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The Impact of 1:1 Technology Initiatives on Lesson Planning

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THE IMPACT OF 1:1 TECHNOLOGY INITIATIVES ON TEACHER PLANNING

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By

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ABSTRACT

THE IMPACT OF 1:1 TECHNOLOGY INITIATIVES ON TEACHER PLANNING

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Dissertation supervised by Dr. Carol Parke

Districts across the country are quickly moving toward a 1:1 student to laptop ratio. Where computer labs or carts were once the norm, many districts are now purchasing all students a laptop to start the year. This movement is occurring at a rapid pace, despite a growing body of research that shows that increased technology does not automatically lead to achievement gains. The teacher plays a vital role in student outcomes, with or without technology. In particular, the manner in which teachers plan lessons is significant to classroom outcomes. This is evident in that the Charlotte Danielson Framework for Teaching (2011), adopted by the majority of states as the rubric for teacher evaluations, recognizes planning as one of the four broad categories essential to effective teaching. Given the explosion of interest in educational technology, as well as the recognition that planning is important to good teaching, the primary goal of this

research study was to determine the impact that 1:1 technology has on teacher planning. A secondary purpose of the research was to determine the barriers to improving the quantity and quality of technology lessons planned in a 1:1 environment. The theoretical frameworks used in this study are the Substitution Augmentation Modification Replacement (SAMR) model and the Technological Pedagogical and Content Knowledge (TPACK) framework. The SAMR model was used as a guide to determine whether technology was used in a way that increased the rigor of a planned lesson (Puentedura, 2014). TPACK was used as a framework to understand barriers to planning technology lessons (Koehler & Mishra, 2005).

DEDICATION

This dissertation is dedicated to Emily, Henry, and Kaleb. Thank you for the encouragement. I missed out on some Nerf basketball and Cribbage, but you kept me in the game most of the time.

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Chapter 1: Introduction

School districts have invested billions of dollars in educational technologies over the last few decades with the belief that it would lead to increases in student achievement (Russell, Bebell, & Higgins, 2004). Computer labs and carts were once the norm, with groups of students sharing class-sets of computers for specific activities. Now decreases in the cost of machines, increased portability, and greater wireless network have made laptop computers more accessible to schools (Penuel, 2006). The ratio of laptop computers to students is moving closer to 1:1, with many districts investing in personal devices to be distributed at the beginning of the year along with textbooks. In a February, 2017 survey from EdTech Magazine shows that nearly 50% of educators reported having a 1:1 student to device ratio, up 10% in just one year. If trends continue, nearly all teachers will operate in a 1:1 environment within a decade ("More than 50%,").

One to one technology programs have led to gains in reading, mathematics achievement, and motivation (Harper & Milman, 2016). However, in many cases, the large financial investment has not led to significant gains in achievement (i.e., Larkin & Finger, 2011). In spite of the somewhat mixed research results, many school districts, as well as state and federal departments of education, continue to jump into the deep end in terms of technology investments. In 2013, more than half of the world's spending on personal devices happened in the United States, reaching more than four billion dollars (Nagel, 2014). Florida, Maine, Michigan, North Carolina, South Dakota, and Texas even invested resources to launch state-wide 1:1 programs (Argueta, et al., 2011; Holcomb, 2009).

Running on a parallel track with recent interest and investments in technology, districts have also recognized the significance of quality teaching to student outcomes. In fact, research has shown that good teaching practices can close the racial achievement gap between groups of students (Farr, 2010). Over the last decade or so, districts across the country scrambled to develop evaluation tools to capture what it means to be a quality teacher. Recognizing its potential charitable impact, The Bill and Melinda Gates Foundation invested 45 million dollars between 2008 to 2013 to study teaching, particularly how to evaluate the effectiveness of a teacher; The RAND Corporation estimates that Hillsborough County Public Schools alone spent 24.8 million dollars to develop a teacher evaluation system (Chambers, Brodziak de los Reyes, & O'Neil, 2013). Lesson planning is consistently recognized as a primary component to high quality teaching, and therefore has occupied a prominent role in evaluation tools. The Charlotte Danielson Framework for Teaching (2011), adopted by the majority of states as the rubric for teacher evaluations, recognizes planning as one of the four broad categories essential to effective teaching.

Given the explosion of interest in educational technology, as well as the recognition that planning is important to good teaching, the primary goal of this research study is to determine the impact that 1:1 technology has on teacher planning.

Statement of the Problem

Over the last few years, the number of 1:1 schools around the nation, and in particular Pennsylvania, has grown dramatically. While state records do not document a comprehensive list of 1:1 schools, a few quick Google searches show the extent to which technology has permeated Pennsylvania schools. For example, North Allegheny, the

largest district in the northern suburbs of Pittsburgh, proclaims on their website that providing a device to each student "will help create a dynamic learning environment" (https://www.northallegheny.org). Lower Merion Schools note that, since 2007, their 1:1 program has resulted in "a learning environment in which problem-solving, critical thinking and leadership skills are developed and enhanced through the responsible use of technology and continuous access to digital resources". (https://www.lmsd.org/academics). Upper St. Clair school district cites customization and personalization of learning as primary goals of their 1:1 program. Although the reasons that schools cite for their 1:1 initiative may vary, it is safe to assume that the school board, district administration, and other stakeholders expect such a major investment to impact teachers' lesson plans and student achievement.

While districts certainly hope for gains in achievement, this is not always the case. In an elementary school study, Carr (2012) examined fifth grade classrooms that showed a drop in scores after using devices. Students from two rural Virginia classrooms used various apps and web-based materials to learn math as part of the district's 1:1 initiative. However, pre and post tests showed little difference in achievement. In general, classroom environments are complex, and raising achievement depend on many variables beyond devices, including the teachers' technological knowledge and ability to use technology to increase the rigor of a lesson (Mishra & Koehler, 2006). It is clear that the teacher plays a primary role in student outcomes, with or without technology. In order to maximize the impact of technology it is important to understand the manner in which teachers plan to use technology when a 1:1 environment is available. Furthermore, there may be barriers such as a lack of professional development that prevent even the most

willing teacher from properly implementing technology into the classroom (Ertmer, 1999). In an environment where district funds are often limited, Pennsylvania schools are investing billions of dollars on technology that may result in little to no achievement gains.

Purpose of the Study

The purpose of this study is to examine the impact that ubiquitous access to technology has on teacher planning in a 1:1 school environment. Specifically, I wanted to determine how the availability of technology at all times, as opposed to access through shared laptop carts, impacts teacher lesson planning. Did teachers plan to incorporate technology into their lessons more often? Furthermore, did teachers plan to use technology in ways that increased the rigor of the lessons? I propose to analyze lesson plans before and after 1:1 technology was available to determine the effect on planning.

A secondary purpose of the research was to determine the barriers to improving the quantity and quality of lessons in a 1:1 environment. I propose to use teacher and student survey data to determine whether first order or second order barriers prevent teachers from incorporating technology into their classrooms. First order barriers are those external to the teacher, such as the network or lack of professional development. Second order barriers are barriers internal to the teacher, such as mindset or attitudes toward technology (Ertmer & Ottenbreit-Leftwich, 2010).

Theoretical Framework

The theoretical frameworks used in this study are the Substitution Augmentation Modification Replacement (SAMR) model and the Technological Pedagogical and Content Knowledge (TPACK) framework. The SAMR model was used as a guide to determine whether technology was used in a way that increased the rigor of a lesson (Puentedura, 2014). TPACK is used as a framework to understand barriers to planning effective technology lessons (Koehler & Mishra, 2005).

The SAMR model, developed by Ruben Puentedura, serves as a framework for classifying the level of technology implementation and can be used as a frame of reference for understanding whether technology improved student learning opportunities (Puentedura, 2006). The framework consists of four categories described below:

- Substitution – Technology substitutes an existing lesson with no increase in learning opportunities.
- Augmentation – Technology serves as a substitute for the existing lesson, but there are some functional improvements.
- Modification – The learning activity can be completely restructured with technology, allowing for significantly improved learning opportunities.
- Redefinition – Technology allows for the planning and creation of tasks and learning opportunities that would otherwise be impossible.

The SAMR Model Framework was designed as a guide for how to use technology to enhance learning opportunities. Puentedura (2013) notes that as you move into the Modification and Redefinition categories, technology provides the opportunity to

transform learning. However, when technology is used at the Substitution and Augmentation levels, the cost of 1:1 technology may not be worth the minimal gains (Romrell, Kidder, & Wood, 2014). When technology activities remain at the lower levels of implementation, students are doing activities very similar to what they might do without technology. The school district may have spent thousands of dollars on devices that represent minimal or even no functional improvement in learning opportunities.

The simple introduction of technology cannot, in and of itself, benefit students. It is dependent upon many factors, including the context of the lesson and the manner in which the material is presented. The Technological, Pedagogical, and Content Knowledge framework (2005) is helpful to make sense of the complexity of teaching with technology. In particular, this framework is useful in understanding the barriers to planning and implementation. Koehler and Mishra first introduced the framework, and the basic idea is that there are three different components, or knowledge bases, necessary to teach well with technology: Technological, Pedagogical, and Content Knowledge (2005). All three are intertwined and will determine whether or not a teacher teaches with technology and whether they effectively do so (Voogt, Fisser, Roblin, Tondeur, & Van Braak, 2013). Mishra and Koehler (2006) described TPACK as a Venn diagram with overlapping circles representing each of the three necessary bodies of knowledge, and the area in the Venn diagram where the three bodies of knowledge intersect is considered most important to "good teaching".

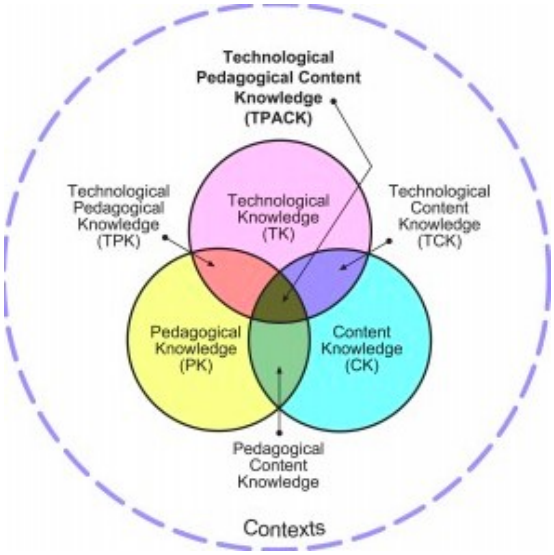

Figure 1: TPACK Model, Mishra and Kohler (2006).

These three areas define the prerequisite knowledge for teaching well with technology, and will be used as a backdrop for making sense of survey data. Teacher and student survey data will be used to determine the particular types of barriers that prevented teachers from planning to incorporate technology into their lessons. For example, if teachers express the need for additional training on how to use the devices, then a lack of technical knowledge may be a barrier to planning technology lessons.

Research Questions

The goal of my research is to answer the following two questions:

- What impact did 1:1 technology availability have on teacher lesson planning?
- What were the barriers to planning lessons in a 1:1 technology environment?

Significance of the Study

Although the cost of educational technology continues to decrease, a one-to-one initiative still represents a huge district commitment to technology. In a culture of shrinking budgets and increased teacher and student accountability, districts must allot for not only the cost of machines, but also an improved network, technology support, professional development, and the stress that change on a system may bring. It is clear that in order to get the most "bang for their buck", districts must support teachers in high-level implementation of the devices. This includes recognizing the importance that lesson planning plays to high level implementation. When making such an investment, it is also important for districts to understand the barriers that may limit technology integration.

Many studies have explored the impact that technology has on teacher pedagogy (i.e., Russell, Bebell, & Higgins, 2004 & Mouza, 2008) and student achievement (i.e., Bebell, Clarkson, & Burraston, 2014). Russell, Bebell, and Higgins (2004) compared 4th and 5th grade 1:1 classrooms with classrooms that relied on shared computer carts. They found that 1:1 environments had more technology use and that pedagogy shifted toward less whole group instruction. Mouza (2008) found that teachers were able to use laptops to create dynamic lessons for their students. Bebell, Clarkson, and Burraston (2014) examined two suburban sixth grade classrooms and found that 1:1 classroom environments led to increased English Language Arts achievement as well as improved quality of social interactions. Bebell, Clarkson, and Burraston further stressed the importance that teachers are *well-prepared* to use technology, pointing to the significance of planning.

Given that student achievement results in 1:1 programs have varied, researchers have looked at the barriers to implementation, as well as the conditions necessary to support high level implementation. However, none of the research in my review of literature zeroed in on the impact that 1:1 programs have had on teachers' lesson planning. In a 1:1 environment, teachers and students have access to nearly unlimited resources, including experts in various fields, educational apps, examples of high-quality work, new and innovative opportunities for collaboration to name just a few. Given this ubiquitous access to resources, does the manner in which teachers plan lessons in a 1:1 environment change? How are the written lesson plans different? Lesson planning is recognized as an essential component to quality teaching (Danielson, 2011). Therefore, studying the impact of 1:1 initiatives on teacher planning will contribute to the body of research and discussion on how to plan for and implement technology more effectively.

Limitations

The teacher sample for this study was limited to just 6 volunteers from 4 subject areas. The teacher sample included only teachers from one high performing, predominantly white, affluent, suburban high school in Pennsylvania. Although this may potentially limit the generalizability of the study, it made the study easily controlled. The study was also limited to the first year of 1:1 implementation. The impact of a 1:1 environment may be different over time as teachers gain more experience with devices and receive additional professional development, peer, and administrative support.

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Chapter 2: A Review of the Literature

In part one, I provide a brief overview of the technology movement in education over the last three decades. This is important to give context to not only the importance of technology in education, but the significance of my study. Billions of dollars have been funneled into technology with movements at local, state and national levels, culminating with recent initiatives to provide every student with a laptop (Holcomb, 2009). The term 1:1 is used when a school supplies all students in the school with a laptop or notebook computing device. This sets the stage for parts two to four of the literature review, which focus on the impact that technology has had on student learning and teacher pedagogy, as well as the framework used to make sense of the prerequisites for high level implementation. I reviewed this literature to help answer the question, "Why are so many schools pouring limited resources into technology?" Several common themes came out of the research, including goals of creating a 21st Century workforce, improving academic achievement, and leveling the educational playing field in terms of access to resources. The research shows that, overall, technology has had a positive impact on achievement and classroom social dynamics (Harper & Milman, 2016). However, research also provides plenty of examples where technology has had little or no impact on student learning (i.e., Carr, 2012). The TPACK Framework can be used to make sense of the complexity of teaching with technology (Mishra & Koehler, 2006).

In part five I explore barriers to effective planning and implementation. With so much potential, why do some teachers plan for and implement technology effectively while others do not? While it is not difficult to find research on the impact of technology

on student learning (i.e., Harper & Milman, 2016) and barriers to effective technology implementation (i.e., Ertmer & Ottenbreit-Leftwich, 2010), very little research exists on the impact that 1:1 technology has on teacher planning. We know that good planning is vital to teaching high quality lessons, regardless of whether there's technology or in the lesson or not (Danielson, 2011). As schools move to 1:1 programs, the goal of my research is to answer the question, "How have teacher plans changed with the addition of 1:1 technology?" In part six I review literature that shows the importance of good planning when it comes to implementing high quality lessons. In part seven I review research on the Substitution Augmentation Modification Redefinition (SAMR) model (2014), a framework used to gauge the effectiveness of technology implementation. The SAMR model basically provides a hierarchy of lessons, moving from examples of low-level implementation to higher-level implementation. While I will explain some issues with using this model to evaluate lessons, it has gained popularity because it provides a simple rubric for evaluating the quality of technology integration.

PART 1: A Brief History

Computers, laptops, and hand-held devices are currently such a staple in many students' lives that it is almost difficult to imagine a time when they were not part of the classroom (Giles, 2006). However, in 1983, the ratio of students to devices was 125:1 (Russell, Bebell, & Higgins, 2004). This means that only 35 years ago there was just 1 computer available for every 5 to 6 classrooms. Given this ratio, it's safe to assume that just a generation ago in most schools, on most days, students did not have individual access to a computer device as part of their instruction.

By 2002 school districts had funneled enough money into computer purchases that the ratio of students to computers had shrunk nationally to 4:1 (Russell et. al, 2004). The technology movement in education was not limited to individual districts seeking to add a technological advantage for their students; significant legislation was passed at the federal level pushing for more technology. The U.S. Department of Education's Enhancing Education Through Technology (EETT) program, as part of the No Child Left Behind (NCLB) Act of 2001, states its primary goals as a) improving academic achievement through the use of educational technology b) ensuring that every student is technologically literate by 8th grade, and c) ensuring the effective integration of technology in teacher training and curriculum development (Bakia, Means, Gallagher, Chen, & Jones, 2009). More broadly, NCLB required districts to raise achievement and narrow achievement gaps.

Given the NCLB mandate to use technology and the pressure on districts to raise achievement, whole states enacted their own technology initiatives. In 2005-2006 the state of Michigan, as part of the Freedom to Learn grants, issued laptops to approximately 20,000 students in 195 schools (Lowther, Inan, Ross, & Strahl, 2012). Just a few years prior, the state of Maine invested $37 million to purchase laptops for every 7th and 8th grade middle school student. Texas followed suit with a statewide initiative of its own (McLester, 2011), and Virginia upped the ante by purchasing 25,000 laptops for students in grades 6-12 (Bebell, 2005). Pennsylvania did not invest in 1:1 initiatives at the state level, but many districts have invested in devices for all of their students.

Shared computer labs and carts used to be the norm in schools, but this new wave of interest in technology created the conditions where schools and individual classrooms

were soon outfitted with enough technology so that nearly all students had access. The student-computer ratio in schools is currently close to 1:1 and nearly all schools across the country have the Internet in classrooms (Gray, Thomas, & Lewis, 2010). This was made possible in part by the decreasing costs of devices as well as their portability, connectivity, and increased Internet availability (Penuel, 2006). The use of technology in classrooms has gained even more momentum in recent years, with many districts issuing a district-funded laptop to students at the beginning of the year along with textbooks.

