Administrator Demographic Sheet

Participant Number: _____

Demographic Data:

Gender: _____M _____F

Age:
___Under 29
___30-39
___40-49
___50-59
___60-69
___Over 69

Ethnicity:
___African American
___Hispanic
___White
___Native American
___Asian/Pacific Islander

Degrees and Area of Study

Bachelor's Degree(s):_____
_____
Master's Degree(s): _____
_____
Doctoral Degree(s): _____
_____

Certifications and Endorsements

Certification(s) and Endorsements(s): _____
_____
_____

Teaching/Administrative Experience

Total Number of Year(s) Teaching (including current school year): _____
Total Number of Year(s) Teaching at current school (including current school year): _____
Total Number of Year(s) in Administration (including current school year): _____
Total Number of Year(s) in Administration at current school (including current school year): ___
Total Number of Year(s) Teaching in a One-to-One Computing School: _____
Total Number of Year(s) in Administration in a One-to-One Computing School: _____

Please indicate the two best times for you to participate in an interview with me.

Day and time: _____ Day and time: _____

Thank you for completing this demographic sheet. I look forward to visiting with you.

Appendix J

Faculty Demographic Sheet

Participant Number: _____

Demographic Data:

Gender: _____M _____F

Age:
___Under 29
___30-39
___40-49
___50-59
___60-69
___Over 69

Ethnicity:
___African American
___Hispanic
___White
___Native American
___Asian/Pacific Islander

Degrees and Area of Study

Bachelor's Degree(s):_____
_____
Master's Degree(s): _____
_____
Doctoral Degree(s): _____
_____

Certifications and Endorsements

Certification(s) and Endorsements(s): _____
_____
_____

Teaching Experience

Total Number of Year(s) Teaching (including current school year): _____
Total Number of Year(s) Teaching at current school (including current school year): _____
Total Number of Year(s) Teaching in a One-to-One Computing School: _____
Please list all grade level(s) you have taught and for how many year(s):

Grade ____ Number of Year(s) ____ Grade ____ Number of Year(s) ____
Grade ____ Number of Year(s) ____ Grade ____ Number of Year(s) ____

Please list all subjects you have taught and for how many year(s);

Subject _____ Number of Year(s) _____
Subject _____ Number of Year(s) _____
Subject _____ Number of Year(s) _____
Subject _____ Number of Year(s) _____

Please indicate the two best times for you to participate in an interview with me.

Day and time: _____ Day and time: _____

Thank you for completing this demographic sheet. I look forward to visiting with you.

Appendix K

Administration Interview Protocol

Date:

Time:

Location:

Thank you for agreeing to participate in this study. We will be discussing the one-to-one Tablet PC program at your school from its inception until today. I will be asking you to recall the programs at key moments in time, the decision to adopt, the implementation period, and its present form. I am interested in understanding your perceptions of educational changes that occurred due to the introduction of one-to-one computing in the school.

Interview Questions

Overview Questions: (this allows researcher to build rapport and have participant answer some "no wrong answer" questions up front.)

1. Briefly, tell me about your involvement with the one-to-one program here at school?

Adoption

1. As you understood it, what were reasons that guided the school to move forward with this program?
2. What was the process of planning for the program and who was involved? What was your role?
3. How was the decision and plan communicated to the various constituents of the school (teachers, staff, parents, students, alumnae)?
4. What was the reaction of the various constituents to the program?
5. Knowing what you now know, would you change any part of the planning, decision making and communication process? If so, what, how, and why? Is there anything you would not change, and why?

Implementation

1. Tell me about a professional development experience related to 1:1 computing?
2. What professional development opportunities are provided for new teachers who have little or no experience with 1:1 computing?
3. What professional development opportunities are provided for veteran 1:1 computing teachers?
4. Can you reconstruct some of the key moments, good or bad, in the implementation of the program?

Goals of the Program

1. What were the goals of the program? In other words, what motivated the school and individuals to embark on this path?
    a. For students?
    b. For teachers?
    c. For administrators?
2. Who was involved in setting these goals? How were they communicated?
3. What results, if any, did you expect from the program?
    a. In the classroom (teaching and learning)?
    b. As a school (environment and culture)?
4. Please describe for me what you would expect to see in a classroom in which technology was integrated.
5. If I were a perspective teacher interested in employment, what would you tell me about the 1:1 computing program?
6. What would you tell me, as a perspective teacher, about the school environment?

Sustainability

Twenty years is a significant amount of time in the life of a school and in the lives of students and teachers.

1. What do you think has contributed to the longevity of the one-to-one program?
2. How do individuals and the school community assess the program and allow for changes, if necessary?
3. What factors have contributed to changes in the 1:1 program?