While costs of devices have decreased over the years, school districts accept significant hidden costs that add to the simple cost of devices. Districts must build out and maintain a network, account for repair and replacement costs, train staff and students on use, and potentially employ technology teams to sustain the effort. A recent survey of schools showed that approximately five out of six districts now employ a staff person devoted just to technology. In the same survey, nearly 70 percent of schools reported that their district adequately invested in technology (Schrum & Levin, 2009). Damian Bebell (2005), senior research associate at the Center of the Study of Testing, Evaluation and Education Policy, at Boston College, described the impact and cost of the technology movement in no uncertain terms: "Few modern educational initiatives have been as widespread, dramatic, *and costly* as the integration of computer technologies into American classrooms" (p.3). At the federal level, the "education rate" (E-Rate) was created to support networks. All K-12 schools and libraries are eligible to apply. This fund has allocated over 20 billion dollars to schools since it was first started in 1998, highlighting the national commitment to technology in schools (Hudson & Rockefeller, 2009). However, unless federal grant money is obtained or the state foots the bill,

districts must determine how to pay for 1:1 programs. Perhaps more importantly, districts must determine what must come out of the budget in order to provide laptops for all students.

By definition, a 1:1 program occurs when students and teachers have ubiquitous access to technology, with each student having a laptop of his or her own. It is important to note, however, that significant differences may exist from one program to the next in terms of the devices and the manner in which they are used. In a review of 1:1 empirical studies, Bebell and O'Dwyer (2010) note that quite a bit of variability in programs exists because of differences in stated goals and educational practices. Simply having devices in the hands of teachers and students is not enough. Schools must focus on how this technology is being used to improve learning opportunities for students. In particular, these high-level learning opportunities will occur through strategic planning on the part of teachers, not by the simple presence of devices.

Part 2: Rationale and Student Impact

Given the seemingly glacial pace at which educational change often occurs, the push for technological innovation, and the rate at which technology has gained prominence in schools, is striking. The purpose for incorporating technology into the classroom, however, is not always the same. In a research synthesis, William Penuel (2006) noted that 1:1 initiatives varied greatly in their purpose. Some initiatives focused narrowly on equity of resources while others focused on more general economic goals like creating a more productive workforce. The differing goals could also be seen in the variety of work products, which ranged from the typical student creations in a traditional

classroom to projects that would have been impossible without technology (2006). Lowther, Inan, Ross, and Strahl (2012) noted that educators, administrators, and stakeholders expect to use technology to increase students' achievement and help them to gain the academic and technical ability that will allow them to be successful in the workforce.

The increase in the sheer amount of technology, coupled with the range of intentions for incorporating technology, shows the high expectations that educational leaders have for 1:1 initiatives. Most research studies show at least some achievement-related benefit to using technology (Harper & Milman, 2016). However, given the varied achievement results, technology is obviously not the "magic bullet" that many might hope for in terms of achievement. In a review of 1:1 literature from 2004 to 2014, Harper and Milman (2016) concluded that, in general, 1:1 implementation *can* have a positive impact on student achievement. After reviewing studies around student achievement, I will highlight other documented benefits to 1:1 classroom technology.

A review of literature showed examples of improvements in student achievement in elementary, middle, and high schools across content areas. In a quasi-experimental study of 4th grade literacy, Sur, Hernandez, and Warshauer (2010) compared students in a 1:1 classroom with student who were not in a 1:1 environment. The study showed slight improvements in the ability to analyze literature as well as improvements in students' writing strategies. Furthermore, they found that the heterogeneous group of 54 students showed greater gains in literacy than the other students after the second year of implementation. This study highlights the potential for technology to be used to eliminate gaps in achievement. In a study of sixth grade classrooms, researchers examined the

impact of 1:1 technology at a suburban middle school and found higher levels of engagement and gains in standardized English test scores (Bebell, Clarkson, & Burraston, 2014). Similarly, another comparison of middle school math scores in 1:1 schools vs. 1:5 schools (1 computer shared for every 5 students) showed greater gains in the 1:1 environment (Clariana, 2009).

It is worth noting several impacts that 1:1 technology has been shown to have in classrooms that may, in fact, help produce gains in achievement. Technology has been shown to have an impact on student engagement, motivation, and the quality of communication and collaboration in the classroom (Harper & Milman, 2016). However, this may be a direct result of increased engagement. Several studies show that putting devices in the hands of students, with the potential to learn in new ways, leads to more time on task and increased focus. In a longitudinal study of the first three years of 1:1 implementation in a middle school, attendance and frequency of discipline issues were used to measure engagement. It was shown that school attendance was greater and disciplinary infractions were significantly lower in the 1:1 laptop environment when compared to schools without such programs (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011). Furthermore, in a study of low SES elementary schools, first year implementation was shown to result in an increase in both engagement and motivation (Mouza, 2008). These results may be particularly significant for schools with a large percentage of low SES students and a high number of discipline referrals.

Bebell and Kay (2010) found that middle school students in first year 1:1 implementation showed an increase in both motivation and engagement. A potential source of increased engagement and motivation is the opportunity that laptops provide for

students to explore topics on their own, as opposed to being dependent upon the teacher to line up activities. When finishing a worksheet or assignment, web access allowed students to look up virtually anything of interest (Bjorvall & Engblom, 2010). In a previously referenced study of elementary school students, students used technology to dig deeper into topics during down time, resulting in more ownership of their learning (Mouza, 2008). In Clariana's study (2009) of 1:1 implementation in a middle school, students relied less on the teacher and were more proactive in figuring out what to do when they were stuck in solving a problem. These studies point to the conclusion that in a 1:1 environment students have the ability to work more independently and continue learning without the support of the teacher. On the other hand, some studies have shown an increase in off-task behaviors when students have devices in their hands. Access to the internet provides the opportunity to browse unrelated websites or message each other inappropriately. Donovan, Green, and Hartley (2010) found that certain student configurations in a 1:1 environment resulted in more behavioral issues. In this study the actions of the teacher in organizing the classroom and grouping students mattered.

An important feature of the No Child Left Behind Act noted earlier was the emphasis on eliminating the achievement gap between groups of students. An appealing notion of 1:1 initiatives is that Internet access provides students with equal access to resources that were previously available to only a smaller number of students, strengthening the connection between school resources and a greater number of students and families (Purcel, et al, 2013; Penuel, et al, 2001). The amount of time students used computers outside of the school day has been shown to be a strong predictor of academic achievement - This highlights a benefit to making technology available to all students

outside of the school day (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). Several studies show that devices can lead to a narrowing of achievement gaps. For example, the use of devices in a middle school class was shown to narrow the gap in achievement between high and low performing students (Shapley, Sheehan, Caranikas, & Walker, 2011).

Articles have been written over the decades voicing concerns about schools relying too much on technology (i.e., Richards, 1999). A few parents echoed this sentiment at an information meeting at the site of this study. They expressed concern that the introduction of laptops will feed the technology frenzy that already engulfs students' lives outside of the classroom. They worried that students already spend too much of their time staring at screens; school should be a refuge from the constant onslaught of television and social media. As one parent succinctly stated to me privately, "How are our kids ever going to learn to communicate with others in real life?" This highlights the important role of the teacher in the classroom. The teacher could certainly just put students in front of the screen and hope that achievement increases. However, Harris, Al-Bataineh, and Al-Bataineh (2011) note that technology cannot be used as a replacement for good teaching. In their study of fourth grade classrooms in a Title 1 school in Illinois, they summarized that technology may have contributed to higher test scores and increased engagement, but the manner in which technology was used to engage students was key.

Studies reveal that 1:1 technology may not only be used to increase student achievement and eliminate achievement gaps, but it also may be used to *increase* the quantity and quality of communication and collaboration in classrooms (Shapley, et al.,

2011). Communications are not only improved between teacher and student, but also between students. In a study of two suburban sixth grade classrooms, researchers Bebell, Clarkson, and Burraston (2014) examined the impact of 1:1 technology and found increased frequency and improved quality of social interactions. Students were less likely to work individually and more likely to work in small groups. Whole class instruction was still the dominant mode of teaching, but this may point to 1:1 technology as a way to decrease the amount of whole group instruction and increase the amount of collaboration/cooperation in the classroom. The observational data in this study showed that collaboration not only increased, but the number of discussions relevant to the curriculum also increased. Not only were many of the students talking more, they were talking about things that the teacher wanted them to talk about. In a different study of middle school students in a 1:1 environment, students communicated more often with each other, more effectively, and overall collaborated more after laptops were introduced. They ended up having more group work and conversations increased in ways that were more academically focused (Shapley, Sheehan, Caranikas, & Walker, 2011).

While a review of the literature overwhelmingly points to the fact that technology can have a positive impact on achievement and improve communication, several studies in this review of literature showed no change in student achievement or even a negative impact. James Carr (2012) analyzed the effects of iPad use in two fifth grade mathematics classrooms in rural Virginia. For nine weeks, the experimental 1:1 class used iPads daily during mathematics instruction while the control group did not. He found no significant difference in scores based on pre and post-tests. In a mixed-methods study of middle school science and English achievement, Hur and Oh (2012) found that

laptops had no impact on achievement. Additionally, they found that the original increase in engagement that occurred with the introduction of technology did not last over time. Engagement increased at first, but then declined as the novelty of the devices wore off. In a study of fifth grade Taiwanese students, Liu, Lin, Tsai, and Paas (2012) analyzed science lessons where the use of digital images seemed to overwhelm the students and hinder learning. In this study eighty-one fifth grade students were assigned randomly to three different instructional groups for their study of plants. One group received text with images embedded in their mobile device. The second group received text in their device in addition to a real-life object. The third group received text and images on their mobile device as well as a real-life object to study. The post-test comprehension exam surprisingly showed that the first two groups outperformed the third group. Students who had access to additional text and images on their devices performed worse, suggesting that additional information on the devices did not support learning. These examples highlight the complexity of teaching with technology, where content, context, and pedagogy are all intertwined.

Part 3 TPACK Framework

The simple introduction of technology does not, in and of itself, improve learning. Classroom instruction is dependent upon many factors, including the context of the lesson and the manner in which the material is presented. The Technological Pedagogical Content Knowledge (TPACK) Framework (2005) is helpful to make sense of the complexity of teaching with technology. Koehler and Mishra first introduced the framework, and the basic idea is that there are three different components, or knowledge

bases, necessary to teach well with technology: Technological, Pedagogical, and Content Knowledge. To incorporate technology effectively, teachers need to be competent in all three domains. In a review of literature, Voogt, et.al. (2013) noted that all three are intertwined and will determine whether teachers use technology effectively (or whether they even use technology at all). Mishra and Koehler (2006) described TPACK as a Venn diagram with overlapping circles representing each of the three necessary bodies of knowledge, and the area in the Venn diagram where the three bodies of knowledge intersect is considered most important to good teaching.

In the TPACK framework, teacher beliefs impact instruction and are generally considered from two perspectives: beliefs about technology and beliefs about pedagogy (Hammond & Manfra, 2009). In the context of a social studies model, Hammond and Manfra argue that when teachers plan and implement lessons, their pedagogical beliefs and lesson goals will directly impact how technology is incorporated into lessons. Teachers decide on the work product and how the lesson should function, and *then* they determine the appropriate technology to suit the goals. Both are important to my research, considering a primary goal of 1:1 learning at the school is to transform learning, not simply to increase the use of computers. Teachers' technological knowledge (TK) was found to be a good predictor of teacher attitudes toward technology (Abbitt, 2011). This is important for administration to recognize when planning professional development opportunities; teachers must have a strong working knowledge of the hardware and applications in order to feel comfortable supporting technology lessons. Research on technology implementation from the TPACK framework shows that as the knowledge base in each of the domains increases, many issues involved with technology

implementation will be resolved (Mishra & Koehler, 2006). Furthermore, as knowledge levels increase, teachers' feelings of self-efficacy and positive attitudes also increased (Lee & Tsai, 2010). Positive feelings about technology are critical to proper implementation of technology. In a study of student teachers, it was found that teachers were reluctant to plan and implement lessons with technology, even with the proper training and prospect of increased achievement, if they had negative views about technology in the classroom (Niess, 2005). Classrooms are complex environments; when making the significant investment in technology, districts need to recognize that student learning is dependent upon the teacher knowledge in each of these three areas. Laurie Brantley-Dias (2013) points out that a limitation of the TPACK framework is that it ignores teacher beliefs as well as the manner in which technology is implemented. It assumes that simply having knowledge in each of these three areas automatically leads to good teaching and student outcomes. This point is obvious to people who have spent time in the classroom – accumulating a broad knowledge base in any number of knowledge bases will not get results. How you plan and implement lessons with this knowledge base is critical.

In summary, research shows that knowledge of content, pedagogy, and technology impacts the manner in which lessons are planned and implemented. It is important to recognize the complexity of classrooms when analyzing the impact of technology. The degree to which technology influences lessons depends on many factors. In the next section I will discuss how research shows that technology, in turn, has been shown to impact teacher pedagogy which in turn impacts student outcomes.

Part 4: Impact on Teacher Pedagogy

From the studies described earlier, it is evident that teachers' plan and implement technology in different ways, with varying results. Teachers with constructivist beliefs tend to use technology in student centered ways while those with more traditional, teacher-centered pedagogy beliefs tend to use technology to support teacher-centered practices (Hermans, Tondeur, van Braak, & Valcke, 2008). Constructivist, student-centered lessons are generally considered to be higher level while more teacher-centered practices are considered low-level (Becker, 1994 & Becker & Riel, 1999). Teachers tend to use technology to support the pedagogical practices present before technology was available. In other words, teachers with student-centered beliefs tend to incorporate technology in ways that support student-centered lessons, while traditional teachers tend to pick up computers and use them in ways that support their control over the lesson and dissemination of information (Sandholdtz, 1997). While a more student-centered approach doesn't necessarily account for increases in achievement, it does point to variations in implementation, and therefore, variations in student learning.

Even though teachers tend to use technology in ways aligned with their existing classroom practices, research shows that over time teacher pedagogy does not remain fixed in a 1:1 technology environment; teachers tend to move toward more student-centered pedagogy (Russell, Bebell, & Higgins, 2004, Mouza, 2008, & Clariana, 2009). When Bebell and Kay (2010) looked across three years of implementation in five different 1:1 schools, they found that even though learning outcomes varied, changes in teacher practice were consistent across schools. Teachers generally shifted toward a more student-centered learning environment. This trend is supported by other studies. In

a study of sixth grade classrooms by Bebell, Clarkson, and Burraston (2014), teachers changed traditional lessons to be more creative and individualized. For example, traditional map lessons in social studies classrooms were revamped to include digital tours of regions around the world. These types of changes showed an increase in collaboration and student engagement. However, it should be noted that there is a steep learning curve. Even when teachers report constructivist attitudes and positive feelings toward technology, it can take several years before this is actualized in classroom practice (Suhr, Hernandez, Grimes, & Warschauer, 2010). Many barriers present themselves when considering technology implementation. Some are external, or outside of the control of the teacher. Others are inherent in teacher beliefs. It is important to analyze these barriers when considering the impact that technology can have on student achievement, teacher pedagogy, and lesson planning.

Part 5: Barriers to Planning and Implementation

Throughout the history of 1:1 devices in schools, the purchase of laptops did not necessarily mean that they would be used effectively, or even at all. An analysis of computer use in several different countries (UK, Thailand, Greece, Australia, and the Netherlands) showed that computers are under-used, both in the amount of time that they are used as well as the quality of their use (Mueller, Wooda, Whilloughby, Ross, & Specht, 2008). In spite of the NCLB national push as well as other local mandates to incorporate more technology into lessons, teachers have expressed fear about incorporating technology into their practice (Hartley & Strudler, 2007).

About 15 years ago, teachers regularly cited the reliability of their network as a concern for using computers (Hill & Reeves, 2004). In a later study that investigated

teacher concerns, researchers found that teachers fell into one of two groups: those that worried about what technology meant to them personally, and those that worried about how they would incorporate technology to meet the needs of their students. The vast majority of concerned teachers were worried about how they would personally be able to change their teaching to include technology (Donovan, Hartley, & Strudler, 2007). The studies just cited point to two distinct types of barriers to incorporating technology into lessons: first order barriers, which include things that are external to teachers (such as the network), and second order barriers, which include attitudes and beliefs of the teacher (Ertmer, 1999).

Defined initially by Peggy Ertmer (1999), first order barriers are external to the teacher; they are outside of the teacher's control. Examples include a lack of adequate access to computers, insufficient professional development, time, a lack of functional equipment, and technology support. In early studies, first order barriers were the primary reasons given by teachers for not using technology (i.e., Adelman, et. al, 2002; Cuban, 2001; Sheingold & Hadley, 1990). As technology first became prominent in schools, usually in the form of computer labs or mobile carts, teachers pointed to the lack of computer availability, the need to reserve carts, or the need to schedule their classes into labs as reasons for not using technology (Adelman et al., 2002). Given the advances in technology and the amount of money poured into building out school networks, one might expect an elimination of first order barriers. However, teachers still regularly cite insufficient technical support and outdated Internet filters that block useful websites as barriers to technology integration (Klieger, Ben-Hur, & Bar-Yossef, 2010).

Beyond technical reasons, several other first order barriers are worth noting. In one study, a "crowded curriculum" was cited as a reason for teachers not using technology. Teachers felt as though there was too much ground to cover, and that they did not have the time needed to try out new strategies (Larkin & Finger, 2011). In a different study, teachers felt that the traditional curriculum was not conducive to innovative, technology-based lessons. They felt that thematic units would be better (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). Some teachers even used the words "fearful" and "intimidated" when considering using more technology in their classroom (Ertmer & Ottenbreit-Leftwich, 2010). This supports the idea that professional development and administrative support are necessary when 1:1 programs are launched to help teachers become more comfortable with devices and ease transitions in pedagogy. In fact, teachers identified professional development as a significant barrier to implementation (Ware & Stein, 2014). In a longitudinal study of science teachers, Drayton et al. (2010) found that a lack of professional development was an obstacle for effective technology lessons. They reported steep learning curves for teachers when new technologies were introduced. Teachers reported that a "lack of time for professional development, especially in the form of teacher collaboration to develop best practices within the school, becomes a barrier to effective integration of computer and Web resources in the classroom" (Drayton et al., 2010, p. 41).