Future

1. What would be your reaction if 1:1 computing was discontinued?
2. What adaptations would you have to make without 1:1 computing?
3. If money and personnel were not an issue, how would you like to see the program develop in the next 5 years or 10 years?

Thank you for allowing me to visit with you about the one-to-one computing program. After I have transcribed your interview, I will ask you to read it for accuracy. I will also ask for a second interview with questions that will allow me to probe some of the common themes that will emerge as I interview various people.

Appendix L

Faculty Interview Protocol

Date:

Time:

Location:

Thank you for agreeing to participate in this study. We will be discussing the one-to-one Tablet PC program at the school from its inception until today. I will be asking you to recall the programs at key moments in time, the decision to adopt, the implementation period, and its present form. I am interested in understanding your perceptions of educational changes that occurred due to the introduction of one-to-one computing in the school.

Interview Questions

Overview Questions: (this allows researcher to build rapport and have participant answer some "no wrong answer" questions up front.)

1. Tell me about your involvement with the one-to-one program here at school?

Adoption

1. What were your thoughts when you learned that the school was implementing 1:1 computing?
2. How did you come to know that the school was moving to 1:1 computing?
3. As you understood it, what were reasons that guided the school to move forward with this program?
4. What role did teachers play in the decision to adopt one-to-one computing?
5. Once the decision was made, what was the process of planning for the program and who was involved?
6. Knowing what you now know, would you change any part of the planning, decision making and communication process? If so, what, how, and why? Is there anything you would not change, and why?

Implementation

1. Tell me about how you use the Tablet PC in your classroom?
2. Tell me about how students use the Tablet PC in your classroom?
3. Has 1:1 computing changed your classroom, and if so, how has it changed?
4. Has 1:1 computing changed the school, and if so, how has it changed?
5. How would you define technology integration?
6. Tell me about a professional development experience related to 1:1 computing?
7. What are your feelings about the effectiveness of this type of professional development?

8. When exploring new ways to use 1:1 computing in your classes, where do you look for help?
9. How do new ideas about the integration of 1:1 computing within the curriculum get shared?
10. What changes have been made to the 1:1 program since its inception?
11. How do you feel about these changes?

Goals of the Program

1. What were the goals of the program? In other words, what motivated the school and individuals to embark on this path?
2. If I were a perspective teacher inquiring about employment, what would you tell me about the 1:1 computing program?
3. What would you tell me, as a perspective teacher, about the school environment?
4. What would you tell me, as a perspective teacher, about leadership?
5. What are your thoughts about leadership and support for 1:1 computing?

Sustainability

Twenty years is a significant amount of time in the life of a school and in the lives of students and teachers.

1. Why do you think the one-to-one program has continued for 20 years?
2. How do individuals and the school community assess the program and allow for changes, if necessary?
3. What factors have contributed to changes in the 1:1 computing program?

Future

1. What would be your reaction if 1:1 computing was discontinued?
2. What adaptations would you have to make without 1:1 computing?
3. If money and personnel were not an issue, how would you like to see the program develop in the next 5 years or 10 years?

Thank you for allowing me to visit with you about the one-to-one computing program. After I have transcribed your interview, I will ask you to read it for accuracy. I will also ask for a second interview with questions that will allow me to probe some of the common themes that will emerge as I interview various people.

Appendix M

Faculty Focus Group Protocol

Date:

Time:

Location:

Thank you for agreeing to participate in this study. We will be discussing the one-to-one Tablet PC program at the school from its inception until today. I will be asking you to recall the programs at key moments in time, the decision to adopt, the implementation period, and its present form. I am interested in understanding your perceptions of educational changes that occurred due to the introduction of one-to-one computing in the school.

Interview Questions

Overview Questions: (this allows researcher to build rapport and have participant answer some "no wrong answer" questions up front.)

1. Please tell me what you teach and about your involvement with the one-to-one program here at school?

Adoption

1. What were your thoughts when you learned that the school was implementing 1:1 computing?
2. As you understood it, what were reasons that guided the school to move forward with this program?
3. What role did teachers play in the decision to adopt one-to-one computing?
4. Once the decision was made, what was the process of planning for the program and who was involved?
5. Knowing what you now know, would you change any part of the planning, decision making and communication process? If so, what, how, and why? Is there anything you would not change, and why?

Implementation

1. What changes have been made to the 1:1 program since its inception?
2. How do you feel about these changes?

Goals of the Program

1. What were the goals of the program? In other words, what motivated the school and individuals to embark on this path?
6. If I were a perspective teacher inquiring about employment, what would you tell me about the 1:1 computing program?
7. What would you tell me, as a perspective teacher, about the school environment?
8. What would you tell me, as a perspective teacher, about leadership?

Sustainability

Twenty years is a significant amount of time in the life of a school and in the lives of students and teachers.

1. Why do you think the one-to-one program has continued for 20 years?
2. What factors have contributed to changes in the 1:1 computing program?

Future

2. What would be your reaction if 1:1 computing was discontinued?
3. What adaptations would you have to make without 1:1 computing?
4. If money and personnel were not an issue, how would you like to see the program develop in the next 5 years or 10 years?

Thank you for allowing me to visit with you about the one-to-one computing program.

Appendix N

Student Focus Group Protocol

Date:

Time:

Location:

Thank you for agreeing to participate in this study. We will be discussing the one-to-one Tablet PC program at the school today. I will be asking you to recall your early perceptions of the program as well as your current thoughts regarding the program. I am interested in understanding how you see your education changed because of one-to-one computing.

Focus Group Questions

Overview Questions: (this allows researcher to build rapport and have participant answer some "no wrong answer" questions up front.)

1. Can you describe for me how you use your Tablet PC at school?
2. How do you use your Tablet PC at home?
3. How do your teachers use 1:1 computing in your classes?
4. Please describe a lesson in which you used your Tablet PC.
5. What are your feelings about that lesson?
6. What have been the biggest challenges of having your own Tablet PC?
7. Can you tell me about the Cave (a center staffed by students and technicians for addressing computer issues)?
8. Has the school recently adopted any new programs or equipment? If so, what are your feelings about these changes?

Goals of the Program

1. What do you think were the reasons for the school's decision to adopt 1:1 computing?
2. How is your learning impacted by 1:1 computing?
3. If I were a perspective student visiting the school, what would tell me about the 1:1 computing program? What do you tell your friends in other schools about the program?
4. How would you describe the school environment (culture) to me, as a perspective student?

Sustainability

Twenty years is a significant amount of time in the life of a school and in the lives of students and teachers.

1. Why do you think the one-to-one program has continued for 20 years?
2. How do students make suggestions for improvements or changes to the program, if necessary?
3. Do you know of any changes that have been made to the program? Why were these changes made?

Future

1. What would be your reaction if the school announced that it was discontinuing the 1:1 program?
2. What adaptations would you have to make without 1:1 computing?
3. If money and personnel were not an issue, how would you like to see the program develop in the next 5 years, and why?

Thank you for allowing me to visit with you about the one-to-one computing program.

Appendix O

Alumna Interview Protocol

Date:

Time:

Location:

Thank you for agreeing to participate in this focus group. We will be discussing the one-to-one Tablet PC program at the school today. I will be asking you to recall your early perceptions of the program as well as your current thoughts regarding the program. I am interested in understanding how one-to-one computing may have changed your education at this school as well as your future education.

Focus Group Questions

Overview Questions: (this allows researcher to build rapport and have participant answer some "no wrong answer" questions up front.)

1. Please tell me what year you began at the school and what year you graduated.
2. Can you describe your experience of using laptop/Tablet PC at school?
3. How did you use it at home?
4. How did your teachers use the laptop in your classes?
5. How frequently did you use your laptop/Tablet PC in class? In what classes, did you use the laptop/Tablet PC?
6. Can you describe a lesson that you remember in which you used your laptop/Tablet PC?
7. What was the greatest benefit of the one-to-one computing program while you were at the school?
8. What were the biggest challenges of having your own laptop/Tablet PC?
9. Was the laptop/Tablet PC ever a distraction for you?
10. When you had an issue with your laptop/Tablet PC to whom did you turn?
11. Can you tell me about the Cave (a center staffed by students and technicians for addressing computer issues)? Did you work in the CAVE?
12. Was the program beneficial to your future in any way?
13. If I were a perspective parent or student, what would you tell me about the one-to-one computing program?
14. If I were a perspective parent or student, what would you tell me about the school environment (culture)?
15. What role, if any, did the 1:1 program play in your further education?
16. What role, if any, did the 1:1 program play in your current occupation?
17. What do you know about the 1:1 computing program as it exists today?

Thank you for allowing me to visit with you about the one-to-one computing program.

Vita

The author was born in Baton Rouge, LA and grew up in New Roads, LA. She obtained her Bachelor's degree in mathematics, with minors in physics and secondary education, from Maryville University in St. Louis in 1980 and her Master's degree in physics from Washington University in St. Louis in 1990. Since 1980, the author has held teaching and administration positions in schools within the Network of Sacred Heart Schools in New York City, St. Louis, New Orleans, and Grand Coteau, LA. In 2002, the author joined the University of New Orleans educational administration graduate program to pursue a PhD in educational administration. Administrative responsibilities that began in 2008 deterred her doctoral studies for a period of time; she returned to the educational administration graduate program in 2016.