The United States Department of Education donated millions of dollars toward the training of teachers to use technology in the form of Preparing Tomorrow's Teachers to Teach with Technology (PT3) grants to universities, K-12 schools, and state departments of education. Polly, Mims, Shepherd, and Inan (2009) evaluated journal

articles and research related to PT3 and found that technology field experiences and mentorships focused on integrating technology are improve teachers' TPACK knowledge bases, and therefore their ability to teach well with technology. Analysis of PT3 research also found that a lack of administrative support proved to be a barrier (Polly, et al., 2009).

School leadership plays a critical role in helping teachers overcome first order barriers. Change in practice requires professional development and the support of administration (Blau & Presser, 2013). Bebell and Kay (2010) found that in teacher and student surveys, schools that had the least computer use cited a lack of leadership support. Supportive school leadership and the creation of professional communities were seen as key to changing pedagogy in 1:1 environments. Professional communities allow teachers to build up their knowledge base, collaborate and align lesson plans, and share ideas about apps or other digital materials. This was seen in two middle school studies (Bebell, Clarkson, & Burraston, 2014 and Downes and Bishop, 2015). By investing in equipment, technological infrastructure, and providing the proper training, including linking teachers to other teachers, administrators can eliminate many of the first order barriers that prevent technology integration. However, this will not necessarily lead to full integration.

A district may build out the network, purchase devices for students, and provide professional development, effectively eliminating all first order barriers, and still not have full technology implementation in classrooms. Dr. Ertmer (1999), who coined the phrase "first order barriers", also coined the phrase "second order barrier" to describe barriers that are inherent in the teacher. They include teachers' personal belief about technology and pedagogy, as well as their willingness to make changes in their practice.

Even if all of the technology works correctly, teachers may not see the benefit to planning and incorporating technology lessons.

Teachers' beliefs are important in how technology is used in the classroom. If teachers see technology as relevant and useful, they will be more likely to incorporate it into their lessons (Mueller, Wood, Willoughby, Ross, & Specht, 2008). In fact, teachers' own beliefs about the relevance of technology to student learning were perceived as having *the biggest* impact on implementation (Ertmer, Ottenbriet-Leftwich, Sadik, Sendurer, & Sendurer, 2012). If teachers do not see the value in technology, it will not lead to student gains. Several studies have shown that negative attitudes about technology even resulted in an increase in students' disruptive behaviors (i.e., Zuber & Anderson, 2013; Andersson, Hatakka, Gronlund, & Wiklund, 2014).

The level of technology implementation varies in classrooms, and student achievement will certainly depend on the manner in which technology is used. In a study of eleven junior high school teachers in a 1:1 school in Israel, only two of the teachers saw a 1:1 wireless environment as an opportunity to replace old methods with new ones. The remaining nine teachers simply incorporated their new devices to do exactly the same types of lessons that they previously did (Peled, Blau, & Grinberg, 2015). This phenomenon has been observed more generally across teaching environments. The primary method of teaching in schools is Initiate-Response-Evaluate, commonly referred to as IRE (Wertsch, 1998). In this traditional teaching method, teachers ask a question of the whole class, a student gives an answer, and then the teacher judges the answer to determine correctness. With this teaching method, students are not given the opportunity to explore new content, argue ideas, or learn from each other. Teachers who teach in this

style are often the most resistant to change, even when new possibilities of teaching are opened up in a 1:1 environment (Blau, Peled, & Nusan, 2014). Teachers may justify this teaching method with the need to maintain control of the class or the need to cover all of the material in the curriculum (Lim & Chai, 2008).

Regardless of teacher rationale, some teachers incorporate technology to advance the learning opportunities of their students while others continue to plan and implement the exact same types of lessons as they always did. Teachers may move more toward student-centered practices, but even teachers with a positive mindset, who have had all first order barriers removed, are still not able to implement technology effectively. To account for this phenomenon, researchers Tsai and Chai (2012) first described a lack of "design thinking" as a third order barrier.

The third order barrier stems from the observation that you can remove first and second order barriers, but still not have implementation of technology in a desired way. In other words, teachers may have all the digital resources available and plan to use them, have the proper mindset, professional development opportunities, supportive administration, etc., but still not implement technology in a way that increases learning opportunities. Tsai and Chai (2012) described the necessary skills of a teacher to implement technology well as an "art". A lack of "design thinking" was found in a mixed-methods study of elementary teachers. While increased learning was reported across levels in this study, many students were distracted by technology, instead using it for gaming and chatting purposes. In spite of appropriate conditions, including teacher attitudes and mindset, the planning and implementation of technology did not always have the intended results (Storz & Hoffman, 2013).

Although she did not label "third order barriers" to implementation, Peggy Ertmer (2005) also discussed how technology implementation takes time and occurs in a spiral rather than in a linear fashion. Teachers pick up certain techniques and learn new things, later return to previous ideas, make a few advances and continue moving forward in their learning. This suggests that teachers who make strides in their pedagogy are those who possess design thinking. They are able to plan, adapt their lessons, and consider new ways to teach. Furthermore, they continually revisit old lessons, try new things, adapt and make modifications in order to improve. Research on barriers, particularly third order barriers, highlights the importance of planning when it comes to effective teaching. Lesson planning when incorporating technology is an area in need of research. In a review of a decade's literature from 2004 to 2014, Ben Harper and Natalie Milman (2016) noted that technology has been shown to improve differentiation and personalization of learning, but that future research should further investigate these teaching strategies in a 1:1 setting. I argue that differentiation and personalization of learning, or any other improvement in learning for that matter, are not going to occur without careful planning. When a 1:1 ratio is made available to teachers and students, it is important to analyze the way that teachers plan to improve the learning opportunities of their students.

Part 6: Lesson Planning

Planning engaging lessons is an essential part of being a good teacher (Skowron, 2001). In a study of 130 teacher candidates, Womack, Pepper, & Hanna (2012) used factor analysis to examine data on teacher effectiveness. They narrowed effective

teaching down to just four components, one of which was lesson planning (2012). They went on to stress, in no uncertain terms, the importance of lesson planning in preparing pre-service teachers for the teaching profession: "The most productive way for our interns to demonstrate effectiveness and efficacy is to do an adequate job of lesson planning.... Preparation does not have to be long and arduous; it just has to be there" (p. 11).

In his book *Accessible Mathematics: 10 Instructional Shifts that Raise Student Achievement* (2009*),* former president of the National Council for Teachers of Mathematics, Steven Leinwand, describes a series of instructional strategies that lead to increased learning. In order to implement these instructional shifts, he described careful planning as essential: "Implementing the shifts that we have discussed is hard, it takes time, *and it takes deliberate planning"* (p. 73). Leinwand goes on to explain that lesson plans may have previously been scribbled on a small sheet of paper, but this is no longer acceptable. "Back when math wasn't expected to work for all students, and back when we worked under far fewer demands for accountability, this type of planning may have worked…. But today's realities are vastly different. We are expected to find ways to make math work for far more kids. We do live in a world of calculators and computers and in a world that expects, even requires, deeper understanding and far greater problem-solving skill. That's why our lessons must be more carefully planned… and that's why effective planning of lessons must address all of those elements that the typical minimalist plan doesn't" (p. 73).

Charlotte Danielson, developer of the Framework For Teaching (FFT) which is currently adopted by 33 states as the rubric for teacher growth and evaluation, declared

the importance of content knowledge and planning quite simply: "A person cannot teach what he or she does not know" (2007, p.44). The FFT rubric defines several characteristics to good teaching over four domains: planning, classroom environment, instruction, and professional responsibilities. While the rubric encompasses many aspects of teaching, the importance of quality lesson planning comes through strongly in its structure, with one of the four domains devoted entirely to planning. This planning domain is broken into six components used to measure a teacher's knowledge of students, pedagogy, content matter, standards, and coherent lesson design. Details of the rubric show that teachers are measured to be effective in this domain by their ability to plan assessment, differentiate instruction, and set rigorous outcomes. To stress the overall importance of lesson planning to good teaching, the very first sentence of the rubric states, "Effective teachers plan and prepare for lessons using their extensive knowledge of the content area, the core curriculum and their students, including students' prior experience with this content and their possible misconceptions" (2011). Distinguished teachers in the 33 states that have adopted the rubric are asked to provide detailed evidence of plans that are designed to meet the needs of all students.

The expectations found in domain 1 of the Danielson FFT represent a departure from the list of tasks that used to make up lesson plans. In the United States, lesson planning has traditionally been considered important, but it was not reflected in the actual written lesson plans, which often consist of a bare-bones set of activities (Shen, Poppink, Cui, & Fan, 2007). Teachers are now expected to provide students with a series of learning opportunities that build upon each other. The expectation is that teachers provide evidence that the lessons will meet the needs of all students and lead to *significant*

learning (Danielson, 2011). The lesson plans of highly effective teachers (as judged by the FFT rubric) provide various pathways for students, including resources beyond what is typically available in district curricula.

Leaders in the field of lesson planning and curriculum design, Grant Wiggins and Jay McTighe (2004), argue that high-level teaching requires careful planning. Students are only able to make meaning and gain understanding when they relate facts to prior knowledge and big ideas, explore essential questions, and apply what they have learned to new situations. Wiggins and McTighe developed an important curricular framework called Understanding by Design (UbD) that relies on intentional backward mapping with big ideas in mind. Within this planning framework, students are asked to inquire, and teaching is all about the facilitation of meaning-making rather than the simple coverage of content. It includes essential questions, desired knowledge and skills, performance tasks, and detailed learning activities. Each part of the plan is deliberate, with very little left to chance (McTighe, Wiggins, & Grant, 2004). Furthermore, teachers are asked to focus on connections and delve deeper into a fewer topics. My purpose is not to go into the UbD framework in great detail, but instead to highlight that this framework, used by thousands of schools across the country, relies on careful planning around a few big ideas to meet student-learning goals (Wiggins & McTighe, 2005).

In a comprehensive study of 24 different schools across all grade levels in 16 states, it was shown that students performed better when curriculum and instruction analyzed fewer topics in greater detail rather than superficially covering the breadth of material in a textbook (Newmann,1996). In another study, researchers in Chicago looked at examples of student writing and mathematics work across grade levels over three

years. They found that students who were able to construct their own knowledge and look at a few topics in greater detail scored higher on the Iowa Tests of basics skills in reading and mathematics. My point is not to argue that content should be covered in depth or that students should receive more rigorous work– this point has been well established (i.e., Wiggins & McTighe, 2005). Once again, the important point in my argument here is that teaching for meaning requires careful planning, and that this planning is crucial to good teaching. This is true regardless of the planning framework or whether technology is used or not.

In the seminal work *The Teaching Gap: Best Ideas from the World's Teachers for Improving Education in the Classroom* (1999*)*, James Stigler and James Hiebert focus primarily on changing the culture of teaching, and they frame much of their argument within the context of Japanese lesson study, where teachers work collaboratively to thoughtfully plan out lessons, implement them, and refine them based on data, observations, and feedback. The feedback loop from careful planning, teaching, reflecting, and then going back to the drawing board to refine plans are noted as essential to improving education.

So far, this section has focused solely on the importance of planning to effective teaching, regardless of whether technology is used or not. Given the number of potential first and second order barriers to implementation, it is safe to assume that the inclusion of technology only adds to the necessity for careful planning. In a study of three high-technology schools, Drayton, et al. (2010) found that, there is, in fact, a steep learning curve when new technologies are introduced. Changing practice first requires professional development and the support of school leaders (Blau & Presser, 2013). Dr.

Ertmer (2005) supports this assertion in claiming that, as 1:1 programs become increasingly popular, the quality of training will be a key predictor in the success of programs.

While the research noted above supports the need for quality planning in general, and professional development for learning how to incorporate technology, there is very little research on the impact that 1:1 technology specifically has on teacher lesson plans. The Substitution Augmentation Modification Redefinition (SAMR) Model (2006) will be used to classify how technology is used in lessons. Described in more detail in part seven, the SAMR model focuses on the added value that technology brings to a lesson. It ignores the characteristics that generally define a lesson as high-level; instead it focuses only on whether technology improved the lesson or not.

Part 7: SAMR Model

The Substitution Augmentation Modification Redefinition (SAMR) model, developed by Ruben Puentedura (2006), serves as a theoretical framework for classifying the level of technology implementation in a lesson. The SAMR Model can also be used as a frame of reference for helping teachers understand how technology can be used to improve student learning opportunities. It will be used as a framework for analyzing teacher lesson plans to consider whether or not the 1:1 technology initiative has led to improved learning opportunities. The framework consists of four categories described below:

- Substitution – Technology substitutes an existing lesson with no increase in learning opportunities. The substitution provides "no functional change" (Puentedura 2014). For example, a teacher may have students type and save notes

on their laptops rather than write them out by hand. Technology is used in the lesson, but with no substantial change in the rigor of the lesson.

- Augmentation – Technology serves as a substitute for the existing lesson, but there are some functional improvements. For example, in an elementary school classroom, instead of listening to the teacher and reading along, students may be able to use individual devices with headphones for the same purpose. This allows students to stop and start and look up information as needed. In this example, the lesson is basically the same, but the learning is more differentiated in that students can work autonomously at their own pace.
- Modification – The learning activity can be completely restructured with technology, allowing for significantly improved learning opportunities. For example, technology may allow students to receive instant feedback on their work from peers, the teacher, or experts in the field. In a comparable pencil/paper lesson, students may have relied on the teacher to provide individual feedback over an extended period of time.
- Redefinition – Technology allows for the planning and creation of tasks and learning opportunities that would otherwise be impossible. For example, in a social studies classroom, students may be asked to create a digital tour of a region to describe characteristics of the people and environment. In this example, students can engage with sights and sounds of the region, and even engage electronically with people who live in the region, in ways unfathomable just a few decades ago.

The SAMR Model Framework was designed as a guide for how to use technology to enhance learning opportunities. Given the first, second, and third order barriers to implementation discussed earlier, as well as the many different ways and purposes for using technology, the model will be useful in determining whether teachers are using technology to improve learning opportunities. As you move up the hierarchy of lessons, the learning opportunities improve, and the addition of technology (theoretically) has a greater impact on learning. Puentedura (2013) notes that as you move into the Modification and Redefinition categories, there is the opportunity to transform learning. When using technology at the lower rungs of Substitution and Augmentation, the changes in pedagogy and planning necessary to use the technology may not be worth the negligible improvements in the lesson (Romrell, Kidder, and Wood, 2014).

One potential drawback of the SAMR model is its relative newness; it is barely represented in peer-reviewed literature (Hamilton, Rosenberg, & Akcaoglu, 2016). The rate at which its popularity is increasing, however, is staggering. To highlight the newness as well as increasing popularity, consider that the 2013 International Society for Technology in Education Conference had just one session out of 800 mention the SAMR model. Just two years later, forty-four ISTE conferences included the SAMR model (Hamilton, Rosenberg, & Akcaoglu, 2016). A quick informal survey of the leadership team in my district let me know that all administrators knew about the SAMR Model, yet a quick "SAMR Model" search of the ERIC database results in just a handful of peer-reviewed articles. Much of the information about the model is presented in slides via Puendetura's (2016) website, http://hippasus.com/blog/. Because there is not a lot of

detail or link to previous research, Hamilton, et al. note that educators are free to interpret it in different ways.

Another potential flaw in the SAMR model is that it suggests that technology is *always* beneficial to a lesson. At best it transforms learning; at worst, it is presented as a "wash" at the substitution level. According to the model, a lesson without technology may be substituted by a technology lesson at no detriment to learning. However, a review of research shows the complexity of technology integration, and student achievement regularly decreases without the proper conditions or pedagogical strategies (Penuel, 2006). The model is too simple and does consider each school and classroom context (Hamilton, Rosenberg, & Akcaoglu, 2016). Schools and classrooms are complex systems, and it is difficult to ignore the students, their history, and the pedagogy of the teacher in analyzing whether a change to the lesson structure will add value. In other words, context is important (Vanassche & Kelchtermans, 2014). Consider, for example, the research noted earlier showing increased communication and collaboration. A computer program or specific task written on paper will not necessarily improve student conversation. The impact of technology depends on the manner in which it is implemented (Higgins & Raskind, 2005). In addition to what happens during a specific lesson, classroom norms and the learning culture established by the teacher over time will certainly play an important role in how a specific technology lesson plays out in real time. Teachers, students, and the decisions that a teacher must make in the moment are all unfortunately left out of the SAMR equation.

Even though the SAMR model offers a concise way to analyze lessons, another potential drawback is its relative subjectivity. No set criteria exist for categorizing lessons

other than the general description outlined earlier. Teachers or observers may have varying opinions about what it means for a lesson to be modified or a learning opportunity to be redefined. Without strict criteria, it is possible for different observers to rate lessons differently. When educators have just a brief description and various models created by individuals to depict the SAMR model, it is possible (and perhaps inevitable) that one person's Augmentation, may be another person's Substitution. Hamilton, Rosenberg, & Akcaoglu (2016) bring out another important point in that the SAMR model focuses on the lesson product over the process. Technology may be integrated at a higher level, but this does not necessarily mean that student learning increased. Few would argue that the value of a lesson depends on the student learning that comes out of it. The SAMR model may lead to the false assumption that technology improved a lesson, without consideration of student gains. Consider the Redefinition lesson described earlier. What if social studies students in a 1:1 classroom worked collaboratively to create a digital tour of a region, but post-tests showed little to no learning took place? Consider further in this hypothetical situation that data from a traditional classroom across the hall showed tremendous increases in student learning at the end of their pencil/paper unit of study. Technology may have redefined learning, but, without gains in learning, it would be difficult to argue that technology represented a functional improvement.

As noted throughout this literature review, technology may be used to increase achievement and engagement, and even improve student interactions. However, it may also have no impact (or worse, a negative impact). Given the number of potential barriers, as well as the knowledge bases necessary to instruct well with technology, teacher planning plays a crucial role in determining outcomes. Districts may invest in

devices to boost achievement and opportunities for their students, but the outcomes ultimately rest upon the learning experiences planned for by the teachers.

Chapter 3: Methods

According to the TPACK framework, high level technology integration depends on a teacher's technological, pedagogical, and content knowledge bases (Koehler & Mishra, 2005). When analyzing the success or impact of 1:1 lesson planning, it is therefore important to understand the context in each of these areas. After providing an overview of the setting and key stakeholders involved in the rollout of 1:1 technology, I will describe the professional development received by teachers. This will include a broad overview of PD required by the state as well as a detailed accounts of professional development delivered at the school level. First and second order barriers impact a teacher's ability to plan and implement technology successfully (Ertmer, 1999), so I will provide contextual background information relevant to barriers. This sets the stage for a detailed description of the goals of the study, sample, data sources, research questions, and methodological approach.

Part 1: Overview of the Setting and the Study

The high school where the study takes place is a suburban school within ten miles of a major city in Pennsylvania. It is a nationally recognized Blue-Ribbon school with the motto *Tradition of Excellence*. Nearly 20 AP course offerings prepare 90% of the students for entry into a 4-year college, and the graduation rate for the 2016-2017 school year was an astounding 100%. The student body consists of approximately 1,000 students in grades 9-12. The homogeneity of the student body is striking. About 95% of the students are white, and more than 90% are middle to upper class. Only 0.8 percent of

the students are African American, and no students were identified as English Language Learners in 2017-2018.

Even though test scores are traditionally high, administration rolled out a plan to transform teaching and learning beginning in the 2017-2018 school year. The plan is based on the work of Alan November, an international leader in educational technology and author of the best-selling book, Empowering Students with Technology (2001). The high school's plan for transforming education has six components: 1) Build student capacity for critical thinking, 2) develop new lines of inquiry, 3) make student thinking visible, 4) broaden the perspective of students with authentic audiences from around the world, 5) create purposeful work, and 6) access "best in the world" examples of content and skills from around the world. While technology is not explicitly stated in the goals, a 1:1 technology initiative is central to district aims to achieve these goals. When technology is incorporated in a way to meet these goals, the lesson moves up the hierarchy of the SAMR model. For example, when teachers use technology to build critical thinking or develop new lines of inquiry, the lesson certainly moves into the Augmentation or Modification stages. When students are able to use the internet to work with students from around the world or access "best in the world examples", the lesson is completely redefined in terms of what is possible in a traditional bricks and mortar classroom. For over a decade, Alan November has advocated using technology as a way to improve teacher pedagogy and increase student critical thinking (November, 2007 & November, 1999). Evidence of administration's intent to use technology to transform pedagogy can be found in the August 2017 Board Notes, where the superintendent stated that a 1:1 technology initiative will be used to meet these six goals and push instruction

toward “best practices”. According to the district’s Digital Shift PowerPoint, the 1:1 initiative was to place a device in the hands of every student grades one to twelve by the year 2020. Students in grades 2, 4, 7, and 9 were the first to receive laptops in October of 2017. Distribution points will happen when students move through grades 2, 4, 7, and 9. An overview of which grade levels will have devices by year is presented below:

- 2017-2018: Grade 2 (iPads), Grades 4, 7, and 9 (laptops)
- 2018-2019: Grade 2 (iPads), Grades 3, 4, 5, 7, 8, 9 & 10 (laptops)
- 2019-2020: Grade 2 (iPads), Grades 3-12 (laptops)
- 2020-2021: Grades 1 and 2 (iPads), Grades 3-12 (laptops).

At $388 per laptop and approximately 250 students per class, the total cost comes to $97,000 per grade level per year. This essentially amounts to the cost of a new teacher per year at each of four different grade levels (PA Department of Education, retrieved from http://www.education.pa.gov/Data-and-Statistics/Pages/Professional-and-Support-Personnel.aspx#tab-1z0). The district’s financial commitment to technology is even more apparent in the context of several large capital improvement projects that will be necessary in the near future, including major multi-million-dollar high school renovation plans and a new football field. In spite of these major expenses, support for the 1:1 initiative was reinforced at a February 2018 administration team meeting when the superintendent said that funds for 1:1 would be “sheltered” from upcoming budget cuts; they would be eliminated only as a last resort. This type of financial commitment is noteworthy since administrative support is important to successful technology implementation (Bebell & O’Dwyer, 2010).

In spite of the hefty price tag, the community still appeared to support the initiative. In the months leading up to the distribution of devices, the superintendent held three different "parent nights" - two at one of the elementary schools on September 19th and September 26th of 2017, and a middle/high school information event on September 28th. According to an email from the assistant superintendent on September 6th, the purpose of the information nights was to "address how the roll out will take place, information about how and why to purchase device insurance, what the insurance will cover, FAQ, etc." Approximately 200 people attended the high school event, where they received a brief introduction to the initiative and answers to Frequently Asked Questions. The superintendent referenced the educational purpose for the initiative, but the concern over cost for the devices was apparent in the FAQ's, where 23 of the 38 questions involved insurance, loss, or potential damage to the devices. At the end of the presentation, the floor opened up to parents for questions that ranged from concern over the weight of the devices to the make and model of the laptops. It is important to note that there were no protests or overt objections to the initiative in general.

In the months leading up to device distribution, the superintendent held several "coffee nights" to highlight the educational vision for the 1:1 initiative and gain the support of parents and community members. Parents could meet the superintendent in a relaxed, informal setting to receive information about the digital transformation plan. In a PowerPoint presentation, he described the primary goal as "replacing the 20th Century model of learning." The future model of teaching and learning consists of the following characteristics:

- Teacher as facilitator

- "Just in Time" direct instruction
- Flexible classroom environment
- Students engaged in a variety of individualized and collaborative tasks
- Focus on critical thinking
- Technology enables student focused learning and pacing.

This vision contrasts with descriptions of the traditional manner of teaching, with instructor at the center of the room and students seated in rows. It is important to note, when considering planning and instruction in the 1:1 environment, that only one component of the future model explicitly references technology. The focus of the 1:1 initiative is about using technology as a tool for shifting instruction. In the context of this study, I believe this sends a message to teachers that when teachers plan to use technology, the expectation is to plan lessons higher up the SAMR Model - not to simply use technology for the sake of using it. On the other hand, without an explicit mention of technology, less tech-savvy teachers, or teachers opposed to increased technology in classrooms, could potentially opt out of learning how to plan lessons using the devices. The superintendent cited data from Project Red research that 1:1 technology access leads to increased achievement *when properly implemented* (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2012). This highlights the importance of lesson planning and teacher pedagogy to the success of the initiative, as well as the recognition on the part of administration that teachers are a crucial part of the equation.

When analyzing the impact of the 1:1 initiative on teachers' planning, it is necessary to consider several key conceptual variables, notably professional development, administrative support, lesson planning, and technical support.

Part 2: Professional Development Context

States have strict guidelines for obtaining and maintaining teaching licensure. Technology training is a prerequisite for licensure, though the depth of training varies. The Pennsylvania state guidelines for preparing highly effective teachers in certification programs include competencies in the following six areas: instruction, state standards, standards-based curriculum, materials and resources, assessment, and interventions; the need for technology is included in the "materials and resources" area. Chapter 354 explicitly states that grades 7-12 teachers must "incorporate technology into instruction appropriately" (The Framework for Secondary Grades 7-12 Program Guidelines PA Department of Education, p.13, 2010). While technology is emphasized, this vague statement allows for latitude in the way that technology is incorporated into teacher preparation programs. To highlight this point, consider a specific certification area such as English. A high school English candidate must be able to apply technology "to enhance the study of language and literature using computers and media" (The Framework for Secondary Grades 7-12 Program Guidelines PA Department of Education, English, p.1, 2010). This vague directive may look different when implemented depending on the teacher program, leading to varied degrees of technological expertise of teachers entering the field.

In the context of the sample of teachers at the site of the study, it is important to note that the teaching force has remained relatively stable over the last few decades. Technologies are continually evolving, though, so the certification training of a recent graduate will obviously be different from that of a 30-year veteran. Of the 35 members of the Technology Integration Team, which includes teachers with two or more ninth

grade classes, just three were hired within the last four years, and all three came with teaching experience from other districts. The average number of years a teacher has taught at the school is approximately 15-16 years.

One can conclude from the 15+ average years of teaching that many of the teachers received their degrees and teacher training before technology was such a prevalent part of the classroom (Koehler & Mishra, 2008). To put this statement in context, consider how technology has changed in that time. In 2001 the first blue tooth phone came out and a new website called Wikipedia made lazy research accessible for all. Early efforts by teacher preparation programs to incorporate technology into their training, specifically those at the beginning of the 21st century when a 15-year teacher would have started his or her career, consisted primarily of just one technology class (Niess, 2005; Pope, Hare, & Howard, 2002). This type of training would have hardly been sufficient to prepare teachers for a 1:1 environment with the technologies now available. To highlight this point, consider a study of special education teachers in Western Pennsylvania. Survey data suggest that while the vast majority of teachers had *some* knowledge of assistive technologies, much more professional development is needed to adequately support students (Sydeski, 2013). Given the importance of professional development to the success of technology integration, coupled with the varied levels of experience and inconsistent levels of technology training, professional development offered at the high school will prove to be an essential elements of a 1:1 initiative.

The bulk of professional development time comes in the form of "extended days." Extended days occur on one Wednesday each month over the course of the ten teaching

months; teachers are required to stay for an hour and a half beyond the school day from 2:45 to 4:15. The focus of the time is determined by administration, but the number of competing needs and interests can be seen in the breakdown of extended day PD topics for the 2017-2018 year. Topics beyond support for 1:1 technology include crisis management, special education, Understanding by Design (UbD) curriculum work, literacy integration, and goal evaluation. Of the ten extended days, three were explicitly devoted to planning/integration of 1:1 technology into classroom practice. Additionally, teachers are supported by professional development days prior to the start of the school year and "lunch and learn" activities organized and implemented by the instructional coaches. "Lunch and Learns" were a key part of the professional development plan; they will be discussed in detail later.

Teachers cite professional development as key factor in the success of a 1:1 initiative (Ware & Stein, 2014). Furthermore, the professional development must be more than product training; it must lead to a change in teacher mindset about their pedagogy in a technology environment. In other words, comfort using the devices will not necessarily lead to increased technology planning or improve the learning environment - A change in the way technology is viewed and the impact that it can have on pedagogy must also occur (Cuban, Kirkpatrick, & Peek, 2001). For this reason, school administration designed professional development to model desired pedagogy and explicitly outline the pitfalls of low-level technology implementation. Technology training was placed within the broader context of the year's professional development. In the 2017-2018 PD plan, administration listed the following Essential Questions for the year's professional development:

- How can I provide more opportunities for students to develop their literacy skills (reading, writing, and speaking) in my content area?
- How can I provide more opportunities for students to hone their critical thinking skills?
- How can I increase the complexity and relevance of instructional activities and assessments to engage students in authentic learning opportunities?
- How can I empower students to take ownership of their learning beyond point collecting?

These goals reflect the broad emphasis on improving pedagogy, not simply the integration of technology.

The first professional development session of the 2017-2018 occurred during the back-to-school kickoff. Administration had three hours to work with all teachers. The specific goals of the session were to:

- Acknowledge teachers hopes and fears about technology. The purpose of this activity was to examine attitudes and comfort level, as well as potential barriers to the planning and implementation of technology lessons.
- Connect technology to the six district pedagogical goals. The six district goals are: Build capacity for critical thinking, Develop new lines of inquiry, Make thinking visible, Broaden perspectives, Contribute to purposeful work, and Access best in the world examples.
- Model a lesson where technology is used to increase collaboration and create a group product in ways that would otherwise be impossible

without technology.

Teacher fears were elicited as a way to understand the potential barriers to planning technology lessons that need to be addressed before students receive devices. Feedback was used to design a six-week lunch and learn course; each lesson tied back to one of the district's six instructional goals for the year. Administration wished to use this opportunity to not only increase comfort with technology, but also support a collaborative approach to planning technology lessons. Administration recognized the need for continued support, with the professional development activities as part of a larger goal to increase teacher technological and pedagogical content knowledge. The 2017-2018 professional development timeline can be found in Appendix 1.1.

Administration and the instructional coaches designed a six-week course of voluntary lunch and learns, which became the most significant professional development offered to teachers during the first semester before students received their devices. Attendance was voluntary, but administration incentivized attendance in the following way: participation in three or more sessions exempted teachers from one after-school extended day. The sessions were designed to introduce teachers to various technology tools and best practices for using technology in the classroom. During planning meetings, administration and the instructional coaches thought that it would be best to model best practices for technology in the sessions as a way to increase pedagogical knowledge while addressing technological knowledge.

The instructional coaches offered a second set of Lunch and Learns in February of 2018, approximately three months after laptops were in the hands of all freshmen. It consisted of five sessions, with an overarching goal of using technology to increase

knowledge of SAMR and Webb's Depth of Knowledge (DOK). The first sessions was a review of SAMR and DOK general concepts, with explicit instruction on each of the SAMR levels and the associated DOK levels. This was followed by sessions on collaboration, reading, writing, and assessments. The coaches' focus on content knowledge can be seen in topics such as using primary source documents in social studies and history. This is blended with attempts to increase technological knowledge through "cool" media literacy tools, such as Quizlet, Slack, Flipgrid, and InsertLearning.

Additional professional development days were built into the school calendar on February 16th and May 4th, 2018. The focus of the February 16th PD day was "innovation", with a morning lecture from Dr. Puentedura followed by three different hour-long sessions in the afternoon. The fact that administration brought the creator of the SAMR model to present to its faculty shows the district's commitment to technology and the SAMR model. In the afternoon, a variety of teachers facilitated hour-long sessions highlighting practices from their classroom. Many of these sessions were focused on increasing pedagogical and technological knowledge

Part 3: Goals of the study

The goals outlined for the district 1:1 initiative are primarily broad, instructional goals. Teachers are encouraged to innovate and increase high level instructional practices, such as formative assessment, collaboration, and personalized learning opportunities. The devices should be used to meet the instructional goals, encouraged by administration through specific professional development activities related to technology. If teachers are going to successfully meet the district goals, it makes sense that they

would plan their lessons differently. One might also conclude that their lesson planning would be different after the district purchased devices for all of its students. This study analyzes the impact that 1:1 technology implementation has on teacher planning. Teacher planning is instrumental to effective teaching, so I examined the changes in lesson plans after students had ubiquitous access to technology (as opposed to labs or cart-based models). From the TPACK model, high-level technology planning and implementation hinges on content, technological, and pedagogical knowledge bases. Barriers to implementation may limit the effectiveness of a 1:1 initiative, even when teachers have these knowledge bases. Therefore, understanding the barriers to planning lessons with technology is the second focus of the study.

Part 4 Teacher sample and notes on the methodological approach

The high school consists of seventy teachers total; those with two or more sections of 9th grade classes are considered "9th grade teachers." The instructional coaches compiled a list of teachers involved in the 1:1 rollout, referred to as the Technology Implementation Team. The Technology Implementation Team consists of thirty-five ninth grade teachers, with 46% (16/35) male and 54% female (19/35). All of the teachers are white. They are overwhelmingly experienced teachers, with all but one of them having taught five or more years. Teachers may apply for tenure after three successful years of teaching in the state, and just two of the teachers are non-tenured in Pennsylvania. However, one of the non-tenured teachers worked for several years out of state. It is also worth noting that no official or unofficial policy exists in the district where experienced teachers have preference in selecting their schedule, so the 15-16 years of

teaching experience for the teaching force as a whole should be consistent with the freshmen teachers. All teachers in the sample are certified to teach in their subject area.

For the study I will analyze the lesson plans of approximately 5-10 teacher volunteers, with a goal to include teachers across various subject areas for a wide range of data. My focus will be on the written lesson plans, but I will ask teachers to talk through their lessons as a way to glean additional information about the lessons and planning process. This "interview" will take approximately an hour and focus on their lesson plans before and after the 1:1 rollout.

Lesson and unit plans are stored in Google Classroom, regularly accessed by teachers and occasionally accessed by administration. Units may span a month or more. I chose to analyze lessons from mid to late September/early October of 2017 before the 1:1 initiative. These lessons were written without the assumption of ubiquitous access to laptop, though carts were available to teachers. I chose lessons after the launch of the 1:1 initiative from mid-March to May of the 2017-2018 school year. At this point, students and teachers have had laptops for approximately six months, so teachers had time to adjust their planning to the idea that laptops were available each day. However, I wanted to avoid selecting lessons too close to the end of the year, near state testing in May.

I retrieved the lessons from Google Classroom. They were either weekly lessons or unit plans, depending on the lesson format submitted by the teacher. I analyzed the lessons first for the quantity of lessons that incorporated the devices and then the quality of technology implementation. I used the SAMR model to determine implementation level. Furthermore, I compared the lessons before and after 1:1 implementation for specific features of high-level technology implementation I looked for the following

characteristics of high-level lessons: access to people or work products beyond the classroom, collaboration, differentiation, and formative assessment strategies. Teachers talked through their lessons to provide additional detail and clarification about their lesson plans that would otherwise be impossible by simply looking at the written documents.

Part 4: Research Questions, Data Sources and Methodological Approach

Research Question 1: What impact did 1:1 technology availability have on teacher lesson planning?

To answer this question, I analyzed weekly lesson and curriculum unit plans. I compared lessons written by the freshmen teachers who volunteered for the study, looking at lessons before and after students had ubiquitous access to technology. A summary is shown below.

Data Source for Research Question 2	Existing or new data source?	Additional Notes
Lesson plans from selected freshman teachers before 1:1 Implementation	New	One set of lesson/unit plans per teacher from September 2017, before 1:1 implementation
Lesson plans from the selected freshman teachers after 1:1 Implementation	New	One set of lesson/unit plans per teacher from approximately April 2018, six months after 1:1 implementation

9th grade teacher interview notes	New	This interview will provide additional information regarding planning that may not appear in written documents.

As part of their professional responsibilities, teachers submit either a weekly lesson plan or an Understanding by Design (UbD) curriculum unit that details the learning goals and daily classroom activities. The UbD units are more detailed and cover an extended amount of time and material. It is important to note that if teachers write a detailed unit, this may replace the required weekly lesson plans generally submitted to administration. I accessed lesson plans and curriculum units from the 2017-2018 school years through the district Google doc site where they are housed. Because the 1:1 rollout occurred at the end of October 2017 for 9th grade students only, I had access to distinct groups of teachers with ubiquitous access to technology. I compared the lesson plans and curriculum units of 9th grade teachers before the 1:1 rollout and after the 1:1 rollout to see how they changed.

When comparing these groups of teachers/lessons, I analyzed whether the amount of technology integration planned increased after the 1:1 rollout. I also investigated the manner of technology planning to determine whether the laptops were planned to be integrated in a way that increased high level teaching and subsequent student learning opportunities. The Substitution Augmentation Modification Redefinition (SAMR) model was used.

It is possible that 1:1 technology could have a significant impact on teacher planning, but the effect may not be visible through the lens of written lesson planning

documents. To provide additional information on the impact that ubiquitous technology had on teacher planning, I am interviewing the 9th grade teachers and having them walk through their planning process with me.

Research Question 2: What were the barriers to planning lessons in a 1:1 technology environment?

To answer this research question, I performed a mixed methods study, using district released documents, my notes from implementation, and survey results. The primary sources of data regarding barriers to implementation are summarized in the table below.

Data Source for Research Question 1	Existing or new data source?	Additional Notes
"Hopes and Fears" Survey data	Existing	Collected twice from 9th grade teachers, before and after the 1:1 technology rollout.
Student technology survey data	Existing	The Likert Scale survey was created by the instructional coach and given to students in March of 2018 regarding the impact of technology on teaching and learning.
Teacher Technology PD Needs Assessment;	Existing	The Technology PD Needs Assessment Survey was provided to teachers in January of 2018. The data was used to determine comfort with

		technology and potential barriers to implementation
Survey of teacher PD "wishes"	Existing	As part of a professional development session, teachers were asked for suggestions for future PD to address concerns. This informal, conversational data supplements the survey data outlined above.

The "Hopes and Fears" data was simply an open-ended question from administration to teachers. It was anonymous, collected from teachers at two different points during the year - once in August of 2017 before the beginning of the school year and once in December 2017 after device distribution. At these two junctures teachers were asked to list hopes and fears regarding student 1:1 technology access. I used the "fears" data to determine perceived barriers to implementation, specifically whether they were first or second order barriers. For example, first order concerns may be reflected in fears about the network or teacher understanding of technology. Second order barriers may also become evident, for example, if teachers are concerned about the expectation to use technology when they feel it is not advantageous to student learning. Teacher "hopes" can be used to similarly understand necessary PD and goals for the use of technology.

Having "before and after" survey information allowed me to identify whether concerns about first order barriers such as the network, filters, student and teacher technology knowledge, etc. continued to exist after implementation. Teachers anonymously recorded their answers on sticky notes and posted their answers on

opposite sides of the room during the professional development sessions. Teachers and administrators were then asked to analyze the answers to look for patterns. The data was not only used to inform professional development, but also to provide insight into the barriers to implementation. In the professional development on August of 2017, forty-one teachers attended the PD; all teachers listed one hope and one fear that were recorded and tallied. The same survey was given in December of 2017, after 1:1 implementation. Twenty-six teachers completed this activity. It is important to note, however, that the December teachers were primarily different than the teachers who completed the survey in August.

A student survey provides additional data about barriers that teachers may have to planning lessoning with technology. All 250 ninth grade students were surveyed to determine how computers were being used, the perceived benefit, how often they used their computers and in which subjects, whether they were used at home, and the extent to which computers impacted learning. Two hundred twenty-three of the student responded, an 89% response rate. Barriers to planning and implementation can be found in questions about challenges to completing assignments, technical difficulties, and instruction needed in order to better use technology. The survey also provided an opportunity to give open-ended feedback regarding challenges that students experienced. While this data relates to student use of the laptops, I will use this information to infer whether teachers planned student learning activities and how the laptops were used.

The teacher technology PD needs assessment survey can be used to help understand the potential barriers to planning lessons with technology. Teachers were

given open-ended questions regarding their successes and challenges using technology. The final open-ended question in the survey asked teachers for the professional development that they think is necessary in order for 1:1 technology to have a greater impact on teaching and learning. This information will be valuable in determining barriers as well as teacher attitudes toward technology (potential second order barriers). The survey was given to all teachers of freshmen in January of 2018, two months after 1:1 implementation. All forty-six teachers responded.

A survey of teachers' PD "wishes" was used to provide additional information regarding barriers. All ninth-grade teachers were informally surveyed during the back-to-school professional development to determine how administration can support their learning. The question was simple and straight-forward, "What are your PD wishes now that we are moving to a 1:1 technology environment?". The data was used to identify teacher competence and needs in working with technology, potential first order barriers. For example, if teachers requested PD on how to perform basic tasks, such as saving documents, technical knowledge was certainly a barrier to planning high level activities that move lessons up the SAMR model. On the other hand, if teachers requested PD on using the devices to improve formative assessment strategies, communication between students, differentiation, etc., then I can infer that they likely have the technical knowledge to use the devices in ways that increase learning opportunities for students. The information was gathered during whole-group instruction. All teachers were asked to participate, but data was only collected from teachers who volunteered answers. Seven teachers volunteered responses.

Analysis of district documents provided important contextual information about potential barriers and supports to implementation. The documents include curricula, schedules, programs of study, student and teacher technology learning opportunities, and notes regarding the support of the administrative team (at both the building and central office level). Additional information about the supporting documents that I used to provide contextual information about the barriers present at the site can be found in Appendix 1.2.

Chapter 4: Findings

At the federal, state, and local level school districts across the United States are spending billions of dollars on educational technology (Hudson & Rockefeller, 2009). Technology offers exciting new possibilities for teachers and students in terms of the resources available at just the click of a mouse. However, it is not so simple as to distribute devices and expect academic gains and learning opportunities to increase. A review of research shows that technology may lead to positive outcomes, but this is not always the case (Harper and Milman, 2016). Because schools are moving at such a breakneck speed to incorporate technology, and because it does not always lead to positive results, we should slow down to study 1:1 technology movements in schools. The ways in which teachers plan to incorporate technology will certainly impact the learning opportunities for students (Puentedura, 2016). Furthermore, various barriers may prevent technology from being properly integrated into lessons, so it is important to analyze the obstacles to technology integration within any system.

In this chapter I will first present the purpose of the study, the research questions, and an overview of the study-site and the people involved. I will then provide an overview of the sources of data used in the study, the data collection procedures, and the data samples. I will then present the results of the study and analyze the barriers that may have impacted the results of the lesson plan analysis. Explicit connections will be made to the Substitution Augmentation Modification Redefinition (SAMR) and Technological Pedagogical and Content Knowledge (TPACK) models, the two primary conceptual frameworks used in the study.

Part 1: Research Questions

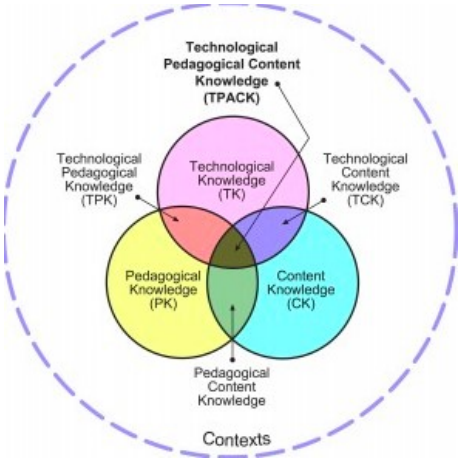
Research question 1: What impact did 1:1 technology have on teachers' lesson planning?

The purpose of this study is to examine the impact that ubiquitous access to technology has on teacher planning in a 1:1 school environment. Specifically, I want to determine how the availability of technology at all times, as opposed to access through shared laptop carts, impacts teachers' lesson plans. I would like to determine whether teachers plan to use technology in their lessons more often. Furthermore, I would like to examine the types of lessons that teachers plan to implement in their classrooms. With a myriad of resources available at all times, do teachers plan their lessons differently? The SAMR Framework will be used to examine whether a 1:1 environment shifted teacher planning in ways that might increase the learning opportunities for their students.

Research question 2: What were the barriers when planning to incorporate technology in a 1:1 environment?

Barriers are generally classified as first order or second order barriers. First order barriers are those external to the teacher, such as the network or machine functionality, a lack of time, or lack of professional development. Second order barriers are hindrances internal to the teacher, such as mindset or attitudes toward technology (Ertmer & Ottenbreit-Leftwich, 2010). A third order barrier introduced by Tsai and Chai suggests that once the first and second order barriers are removed, teachers may still struggle with technology; flexibility in design and an ability to problem-solve in real time are required.

This has been referred to as "design thinking" (2012). According to the Technological Pedagogical and Content Knowledge (TPACK) Framework, it is necessary for teachers to have technological knowledge, pedagogical knowledge, and content knowledge to plan for and implement technology lessons effectively. The TPACK Framework presents each type of knowledge separately in a Venn diagram, with their intersection defined as the "sweet spot" where quality teaching with technology occurs.



TPACK Model, Mishra and Kohler (2006)

I will focus on potential technological and pedagogical barriers in this study, as well as first order physical barriers such as problems with the network or devices. An analysis of barriers is important when considering the impact that ubiquitous technology has on teacher lesson planning. In order to increase the level of planning and ultimately high-level implementation, districts should consider the obstacles to overcome.

Part 2: Overall Context of the school/history

The high school in this study is a suburban school within ten miles of a major city in Pennsylvania. It is a nationally recognized Blue-Ribbon school with the motto

Tradition of Excellence. Nearly 20 AP course offerings prepare 90% of the students for entry into a 4-year college, and the graduation rate for the 2016-2017 school year was an astounding 100%.

The student body consists of approximately 1,100 students in grades 9-12. The homogeneity of the student body is striking. About 95% of the students are white, with just about 10% receiving free or reduced lunch. Only 0.8 percent of the students are African American, and no students were identified as English Language Learners in 2017-2018 (2017-2018 School Performance Profile, retrieved from http://paschoolperformance.org/Profile/4334).

Approximately 70 teachers work at the school, which operates on a traditional 9 period schedule, with 42-minute class periods. Over the last three years, the district has been moving toward project-based learning and more student-centered pedagogical practices. While the number of Advanced Placement (AP) courses has increased over the last decade, the school has made concerted efforts to promote the arts. Administrative observation data shows that traditional teacher-led practices are quite common, but teachers have made strides in creating more innovative, student-centered classrooms. As part of the effort to innovate pedagogy, the district rolled out a 1:1 computer initiative that began during the 2017-2018 school year with the ninth-grade students. Prior to the 1:1 technology rollout, professional development revolved around rewriting the K-12 curriculum using the Understanding by Design (UbD) framework. This curriculum and professional development provide important context for making sense of the results of the study and will therefore be discussed in much more detail later in the chapter. Two instructional coaches, along with administration, supported the 1:1 technology rollout. As

an assistant principal at the high school, I supported the logistical rollout and professional development associated with the 1:1 initiative. I have been employed at the school in this capacity for the last 5 years. Prior to this role I was a teacher, instructional coach, and curriculum coordinator for a large urban district. While my background in technology is relatively limited, I have a keen interest in pedagogy and how to support teachers. The data sources used in this study stem primarily from administration and instructional coaching efforts to get feedback from students and teachers about the challenges and successes of using technology at the high school.

Part 3: Data Sources

Data source to determine the impact on planning

The primary source of data used to determine the impact on planning was teacher lesson plans. Six teachers across four subject areas participated in the study, allowing me to analyze their lesson plans to see how they changed from September 2017 (before 1:1) to April 2018 (approximately 6 months after 1:1).

Teachers are required to upload weekly lesson plans by Sunday evening before the start of the school week, but administration rarely looks at them, generally only before observations. The lesson plan is a skeletal template, requiring a few pieces of key information, including course, unit, Essential Understandings, Essential Questions, standards, relevancy, sequence of learning activities, formative assessment type, and formative assessment level of complexity (Appendix 1.3, sample weekly lesson). In lieu of turning in weekly lesson plans, teachers may upload into a site called EduPlanet a complete unit of instruction, with several weeks' worth of plans. Most teachers have been

working on these units of instruction over the course of 4 years, the product of extensive professional development and collaborative planning.

During the 2014-2015 school year, administration rolled out an initiative for teachers to write units of instruction for each course using Wiggins and McTighe's Understanding by Design (UbD) framework. The curricular framework focuses on planning units of study that provide students with opportunities to explore the big ideas of subject and transfer their understanding to novel situations (Mctighe, Seif, Wiggins, & Grant, 2004). A significant aspect of the process is that teachers plan the units backwards, with the end goal in mind. A unit of study consists of three distinct parts:

- Stage 1 – Desired Results. Teachers focus on the important transferable learning goals. In addition to specific skills and knowledge that they want students to walk away with, teachers consider the important connective tissue that binds units and courses of study. This comes in the form of Understandings and Essential Questions. A quick scan of units shows that a typical unit may include one or two transfer goals, three to five Understandings and Essential Questions, and ten to twenty acquisition goals.
- Stage 2 – Evidence. Teachers consider how they will assess student understanding. Teachers may include a performance task as well as traditional assessment information, such as quizzes, exit tickets, and homework assignments.
- Stage 3 – Learning plan. The daily classroom activities are included in stage 3. Teachers may write out each lesson separately or simply list the activities that students will complete over the course of the unit. This section includes a learning goal, coded as A (acquisition), M (meaning-making), or T (transfer). These labels

correspond to the cognitive demand of the lesson, with A at the bottom and T at the highest level. Teachers also include information about how they will monitor progress and address potential misconceptions.

For the purpose of this study, I focused primarily on Stage 3, the learning plan. The learning plan typically provides the teacher and administrator with information about the activities the students will do each day. Stage 3 of the unit generally provides insight into how (and whether) technology was used in the classroom. For example, in an English class, the learning plan may provide details about: 1. the text students will read, 2. the essay that they will write, and 3. whether they used Google docs or perhaps the Newsela reading program. The learning plan for a math class may indicate the use of Desmos or other online graphing technology, and science stage 3 lessons may provide an account of the experiment students will perform and homework assigned, with information about videos or other technology used if applicable. I also analyzed stage 2 evidence for possible formative assessment strategies that may have used technology.

Because it is often difficult to gauge specific details from lesson plans, the teachers who wrote the lesson plans agreed to describe the lessons in detail and respond to any questions that I may have. For example, the words “exit ticket” in a lesson plan or in Stage 2 of a curriculum unit may simply amount to having students write the answer to a question on a sticky note. However, it could also mean using student devices to answer a question in Google Forms, a program that allows the teacher to instantly access summary data and alter a lesson in real-time. In this way, use of technology, and the functional advantage that it provides, is only available through the discussion with the teacher, not the skeletal lesson planning document.

Data sources to determine barriers

After analyzing the impact that 1:1 technology had on teacher planning, I will examine the specific site-based barriers to technology integration. Three primary sources of data were used to determine barriers:

1. Teachers' "Hopes and Fears" data from August 22, 2017 and December 16, 2017
2. One question from a Teacher Technology Needs Assessment Survey
3. Student responses to a technology survey distributed by the instructional coaches, and

I will supplement these three sources of data with information from an informal discussion of teachers' professional development wishes.

The first data source stems from two "hopes and fears" professional development activities, one before 1:1 and a second one after the devices were introduced. In the August session, forty-two ninth grade teachers were present for a professional development session led by administration to launch the start of the school year. This group of teachers consisted of the thirty-five member 1:1 Implementation Team and seven additional faculty members. At the beginning of the session, the teachers were asked to list their hopes and fears about the prospect of soon being a 1:1 classroom. This professional development session was designed specifically for teachers who would soon be 1:1 teachers. Their feedback would be used to design some of the professional development activities for the year, including a series of technology "Lunch and Learns" used to prepare teachers to design and implement lessons using technology. Teachers who attended at least three of the Lunch and Learn sessions would be exempt from the

professional development in December, the source of the second set of Hopes and Fears data.

Another round of comparison Hopes and Fears data was collected from a different set of teachers during a professional development session held on December 16, 2018. Twenty-six teachers attended this session, eight of whom were present for the August PD as part of the ninth-grade technology integration team. The teachers taking part in this professional development were those who did not participate in at least three of the six-week Lunch and Learn courses. Fewer than a third of the participants in December were part of the professional development session in August. Eighteen of the teachers in the December session primarily taught upper grades, 10^{th}-12^{th}, and therefore were only peripherally part of the 1:1 rollout. However, the data is valuable in that it provides contextual information and clues about barriers to technology implementation school-wide. Teacher and student survey data also provided key information about barriers.

An additional source of data came from the results of a Teacher Technology Professional Development Needs Assessment sent out by the instructional coaches to all teachers in November of 2017. It was sent through Google Forms, approximately 6 weeks after students received their devices. The survey consisted of two Likert scale questions and three short-answer prompts. In the Likert Scale questions, teachers were asked to rate the impact that 1:1 technology had on teaching and then on student learning. The response options were strongly positive, somewhat positive, neutral, somewhat negative, and strongly negative. The three open ended questions were:

- What challenges or struggles are you facing with the 1:1 laptop initiative?
- What successes have you experienced with the 1:1 laptop initiative?

- In order for the 1:1 initiative to have a greater impact on teaching and learning in my classroom, I would like further professional development regarding (blank).

While the questions do not pertain directly to planning, the Likert scale questions provide insight into the ways in which lessons (and therefore planning) changed after students received their laptops. Because the three open-ended questions request feedback on successes, challenges, and desired professional development, they provide a window into potential barriers to 1:1 planning and implementation.

The third source of data comes from the Student Technology Assessment Survey that was administered in March of 2018, approximately 5 months after the 1:1 rollout. It was created by the instructional coach and emailed to all of the 9th grade students who received laptops. Two hundred twenty-two students out of two hundred fifty completed the survey. This response rate represents just under eighty nine percent of all freshmen who received laptops. The survey can be found in its entirety in Appendix 1.4.

The Student Technology Assessment Survey consists of 19 questions, with three distinct parts in terms of format and information gathered. Part 1 is a Likert scale survey where students are asked to rate whether technology has had a negative impact, no impact, a somewhat positive impact, or a very positive impact on nine different aspects of their learning. These 9 questions cover many of the reasons cited in literature for schools to adopt 1:1 technology, such as leveling the playing field in terms of access, receiving feedback from teachers, increasing engagement, collaborating with others, and being creative.

In the second part of the survey, students were asked to provide information about when and how often they use their computers. Students were asked how often they use

their school-issued laptops per week in school and at home, and in what subject areas. The third part of the survey was open-ended, allowing students to cite any challenges or technical difficulties that they have experienced. Students were also given the chance to write about instruction they would like to have regarding the school-issued computer as well as offer any remaining thoughts about the laptops that did not come out in the survey.

The survey questions were designed to provide feedback from the students about how and when the computers were being used in school. While the focus of this study is on the teacher, data collected from the student perspective provides valuable insight into the barriers that teachers may have encountered when planning technology lessons. For example, if students noted that logging into their computers was a consistent issue, one can reasonably conclude that teachers experienced this as a first order barrier as well. Consistent student issues with technology would certainly impact the way teachers plan future lessons.

The final source of data for barriers came from a discussion during the professional development on August 22, 2017, the session in which the hopes and fears were gathered, In a whole group setting, teachers were asked the following question: "What are your professional development wishes?" Several teachers answered the question in a whole group setting. The data will provide insight into the ways teachers planned to use technology. Conversely it may provide insight into teachers' abilities to use technology. For example, if teachers request help on the basics of operating a laptop, this most certainly will indicate the technological barriers exist to high level implementation.

Part 4: Data Collection

Data Collection Procedures: Sample of Teachers and Lessons

Six teachers volunteered to be part of the research study: three English teachers, one science teacher, one math teacher, and one social studies teacher. Half of the participants were male; half were female. All of the volunteers are tenured teachers, with an average of approximately 15 years of teaching experience. Age and demographic data suggest that the teachers are a representative sample of the school faculty. The school secretary emailed the teaching faculty, requesting volunteers to be part of the study. Requirements for participation were that teachers were part of the 9th grade 1:1 implementation team during the 2017-2018 school year and are not currently under my direct supervision.

The participating teachers volunteered lesson plans from September of 2017, before the 1:1 initiative, and then lesson plans from April or May of 2018, approximately 6 months after the 1:1 rollout. Four of the teachers submitted unit plans in the UbD format. One of the teachers submitted descriptions of the learning plans in a Microsoft word document. The remaining teacher agreed to talk through their lesson planning in general terms. For continuity, I analyzed the same number of lessons before and after 1:1 implementation for each teacher.

Data Sample (details demographics about teachers and students)

The students considered in this study are freshmen who received laptops from the school in the end of October, just two months after the start of the school year. Approximately one thousand students attend the school, with students distributed fairly

equally across four grade levels. The teaching faculty consists of approximately seventy teachers in total. Thirty-five of these teachers make up the 1:1 Implementation Team – faculty who teach two or more sections of ninth grade classes. A fairly even split between male and female teachers exists within the faculty as a whole (46% to 54%). All of the teachers involved in the study are white. All but one of the teachers on the 1:1 Implementation Team are tenured teachers with five or more years of teaching experience. The stability of the teaching force can be seen in that the school rarely hires more than one new teacher in any given year. Furthermore, only three of the teachers in the school have not received tenure in the state of Pennsylvania. For the study I zeroed in on the lesson plans of six teachers from the 1:1 Implementation Team who agreed to be part of the study. They are representative of the teaching body as a whole, with three male and three female participants, all of whom have obtained tenure.

The stability of the teaching force is significant to this study given the constantly evolving nature of technology and the professional development available to teachers to help them adapt to these changes. The average teacher at the school has between 15-16 years of teaching experience. Researchers Koehler and Mishra (2008) note that many teachers to not see the relevance of technology to their practice, and that this may be due, in large part, to the fact that many teachers received their degrees and teacher training before technology was such an integral part of the classroom**.** Furthermore, consider that teacher preparation programs, specifically those at the beginning of the 21st century when a 15-year teacher would have started his or her career, consisted primarily of just one technology class (Niess, 2005; Pope, Hare, & Howard, 2002). It is difficult to imagine that one college class could sufficiently prepare teachers for a 1:1 technology

environment nearly two decades later. One can conclude, then, that the professional development context at the state and local levels, are significant to the impact that technology would have on teacher planning as well as the ability of teachers to overcome technological barriers. Given the nature of this study, it is important to provide additional contextual information about teachers' professional development and lesson planning.

The Pennsylvania State Department of Education requires that teachers complete continuing education credits, called ACT 48 credits, every five years. Teachers must either take 6 credits of college coursework, or "180 hours of continuing professional education programs, activities, or learning experiences" to maintain licensure (ACT 48 FAQ's). School districts and Intermediate units generally provide learning opportunities on any number of educational topics. School districts may also provide workshops on topics that align with local goals, but teachers are otherwise not required to take part in training on any given topic. In other words, if a teacher is not interested in learning about technology, he or she can certainly avoid it (at least to fulfill state continuing education requirements). The instructional coaches stated that technology training was offered at the school in the form of various workshops and lunch and learns, but they were generally poorly attended. For the purposes of this study, it is significant to note that, while certain technology workshops were offered, professional development was not focused primarily on technology until the year that 1:1 implementation occurred. And even though technology training was the primary focus during that year, competing interests for PD time included Understanding by Design curriculum work, safety training, special education work, and the arts collaborative. It is safe to say that technology was a priority, but not the only priority.

Because the study analyzes technology before and after the 1:1 initiative, it is important to also provide contextual information regarding teacher use of technology before each student received a laptop. Before the 1:1 rollout in late October of the 2017-2018 school year, teachers at the school only had access to technology in the form of classroom carts. Six carts with 30 laptops each were available for teachers to share. The high school outlined a policy for signing out and using the carts, what to do in case of technical issues or missing devices, security, maintenance, and guidelines for classroom use.

Technology was being used quite a bit by teachers before the 1:1 initiative, evidenced by the extensive, often frantic use of the shared laptop carts. Emails were regularly circulated in attempts to locate a missing cart. For example, on May 16, 2017, the instructional coach sent the following message to all faculty and staff: "Looking for iPad Cart #1. It is not signed out by anyone and not in it's (sic) past location." Issues also regularly arose when devices were missing, leading to a chain of emails intended to track down the device(s) (For example, the email chain on April 24, 2017, searching for the location of device #26 from a teacher's room). An email from one of the instructional coaches sent on December 5, 2017 highlights the often hectic nature of the system. Reminding the faculty about the cart policy, the coach wrote "On behalf of a teacher who was doing the frantic search for the missing iPad cart (*as many of us have done*)…this is a friendly reminder to please use the Google Calendar link below to sign out the carts." The information outlined in these emails shows that technology was being used. It also potentially highlights the need for additional technology in the building.

Lesson Plan Data Analysis

Lesson analysis involved determining the quantity of technology lessons and then identifying SAMR level at which they were implemented. I initially analyzed the written lesson plans, looking for key words that suggested technology use (i.e., "typed", "researched", "Google docs", "Newsela", etc.). I highlighted these technology lessons and gleaned any information possible from the written plans about the level of implementation. I completed this process at least a day before meeting with the teacher. During the subsequent teacher meeting, I took notes while the teacher talked through each set of lesson plans. I took notes, considering the program or app used (if any), whether technology was used for differentiation or formative assessment, the type of work product, etc. to determine the implementation level. I created and referenced the summaries below when determining SAMR levels:

- Substitution: technology provides no functional change or improvement to learning opportunities. (For example, typing a paper or taking notes on the laptops)
- Augmentation: Technology provides a functional improvement to the lesson. Technology may have been used to present topics differently or provide data about student performance, or alter the learning path. The lesson would have been possible without it, but technology provided a functional improvement primarily at the teacher level.
- Modification: Within the modification level, the technology utilized allows for the learning activity to be modified or redesigned in some way (Puentedura, 2014). The learning activity would not have been possible without technology. For

example, Newsela articles that differentiate text and questions based on reading level.

- Redefinition: The last and highest level of the SAMR model is the redefinition level. Within the redefinition level, the technology utilized allows for the creation of a product that could not have been created without utilizing technology (Puentedura, 2014). For example, students create a walking tour of a region or interact with students around the globe to solve a problem.

I tallied the number of technology lessons for each teacher before and after 1:1 implementation and determined the corresponding SAMR level. Detailed information about each lesson can be found in Appendix 1.5. I analyzed a total of 93 days' worth of lessons across 4 different subject areas. Each lesson was identified as a technology lesson or not. I then organized the data in a table with a sum of lessons at the S, A, M, and R levels.

Barriers Data Collection Procedures: Hopes and Fears

At the beginning of the August and December professional development sessions, teachers were given three to five minutes to write a "hope" on one sticky note and a "fear" on a different sticky note. The teachers were asked to place their sticky notes on a piece of poster paper, one in the front of the room to represent their hopes moving forward; the other in the back of the room for fears that teachers would like to leave behind. No identifiable information was on the sticky notes. Teachers were instructed that the purpose of the assignment was to acknowledge group fears about the initiative and then use the data to develop professional development to address their concerns. For the

purposes of this study, "fears" provide insight into teachers' perceived barriers and attitudes about technology. They also can be helpful in providing information about previous obstacles to planning technology-based lessons that teachers may have experienced while using carts, such as issues with the network or lack of time in a 42-minute period.

At the end of each session, I collected the sticky notes from the chart paper. The information from the sticky notes was then typed into an Excel spreadsheet exactly as written by the teacher. I first determined whether the fear could be classified as external to the teacher (first order) or internal to the teacher (second order). I then scanned each category to look for a keyword and seek patterns in the data. I clustered the fears into similar categories based on key words or phrases. I then tabulated the key words and phrases into tables in order of frequency. The process for collecting and organizing the "hopes" data was different from the fears in that I only scanned the answers looking for information about potential barriers. I pulled out the answers related to barriers and then looked for key words and patterns.

I analyzed the two sets of hopes and fears data separately, first examining the fears from August and then the fears from December 2017. The data about teacher fears were collected to bring out potential barriers, while the "hopes" provide information about the ways teachers envisioned technology supporting their teaching goals. The hopes data ended up providing some additional insight into potential barriers.

Barriers Data Collection: Teacher Survey

The teacher survey was distributed through Google Forms to the all 44 9th grade teachers. All but two of the teachers responded to the survey. The survey was distributed

approximately 6 weeks after the students received their devices. The survey consisted of 5 questions which focus on teachers' feelings of success, barriers, and professional development needs.

Barriers Data Collection: Student Survey

The student survey was distributed to students via email using Google Forms. Students completed the surveys during their English classes between February 23rd and March 1st, depending on when teachers took class time to have students complete the survey. The instructional coaches compiled the data into a PowerPoint presentation shared to administration on March 2nd, 2018. I used Microsoft Excel to sort and count student responses to the Likert scale questions and calculated percentages to compare the values.

Barrier Data Collection: PD needs assessment

Supplementing the hopes & fears data and two surveys is data from a conversation with teachers during professional development. As the presenter at the August 2017 professional development, I asked the teachers to describe the new learning that would allow them to most effectively plan and implement technology lessons this school year. The information would be used to inform professional development planning for the year. After approximately 15 seconds of wait time, six different teachers gave answers, one at a time. The answers are provided in a bulleted list. The same faculty that contributed to the hopes and fears data were all in attendance.

Before launching into the specific data sample for the study, the impact on lesson planning, and the potential barriers in this study, it will be helpful to provide an overview, in general terms, of barriers to technology integration.

Part 5: Types of Barriers

Two distinct types of barriers exist as teachers attempt to incorporate technology into their: first order barriers, which include things that are external to teachers (such as the network), and second order barriers, which include attitudes and beliefs of the teacher (Ertmer, 1999). Defined initially by Peggy Ertmer (1999), first order barriers are external to the teacher; they are outside of the teacher's control. Examples include a lack of adequate access to computers, insufficient professional development, time, a lack of functional equipment, or perhaps inadequate technology support. Given the amount of money poured into educational technology, as well as the advances made in technology over the last twenty years, one might expect an elimination of first order barriers. However, teachers still regularly cite insufficient technical support and outdated Internet filters that block useful websites as barriers to technology integration (Klieger, Ben-Hur, & Bar-Yossef, 2010).

Beyond technical issues, several other first order barriers should be considered. In one study, a "crowded curriculum" was cited as a reason for teachers not using technology. Teachers felt as though there was too much ground to cover, and that they did not have the time needed to try out new strategies (Larkin & Finger, 2011). This may be particularly noteworthy when considering Literature, Biology, and Algebra, subject areas in Pennsylvania with end-of-year high stakes exams. In a different study, teachers

felt that the traditional curriculum was not conducive to innovative, technology-based lessons (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). Some teachers fretted about their own technical or pedagogical knowledge when considering technology, using words such as "fearful" and "intimidated" when considering the prospect of technology in their classrooms (Ertmer & Ottenbreit-Leftwich, 2010). This supports the idea that professional development and administrative support are necessary when 1:1 programs are launched to help teachers become more comfortable with devices and ease transitions in pedagogy. In fact, research shows that teachers identified lack of professional development as a significant barrier to implementation (Ware & Stein, 2014). They also reported a steep learning curve for adding new technologies. In a longitudinal study of science teachers, Drayton et al. (2010) found that a lack of professional development was an obstacle for effective implementation.

A district may build out the network, purchase devices for students, and provide professional development, basically eliminating all first order barriers, and still not have full technology implementation in classrooms. Dr. Ertmer (1999), described barriers inherent in the teacher as "second order barriers." They include teachers' personal and fundamental belief about technology and pedagogy, as well as their willingness to make changes to their practice.

Teachers' beliefs are important in how technology is used in the classroom. If teachers see technology as relevant and useful, it follows that they will be more likely to find ways to incorporate it into their lessons (Mueller, Wood, Willoughby, Ross, & Specht, 2008). Teachers' beliefs about the relevance of technology to student learning were perceived as having *the biggest* impact on implementation (Ertmer, Ottenbriet-

Leftwich, Sadik, Sendurer, & Sendurer, 2012). It is therefore important to look for evidence of second order barriers when considering the impact that 1:1 technology has on teacher planning.

After analyzing the impact that 1:1 technology had on lesson planning, I will present the potential barriers revealed in the student survey, hopes and fears data, and the teacher surveys regarding professional development

Part 6: Results and Discussion

Lesson Planning Data: Results

I analyzed a total of 93 lessons from six different teachers before and after 1:1 implementation. The first step in analyzing lessons was determining which lessons included technology. I then used the information from the lessons and teacher interviews to determine the SAMR level at which they were incorporated. A summary of the results from the lessons before 1:1 implementation is detailed in table 1 below. I extracted the information about the technology lessons and included them in a separate table. Specific notes and analysis of the lessons for each teacher can be found in Appendix 1.5.

Table 1: A summary of lessons before 1:1 implementation

Teacher	Total Lessons Analyzed	Technology Lessons	Technology Lesson SAMR Level
Teacher A - English	25	13	7 Augmentation
			6 Modification
Teacher B - English	18	13	2 Substitution
			10 Augmentation
			1 Modification
Teacher C - English	5	2	1 Substitution
			1 Modification
Teacher D - Science	15	4	4 Augmentation
Teacher E - Social Studies	10	10	10 Augmentation
Teacher F - Math	20	2	2 Augmentation
Total	**93**	**44/93**	**3 Substitution** **33 Augmentation** **8 Modification**

- Of the 93 lessons analyzed before 1:1, 44 were technology lessons, 49 were not technology lessons
- By Subject:

  English: 28 out of 48 lessons included technology

  Math: 2 out of 20 lessons included technology

  Science: 4 out of 15 lessons included technology

  Social studies: 10 out of 10 lessons included technology
- When considering English and social studies lessons combined, almost 2/3 of the lessons involved technology. This is nearly 4 times the ratio of combined math and science lessons (6/35)

Table 2: Summary of the technology lessons before 1:1 based on subject area and SAMR classification

	S	A	M	R	Total
English	3	17	8	0	28/48
Science	0	4	0	0	4/15
Social Studies	0	10	0	0	10/10
Math	0	2	0	0	2/20
Total	**3/44**	**33/44**	**8/44**	**0**	**44/93**

3 out of 44 technology lessons were at the Substitution level

33 out of 44 technology lessons were at the Augmentation level

8 out of 44 technology lessons were at the Modification level

Table 3: A summary of lessons after 1:1 implementation

Teacher	Total Lessons analyzed	Technology Lessons	Lessons at the A, M, and R levels
Teacher A - English	25	13	11 Augmentation
			2 Modification
Teacher B - English	18	15	3 Substitution
			9 Augmentation
			3 Modification
Teacher C - English	5	4	1 Substitution
			3 Augmentation
Teacher D - science	15	4	4 Augmentation
Teacher E - social studies	10	10	10 Augmentation
Teacher F - math	20	2	2 A Augmentation
Total	**93**	**48**	**48**

Table 4: Summary of the Post 1:1 implementation data based on subject area and SAMR classification

	S	A	M	R	Total
English	4	23	5	0	32
Science	1	3	0	0	4
Social Studies	0	10	0	0	10
Math	0	2	0	0	2
Total	**5/48**	**38/47**	**5/48**	**0**	**48**

Side by Side Comparison:

Before 1:1

	S	A	M	R	Total
English	3	17	8	0	28
Science	0	4	0	0	4
Social Studies	0	10	0	0	10
Math	0	2	0	0	2
Total	**3/44**	**33/44**	**8/44**	**0**	**44**

After 1:1

	S	A	M	R	Total
English	4	23	5	0	32
Science	1	3	0	0	4
Social Studies	0	10	0	0	10
Math	0	2	0	0	2
Total	**5/48**	**38/48**	**5/48**	**0**	**48**

Summary:

- The total technology lessons increased from 44 to 48 after 1:1 implementation
- The lessons in the Augmentation level increased from 33 to 38 while modification lessons deceased from 8 to 5
- No teachers planned lessons at the redefinition level, where technology is used to create a product otherwise impossible without technology

Data Analysis

I ran repeated measures ANOVA to test whether there was a statistically significant difference between: 1) the number of technology lessons before and after 1:1; and 2) the type of technology lessons before and after 1:1. Since the number of lessons submitted by teachers varied so greatly, I used proportions of lessons to create a scale between 0 and 1. To run these analyses, I calculated the proportion of lessons related to technology and the proportion of the technology lessons that were substitutions, augmentations, or modifications.

First, the proportion of technology lessons did not differ significantly before and after 1:1, $F(1,5) = 1.690$, $p = .250$. Additionally, the proportion of the lessons that were substitution did not significantly differ before and after 1:1 implementation $F(1,5) = 1.00$, $p = .353$. The proportion of the augmentation lessons did not significantly differ before and after 1:1, $F(1,5) = 1.306$, $p = .305$. The proportion of the modification lessons did not significantly differ before and after 1:1 implementation, $F(1,5) = 1.306$, $p = .305$. When considered together as a group, there were not mean-level differences in types of lessons before and after 1:1. Although the lesson plan analysis suggests that 1:1 implementation

had little impact on teacher lesson planning, it can be seen in the tables that the frequency of lessons at the augmentation level did increase slightly after 1:1.

When considering changes in planning, it is possible that the written documents remained unchanged while the practice of lesson planning more broadly was impacted. In other words, it is possible that lesson planning changed, but it was not reflected in the documents that teachers submitted to administration. Data from the teacher interviews suggest that ubiquitous technology may, indeed, have had a more significant impact than indicated in the written lesson plans. Three of the six teachers interviewed expressed that ubiquitous technology had a significant and positive impact on their lesson planning in specific ways. One teacher was happy to never need a "plan B" when lesson planning. A second teacher claimed that his opportunities to plan collaborative lessons increased now that all students have laptops. A third teacher noted that science tutorials are now always available, and this is planned weekly "as time permits." A fourth teacher claimed that 1:1 had a positive impact on planning, but did not elaborate with details.

A potential explanation for the lack of impact on written plans lies in the level of detail found in the UbD curriculum template, along with the amount of professional development and the cumulative amount of work put into completing just one curriculum unit. Over the course of four years, teachers were not only asked to convert their discrete weekly lesson plans to cohesive units of study, they were asked to write "Understandings" and overarching Essential Questions that connect units of study to the big ideas of the discipline. In each unit they were asked to present, in writing, ways in which students will transfer their understanding to unique, real-world situations. This is no small task for even the most seasoned curriculum writer, much less a teacher new to

this philosophy, working within a complex framework. It required significant time and professional development, especially considering that most of the faculty teach at least 2 or 3 different classes per year, with 5-10 units of study in each course. This translates to teachers writing anywhere from 10 to 30 curriculum units from scratch.

Over the course of about four years, teachers received intense professional development on topics ranging from the overarching philosophy of Understanding by Design (UbD) to writing Essential Questions and Performance tasks. The school year "kick-off" professional development for three years from 2014 to 2016 was devoted to UbD, and the vast majority of teachers' "extended day" PD time was devoted to writing and reflecting on units.

Teachers spent the bulk of their professional development and collaborative time over a three-year period writing curriculum. Units were compiled into a shared Google Drive folder until 2017, when teachers were asked to move units into a site called EduPlanet. This added layer of work made an already arduous task even more cumbersome. Teachers were asked to copy/paste parts of existing units that were in-progress from the Google drive over to EduPlanet before continuing to write. One of the teachers described this process, and EduPlanet in general, as "incredibly frustrating and time consuming" (1:1 Timeline). The four-year process of writing and editing units, coupled with the EduPlanet integration, could potentially lead to teacher burnout in writing and editing units. After such extensive work, it is possible that teachers would be reluctant to modify existing units to incorporate technology. This could certainly create an environment where even the teachers who incorporated technology into their lesson planning may not have changed the written documents.

The level at which the framework continues to permeate district work can be seen in the fact that the professional development plan for the 2017-2018 school year was written in the UbD template. Even though the district rolled out 1:1 technology in 2017, six of the professional development activities for the year still centered around writing UbD units, compared to just five activities devoted to technology integration. This highlights the need to analyze barriers when studying 1:1 implementation in schools. "Competing initiatives" was just one of the barriers listed by teachers.

Barriers to 1:1 Implementation: Data Results

To better make sense of the data on the impact of lesson planning, it is important to understand the site-specific barriers present as teachers plan to use technology. In the section below, I will present the results of four sets of data: Teacher hopes and fears expressed during the August and December professional development sessions, the student technology survey, and then results from the teacher technology survey. Additional information is gleaned from a list of teacher professional development wishes. Within each data set I will analyze whether the barriers are first or second order barriers. I will then conclude with a more holistic summary of the barriers that may have prevented teachers from planning lessons with technology. Details are organized in tables, when possible, with details and analysis following afterward.

Data Set Results: Fears - August, 2018

First Order Barriers	**Frequency**
District not providing enough technical support for students/faculty; teacher not having answers to technology problems	11
Technology not being available due to student errors (i.e., students forget their computers or show up with a dead battery)	10
Teachers teaching multiple grade-level classes (only the 9th graders have computers in first year of 1:1 rollout)	3
School will not put strict enough rules in place	1
Specific rooms not getting technology products they need	1
Total	**26**

Second Order Barriers	**Frequency**
Technology will be a distraction	12
Having technology for technology's sake (creating more work)	2
Technology will not help students speak the language	1
Having too many initiatives	1
Total	**16**

Five distinct types of first order barriers appeared in the data, with twenty six out of forty two teachers (62%) citing first order barriers as a major concern. The primary themes center around a lack of technical knowledge (11 responses) or a potential lack of

functional resources (10 responses). Combined this means that more than a 25% (11/42) of the teachers responsible for 1:1 implementation were concerned with not being able to properly use the machines. An additional ten teachers worried that students would enter the classroom without properly functioning machines. From a lesson planning perspective, this means that nearly twenty five percent of the teachers (10/42) feared that they might need a back-up plan for students without functioning devices. These two categories are similar, but I separated them because one concern is related to external actions of the district or the student, while the other category involves the teacher not having enough technical knowledge. However, when lumped together, this data means that exactly half of the surveyed teachers (21/42) were concerned that either the machines wouldn't work or that the teacher lacked the technical knowledge to problem-solve issues. Technical knowledge is one of the broad categories cited in the TPACK framework as necessary for quality teaching, and this data suggests that a lack of technical knowledge served as a significant barrier to planning technology lessons.

Three teachers cited the external concern that students would not be scheduled properly. This scheduling concern likely revolves around the proposed plan for rolling out devices. Ninth grade students were the first students to receive devices. This initial rollout created a situation where devices are not ubiquitously available to students in mixed-grade classes. It would, therefore, be difficult for some upper level teachers to plan technology lessons without reserving a cart for the first three years of implementation. Some ninth-grade classes (for example, Geometry) may have tenth graders in it. One teacher worried that specific rooms would be short-changed in terms of technology needs.

In summary, sixty two percent (26/42) of the teachers in attendance had concerns about first order barriers. These fears may have stemmed from experience using the district laptop carts, or they may have been grounded in an inherent distrust of the functionality of technology. Either way, it is safe to conclude that the majority of teachers entering the first year of implementation had reservations about how this new initiative would play out daily in their classrooms. The data does not provide detailed information about the extent of the concerns. However, it seems a logical conclusion that teachers may not plan for daily use, or even a significantly increased use, until concerns about functionality were alleviated. It is certainly possible that these types of concerns may prevent teachers from planning technology-based lessons for the first year.

Second order barriers represent impediments internal to teachers, such as their attitudes about technology. They represented a smaller portion of fears, compared to first order barriers, but the single largest concern for the teachers was a second order fear. Nearly thirty percent of the teachers (12/42) worried that technology would simply be a distraction in the classroom. While each teacher also wrote about a hope for technology, it is significant that the greatest teacher fear was that technology will detract from learning. At worst, this may mean that teachers do not see the value in technology. Instead, this concern may represent a worry that teachers lack pedagogical knowledge, one of the three types of knowledge referenced in the TPACK model. These teachers may believe that technology will function properly and that it *can* lead to increased learning. However, they may be insecure in their ability to coordinate technology and manage a classroom well enough to get results in the classroom. In either case, it is safe to assume that these teachers may not be in a position to plan lessons that maximize the potential

impact of technology. Regardless of the explanation, it is likely that teachers would need to overcome this fear, or gain the requisite pedagogical knowledge, in order to overcome their internal concerns that technology will simply be a distraction.

Two teachers worried that they would be required to use technology just for the sake of incorporating technology, suggesting that planning technology lessons would be something done to please students and/or administration, not to help learning. One teacher suggested that 1:1 was "just another initiative", and another worried that technology cannot help students learn. In these cases, it is likely that teachers would resist planning lessons with technology, at least in the short-term, until they determined whether this was just a passing phase or not.

Consider the potential impact that these second order barriers may have on the way teachers plan to use technology once it is ubiquitously available. Just two months before the 1:1 rollout, more than a third of the teachers on the 1:1 Implementation Team (16/42) had concerns about the inherent educational value of technology. If a teacher has serious reservations about the worth of educational technology, it is unlikely that they will plan to use technology more, much less plan to use it in innovative ways that increase the learning opportunities for students. It is likely that professional development over time to improve the technical and pedagogical knowledge of teachers would be necessary to alleviate these concerns.

Data Set Results: Fears - December, 2018

First Order Barriers	**Frequency**
Technology not available or working properly (batteries, etc.)	6
Time/Crowded curriculum	2
District not offering enough tech support	1
Management (knocking them over when walking in the aisles)	1
Wi-fi not working	1
Total	**11**

Second Order Barriers	**Frequency**
Technology Overload (i.e., "you can't google everything", "students need to know how to do things with pencil/paper", "technology becomes the classroom")	8
Technology is a distraction	1
The laptops will get in the way – physically (reflecting a lack of need)	1
Total	10

Similar to the hopes and fears data set from August 2017, the primary first order fear in the second data set from December 2017 (two months after the ninth grade 1:1 rollout), is that the machines will not work properly and/or teachers will not have the technical knowledge to support a computer-based classroom. Six out of eleven (55%) first order responses centered on the concern that technology would not be functional.

The number of responses classified as first and second order was nearly equal, with eleven first order concerns and ten second order. It is noteworthy that two teachers were concerned about a lack of time, or a "crowded curriculum". While this was cited in the literature as a common concern, it was not brought up by any of the forty-two teachers in the August PD session, but twice by teachers after the 1:1 rollout. A possible explanation is that the second session had upper level teachers in attendance, many of whom teach Advanced Placement (AP) courses. A traditional concern of AP courses is that the curriculum is crowded, with a breadth of material to cover in a limited amount of time.

The ratio of first order to second order concerns among teachers in each session remained similar, but a striking difference in answers can be found in the types of second order concerns expressed by teachers. Before the 1:1 rollout, the greatest second order teacher concern was that it would be difficult to keep students on task with technology - that technology would be more of a distraction than it was worth. Approximately two months after becoming a 1:1 school, more teachers were worried about students reaching "technology overload" than anything else. They were not so much concerned that technology would be a distraction, per se; they were just worried that students' lives were being inundated with it. One teacher went so far as to write that, "Students will continue to invest more of their soul into an electronic-centered existence and forget how to be a secure and compassionate real human being." Perhaps these fears arose from seeing an increase in usage in the school, or even a response to feelings of increased pressure to incorporate technology.

The concern that technology should be all-consuming, or even that it is incompatible with pencil/paper learning goals, is at odds with district messaging about

the 1:1 rollout. Given the district's history of high achievement, it is important to note that administration adopted a cautious, incremental approach to transforming teacher pedagogy with technology. At a September 2017 leadership meeting, the superintendent voiced concern about trying to do "too much too quickly". In an after-school meeting with all teachers on October 4th, the high school principal echoed this sentiment in response to teacher worries about the upcoming device rollout. She stated that the district would not, suddenly, expect teachers to do "anything different." They were explicitly told at the meeting's end to "keep doing the good work that you are doing!" The second set of fears-data points to the conclusion that these messages did not completely alleviate anxiety about the rollout; or teachers may have used this messaging to justify their existing trepidation about planning technology lessons. My personal concern is that the cautious messaging potentially undercut the expectation that classroom planning and pedagogy *should* change to make the most out of a 1:1 setting. Teachers could interpret the district message as permission to opt out of using devices, or as a green light to maintain traditional teaching strategies. This could possibly account for the lack of change found in research question 1 regarding quantity of technology lesson planning.

While the school's "Tradition of Excellence" (high test scores, college acceptance rates, local accolades, etc.) was not explicitly referenced in cautionary messages to teachers, such success creates an environment where wholescale programmatic change, even with the best of intentions, carries significant risk. In spite of the apparent community and administrative support, cautious messaging to teachers, as well as the history of success, could have signaled to teachers that the pedagogical status quo is OK.

The data points to the conclusion that many teachers may actively resist the addition of technology into their lessons.

To further support both the district commitment to technology as well as the potentially contradictory messaging to move slowly and be thoughtful about how and when technology is used, I point to the district's full-day professional development in February of 2018. Dr. Ruben Puentedura, developer of the SAMR Model, was the guest speaker for the morning. His mere presence shows the district emphasis on technology and its use to increase the learning opportunities of students. After his hour-long presentation, teachers attended peer-led sessions in the afternoon. However, in a February 1st email the curriculum coordinator stated, "Keep in mind the (afternoon) sessions do not necessarily need to be framed exclusively through the technology lens. The theme of the day is innovation, and we have several examples of innovative instructional practices occurring in the district (Human-Centered Design, STEAM activities, Breakout EDU classroom kits, Multi-disciplinary projects, etc.)." Technology is highlighted, but it was continually emphasized that good pedagogy is most important, with or without technology. Over time perhaps this messaging will support an increase in lessons at higher levels of the SAMR framework, but it is quite possible that such a dramatic change would not take hold within six months of 1:1 implementation. It is possible that teachers would hold off on incorporating technology, at least until they knew how to use it to increase learning opportunities. These attitudes, along with a lack of technical and pedagogical knowledge, could easily account for the sum total of technology lessons initially remaining constant.

The Hopes and Fears data supports the difficult balancing act between maintaining traditional school success and the desire to innovate. This became apparent in other school venues as well. At the February 2018 school board meeting, the high school principal and two assistant principals presented an "academic redesign" plan, outlining the necessity to change the high school schedule, increase student collaboration, improve partnerships, and more holistically change the way time and space are used (Academic Redesign PowerPoint). The 1:1 adoption is set in the context of this broader plan that was well-received by the school board. In fact, all 9 school board members praised the plan that was collaboratively developed by administration, principals, and the curriculum coordinator. However, building principals privately expressed some reservations about such wholescale changes. In an October 2017 conversation, the principal and assistant principal noted that the school "does traditional school very well." For a district that regularly earns top 5 rankings in regional school ratings, objective measures leave little room for growth, but significant room for decline. This history of success, along with the noted messages for teachers to continue with business as usual, may create an environment where teachers had little incentive to overcome barriers (external or internal) to effective 1:1 planning. In other words, why rock the pedagogical boat when state measures of success have rewarded existing practice handsomely for years? The external rewards for business as usual could easily create the conditions where a tacit agreement between teachers and administrators allows for the status quo, in spite of the huge district technology investment.

The struggle to balance pedagogical theory with practical strategies is also evident in professional planning notes by the instructional coaches. In a January 2018 Google

planning document, three months after the 1:1 rollout with freshmen, a note in the margins begs the question, "How do we break this down into manageable sessions without frontloading with a bunch of theory?... Need a balance of why this is important, practical application of tools/planning, and getting teacher buy in for actually trying this and working with us for the coaching cycle." The fact that teachers require manageable sizes of information suggests a lack of technological knowledge. Perhaps more important, though, is the fact that teachers still need to be reminded of why this technology work is relevant in the first place. This suggests second order barriers in terms of mindset. This one quote from the instructional coach supports the second set of hopes and fears data in no uncertain terms: In the opinion of the instructional coach who has worked closely with teachers for the last five years, many of them still need to be reminded that technology is important.

Additional notes from the instructional coaches imply barriers to planning lessons that incorporate technology. A session on classroom management was ultimately ruled out, but it was noted in the coaches' professional development planning document, "I feel like teachers are still stressing or thinking about this (management)!" (Google Docs L&L 2nd Semester Planning). Concern over classroom management and teacher buy-in suggests that some teachers may lack the pedagogical or technological knowledge to implement lessons with confidence. Or at the very least, teachers who are focused on basics like classroom management may not plan ways to use technology in sophisticated ways that improve learning opportunities. This is supported by the Hopes and Fears data collected, where many responses were either directly or indirectly related to classroom management.

It is important to point out that teachers who provided the second set of Hopes and Fears data may be the most reluctant to incorporate technology into their classrooms. The only teachers required to attend the December after-school professional development were those who *did not* attend a series of technology lunch and learns led by the instructional coaches. Volunteering for at least three of the six sessions exempted teachers from staying after school. Teachers RSVP'd for sessions through a Google form sent out by the instructional coaches. The sessions occurred during 5th, 6th, or 7th period; teachers generally got their lunches and ate during the sessions. A high level of support for the 1:1 rollout can be seen in that 76 faculty and staff members attended the first session, including counselors, paraprofessionals, academic support teachers, building substitutes, and administrators. Considering the high school has just sixty-two full time faculty, twelve paraprofessionals, four counselors, three building substitutes, and three administrators, this means that nearly all building-based employees participated in the first session. Despite the apparent excitement and broad support for the technology lessons (or at the very least excitement about the proposed incentive for participation), the teachers from which the second set of hopes and fears data were derived were the only ones who did not attend at least three of these sessions. This may account for the increase in second order barriers in terms of attitudes toward technology.

Data Set Results: Teacher "Hopes"

Collecting teacher "hopes" along with the fears was originally designed as a way to generate excitement from the teachers, not as a source of data for this study regarding barriers. A primary function was to spark enthusiasm; to consider best-case scenarios for

technology and share ideas on how it could be used to meet the district learning goals. Surprisingly, the "hopes" provided an additional source of data about barriers. Enthusiasm was laced with trepidation; inspiration weighed down by concerns. Barriers and fears were apparent even as teachers were asked to envision their ideal technological classroom.

Forty-four hopes were listed on sticky notes during the pre-1: professional development session in August of 2017, and the greatest hope actually represented a potential barrier. Eight teachers' greatest hope for technology was that they would have enough time to use the technology. A lack of time has been cited as a common first order barrier (Larkin and Finger, 2011), and when considering ways to enhance lessons, nearly 20% of teachers at this site considered time to be a potential obstacle that they hoped to overcome. This would invariably impact planning, as quite a few of the teachers assumed from the outset that they may not have enough time to make this work.

Five teachers hoped that teachers would become more fluent in software tools, suggesting that a lack of technical knowledge may prevent teachers from realizing technology's potential. Another teacher simply hoped that students would come prepared with devices charged, and two teachers hoped that their rooms would get the technology that they need. In all, sixteen of the forty-four "hopes" actually represented potential first order barriers to technology integration.

The hopes listed from teachers in the post-1:1 professional development in December provide additional insights into perceived barriers. Two teachers in this session also cited "time" as a hope. Another teacher hoped for the ability to manage potential discipline issues in a classroom filled with devices, pointing once again to a lack of

pedagogical and technical knowledge. Two additional teachers cited hopes about management, wishing for compliant students who will use the machines responsibly and bring them to class charged. Overall, this shows that two months after the computers were in the hands of ninth grade students, nearly a third (6/17) of the teachers aspired to overcome potential first order barriers.

Second order barriers also showed up in the hopes data. One teacher hoped for "business as usual" while another hoped that students "make an effort to use the target language when they can." At best, hoping for "business as usual" means a seamless integration into what the teacher is already doing with technology. This would still imply that, in spite of the 1:1 transformation, no substantive change would occur in pedagogy or planning. At worst, this implies that the teacher hopes to simply continue his or her practice and avoid the new initiative. In either scenario, the teacher does not realize a change in lesson planning.

Analyzing hopes and fears regarding technology provided a window into teacher attitudes and potential barriers. Teacher deficiencies in technical knowledge became evident in concerns that they will be unable to troubleshoot issues. A lack of pedagogical knowledge showed through in concerns about how to incorporating technology-related routines and procedures into their existing classroom management model, or concerns that computers would simply become a distraction. Additional insight into these potential issues can be found by examining results from the student survey as well as what teachers wished to learn more about.

Data Set Results: Student Survey

Evidence from the instructional coach's student technology survey suggests that at least some of the teachers are planning lessons using the devices and students regularly incorporate their devices into their learning. Almost all of the students are using their devices at least once a week, with the vast majority using them a few times a day. Ninety four percent of the freshmen (209 out of the 222 surveyed students) responded that they use their computers at least once per day. Sixty two percent (138 out of 222) claimed to use the devices "a few times per day" while just under twenty percent of the students (44 out of 222), said they use them "many times per day" for schoolwork. Just thirteen students reported using their devices once a week or less. This suggests that teachers are able to plan technology-based lessons and the computers are functional.

Students are using their devices during the school week, but this does not mean first order barriers are absent. Nearly sixty percent (131 out of 222) of the freshmen reported having technical difficulties with their brand new, school-issued devices. This would invariably impact teacher lessons and possibly future planning. In the survey students were given the opportunity to explain their technical difficulties, and one hundred twenty-three students provided feedback. I analyzed the open-ended data for key phrases and patterns. By far the most prevalent complaint involved password and login issues. The key words "login" and "password" appeared sixty times. This means that nearly a quarter of the entire freshmen class experienced difficulty logging on or using their passwords. Students are given login and password information when the device is issued. When students need to change a password or have trouble logging onto their devices, they are instructed to go to the library, where either the librarian or the library

secretary will trouble-shoot the issue and/or help the students reset their passwords. The survey does not provide information about the number of times this issue arose for each student. However, this issue would be disruptive to classroom activities considering that teachers are not able to address the issue in their classrooms; students are required to seek technical support outside of the classroom. The survey was given five months after device distribution and students reported this as a technical difficulty. This may represent a particularly significant barrier to lesson planning. If nearly a quarter of the students experience trouble logging on, one can conclude that on average seven students in a class of thirty at some point experience frustration logging on to their device. This was a prominent teacher fear that appears to have come to fruition.

Fifteen students reported that their school-issued device runs slowly. Another ten students reported having difficulty with the mouse/cursor disappearing from their screens, and another thirteen students added that their batteries run out too quickly. It should be noted that the school is not equipped with charging stations, and outlets in classrooms are limited. Therefore, the need to charge could derail classroom activities. In the Hopes and Fears data, teachers cited charging as a first order fear. An additional five students reported receiving a message that the computer does not have enough resources. This prompts the student to restart their machines.

To get a full picture of potential barriers, it is important to extend the conversation of functionality to whether students are able to use their devices to complete assignments at home. Teachers may plan lessons using a flipped classroom model, requiring students to watch videos or receive instruction online in preparation for class. They also may plan for students to communicate either with the teacher or with each other online. Over one

hundred students reported completing web-based activities for homework either daily or a few times a week. However, far fewer students used their *school-issued device* at home. Students reported using these devices at home less than once per week. In general students are busy completing web-based assignments for homework, but they are not using their school-based computer. While students are not using their school-issued device at home, I would hesitate to conclude that this is due to the existence of barriers. In the open-ended section, only a handful of students reported having difficulty gaining access to wi-fi at home. Fifty nine percent of students also reported that the school-issued devices positively impacted their ability to do homework while just four percent of students reported that the devices negatively impacted their ability to do homework. The fact that more than half of the students reported that their computers do help them complete homework suggests that students are utilizing their school-issued devices at home in some capacity.

While the students report regularly using technology throughout the day, the classes in which they use technology are not balanced. Over ninety percent of students report using technology most in either their English or social studies classes. Over thirty percent of students report using technology most in their health/wellness classes. What is most striking about the data is the dramatic drop-off in the survey response from these three classes to the other classes. Fewer than one percent of students report using their devices most frequently in their art, music, business, academic seminar, foreign language, and technology classes. The student survey data is supported by the lesson plan analysis, where the proportion of technology lessons to non-technology lessons in English and social studies classes was much higher than the proportion in math and science. This data

perhaps raises more questions than answers, though. Are teachers in these classes incorporating technology into their lessons, but just not as often as in English, social studies, and wellness teachers? Does the curriculum of these courses lend itself to technology more than the others? Do teacher attitudes toward technology differ based on subject area? Is the technological and pedagogical knowledge greater or less within these subsets of teachers? More analysis would be necessary in order to fully answer these questions.

Another potential barrier to teachers when planning lessons is technological knowledge. The study focuses largely on the teachers, but student inability to properly use the machines could certainly play a role in the way teachers plan to incorporate the devices into their classrooms. Details in the open-ended student answers concerning how they would like to see the computers used in classes suggests that the freshmen, by and large, do have experience and technical knowledge to use their devices to support their learning. Just ten students listed single statements suggesting barriers such as an inability to use software that was installed, how to use features such as sticky notes, and the need to use camera and video editing features. However, when asked if there was anything that they would like instruction on, the vast majority simply stated, "no." This open-ended question regarding instruction on features offered another opportunity for students to complain about technical difficulties, again suggesting that first order barriers exist to some extent. Ten students complained about many of the issues already covered, from poor battery life to general functionality. One student even exclaimed that the computers are "more trouble than they are worth." Three students stated that certain educational sites are blocked.

While just three students complained about educational websites being blocked in this open-ended question, this theme of network access jumped off the page when analyzing responses to the last question, "Is there anything else you would like us to know about having your own school-issued device?" Forty-one students stated that websites with potential academic use are blocked. In addition to the survey results, teachers and students complained about the web filters enough that the district's director of technology held a meeting with students to learn more about student frustrations in this area. This meeting occurred in the spring of 2018, six months after rollout. In this discussion, the director of technology said that the school's network, in an effort to block inappropriate content, invariably keeps students from accessing certain legitimate content due to certain key words. For example, a site for information on "breast cancer" may get tied up by the filters. Several students also suggested that the school pushed a "liberal bias" by blocking information from right wing, conservative sites. The director denied the bias, instead attributing blockage to the presence of hate speech. The instructional coaches, who also teach English, cited the filters as a particularly burdensome challenge when planning research lessons.

Student descriptions of the manner in which the devices are being used provides insight into potential barriers. Students listed sixteen different types of classroom activities that they have enjoyed, suggesting that teachers are incorporating devices in a variety of ways. Google Classroom and Google Docs represented the highest percentages at 18.8% and 15.5%, respectively. This information does not provide specific details about which teachers are using the devices and which are not. It is possible that a small group of teachers are using the devices dynamically. However, the variety of apps and

programs used, coupled with the simple fact that they are used to the extent that students have favorites, suggest that teachers are planning technology lessons that enhance instruction.

The types of apps and programs used provide insight into how teachers plan technology lessons. Consider that by a 2:1 ratio, students report that the devices are having a very positive impact on their learning when compared to negative. In fact, ninety five percent of students report either neutral or positive impacts. A function of Google Classroom and Google Docs is to improve classroom communication, both between students and then also between teacher and student. Using technology in ways to increase communication suggests that teachers are planning technology in ways that Augment their lessons, moving up the SAMR model. However, it is worth noting that a large number of students (11%) cited that they enjoy taking notes on the computer. In isolation, this represents a use of technology at just the Substitution level of the SAMR model.

Data from this survey suggests that barrier do exist, but the fact that students by and large perceive technology as having either a positive or neutral impact implies to me that the barriers are not insurmountable. Teachers are able to plan for and implement lessons that make use of the devices. It is reasonable to assume that if teachers planned to use the laptops in class, but were *unable* to use them properly (or technical issues prevent the lesson from being carried out), more students would report a negative impact. Less than five percent of respondents reported a negative impact on computer ability to learn new material and seven percent reported a negative impact in their ability to review material.

While the study focuses primarily on teacher lesson planning and perceived barriers to planning lessons with technology, student feedback helps provide a complete picture of the issue. By analyzing student feedback, I found that seventy eight percent of students reported that the laptops are supporting collaboration and 55% report that 1:1 supports receiving feedback. This indicates that teachers plan lessons that move up the SAMR hierarchy. However, 43% of students report that technology is having no impact on getting feedback from teachers. This is a large number and suggests plenty of room for growth in terms of planning lessons that use technology for increased formative assessment. Overall, students report that teacher lessons use technology, and it is used in ways that increase learning opportunities.

Data Set Results: Teacher Survey:

The instructional coaches created the survey and requested feedback from all 44 of the 9th grade teachers. Forty-two teachers responded, representing a 95% response rate. The instructional coaches compiled the results of the Likert scale questions and created a pie graph of results (Appendix 1.6). For teachers to report a positive impact on their classroom, I believe one can logically conclude that they planned to use the laptops. However, I believe it would be too big of a leap to generalize about planning based on the perceived impact on student learning. For example, teachers may plan to incorporate their lessons daily, and even follow through with implementation, but still feel that the new technology is not having an impact on student learning. I will focus on the first open-ended question, "What challenges or struggles are you facing with the 1:1 laptop initiative?" to better understand barriers.

Approximately 55% (24/44) of the teachers claimed that 1:1 had a somewhat positive or very positive impact on their classrooms, compared to just over 2 percent who felt that the initiative had a somewhat negative effect. Nineteen of the teachers (43.2%) thought 1:1 had no impact on their teaching. It is worth noting that zero teachers perceived the initiative as very negative; the vast majority of the teachers saw the 1:1 initiative as having either no impact or a slightly positive impact on their classrooms.

I reviewed the responses to the open-ended question about challenges for key words that may indicate a first or second order barrier. For example, frustrations about time or the network would be classified as first order barriers, while concerns about district expectations to use technology may indicate a second order barrier. Of the 44 teachers who participated in the survey, 31 described challenges to using technology. A summary of the results can be found in the table below.

First Order Barriers	**Frequency**
Time	7
Students aren't charging their devices or bringing them	6
Class management; lack of technical or pedagogical knowledge	6
Software needed is not on the 1:1 devices, is on cart devices	6
Mixed Grade Level classes	3
Unable to print	1
Lack of student technical knowledge	**1**
Total	**30**

Second Order Barriers	Frequency
Laptops don't provide a functional improvement	1

Once the 1:1 initiative was in place, teachers overwhelmingly (30/31) reported that their primary challenges to implementation were first order in nature. They cited a lack of time, concerns about class management, and an absence of software and functional devices as the primary obstacles.

It is interesting to note differences between the barriers that teachers reported in the technology PD needs survey compared to the potential barriers that showed up in the Hopes and Fears data. In the Hopes and Fears data, second order barriers were prominent. In August, two months before the 1:1 rollout, nearly 30% (12/42) of teachers feared technology would simply be a distraction. The vast majority of participants in the December PD were upper level teachers not part of the 1:1, and their responses echoed this sentiment, with nearly 40% (8/21) concerned about technology overload. Their detailed responses showed skepticism over the transition to increased technology ("you can't google everything", "technology becomes the classroom", etc.). These types of responses found in the Hopes and Fears data contrast greatly with the frustrations expressed in the technology PD needs survey, where only one teacher stated that laptops do not provide a functional improvement. Not one teacher had concerns about "technology overload", perhaps recognizing that teachers have control over the level of use in their classrooms. The variety and distribution of first order barriers cited after implementation, from students not charging their devices to class management, suggest

that teachers plan to use technology in their classrooms but experience specific roadblocks.

Data Set Results: PD Wishes

During the August 2017 professional development, six teachers stated their professional development wishes. While this represents less than 10 percent of the overall faculty, it is worth noting that the teachers by and large expressed a desire to learn about programs that will allow them to plan and implement lessons that improve the learning opportunities of students. The results are listed below:

- How to create and edit videos
- Google Classroom
- "Best practices" in using technology. (I would like to see sessions on how to differentiate instruction or use technology to give/receive feedback.)
- Using technology to support PBL's.
- Peer sharing of best practices
- Use of technology to support math instruction

Overall teachers requested PD that would help them differentiate instruction, provide formative assessment feedback, and support Project Based Learning. The absence of answers that reflect first or second order barriers is noteworthy. For example, teachers did not ask for workshops on the basics of using computers in a classroom or how to administer technical support when things go wrong - answers you may expect when first order barriers are present. The responses also did not include answers that

would suggest a lack of desire to incorporate technology into lesson planning. The data set is limited in scope considered the number of participants and the fact that they were volunteers. However, the answers point to a school culture where at least a portion of the teachers openly embrace technology as a tool for improving lessons.

Overall the data as a whole suggests that teachers are using the laptops in their lessons, but it does not show that use significantly increased from the time that the school utilized carts to when it moved to a 1:1 school. Of the six teachers who volunteered to be part of the study, their lessons did not significantly change in spite of statements that the 1:1 initiative was beneficial in their lesson-planning. It is certainly possible that the teachers who volunteered to participate in the study had already embraced technology to support their lessons. Perhaps the 1:1 initiative made planning with technology more convenient, but they might have incorporated technology to similar degrees either way. This is worth further study. The student and teacher data suggest that barriers to implementation existed, but the school-issued laptops still became an important part of teacher planning and student learning. It is quite possible that eliminating these barriers will lead to an increase in planning over time. It is also possible that teachers who already utilized technology figured out how to make things work, and the teachers who were not as receptive to technology had an "out" given the number of first order barriers.

It may be significant that the 1:1 initiative began six weeks into the school year. At that point, many teachers, especially experienced ones, have already established their classroom rituals and routines. It might be naïve to consider that a fifteen-year veteran would substantially change his or her practice mid-year, regardless of the expense and importance of the initiative. It's quite possible that teachers continued to incorporate

technology at the same rate and level, and that future PD and collaboration opportunities may increase technology planning and practice over time. Additional research will be needed in this area. Limitations and suggested next steps will be part of Chapter 5.

Chapter 5: Discussion, Limitation, and Next Steps

Part 1: Summary of the Findings

The introduction of 1:1 computer devices for 9th graders at the high school did not have an impact on the number of teachers' written lesson plans during the first year of implementation. It also did not have an impact on the proportion of the lessons planned at substitution, augmentation, modification, redefinition levels of the SAMR framework. It is possible that the process of lesson planning changed more broadly, but the written documents remained relatively unchanged. Four out of six teachers in the study claimed that 1:1 impacted the manner in which they planned lessons, but the impact did not show up in the relative number of technology lessons that they planned before and after becoming a 1:1 school. The focus of the study was on the written documents, but insight into the impacts on planning came through as the teachers talked through their lessons.

The self-reported impact that technology had on planning may be explained by the increase some teachers showed in the frequency of lessons planned at the Augmentation level. Two teachers explained that they liked having videos available that students could watch at their own speed. One teacher explained that the most dramatic impact on his planning was a result of a device consistently being in the hands of the teacher. In this case, the 1:1 initiative isn't what accounts for the changes. Rather, the presence of teacher technology, and the ability of the teacher to use a computer to plan presentations and collect data on how the students are doing, was most significant in terms of functional improvements. At the Augmentation level, technology is regularly used to present topics differently or provide data about student performance.

Barriers to planning lessons with technology presented themselves in both the teacher and student data. Before and after becoming a 1:1 school, over half of the teachers feared that the technology would not work properly and that they would be unable to problem-solve if/when issues occurred. First order barriers played out in the form of various technological issues evident from the student survey data. Nearly 60% of the students surveyed reported at least one technical difficulty when using their brand new devices. The "fears" data also revealed that a common teacher worry was that the technology would not work, teachers felt as though they lacked the technological knowledge necessary to adapt lessons in real-time if problems were to occur. The "hopes" data also supports the concern that technical issues would prevent teachers from planning to use the new devices into their lessons. Just weeks before distribution of devices, teachers cited functionality, time, and their own knowledge as potential barriers. However, it is difficult to determine from this study the extent to which the barriers prevented teachers from incorporating technology into their planning. While the student survey data supports teacher concerns about functionality to a certain extent, it is also clear from the student data that students and teachers used the laptops regularly. One can conclude, then, that the first order barriers were not significant enough to prevent teachers from planning technology into their lessons.

In addition, second order barriers were cited by nearly a quarter of the ninth grade teachers; before students even received their laptops, a large percentage of teachers felt technology would simply be a distraction to the learning process. The six teachers who participated in the interview process did not indicate that they felt computers were a distraction to learning, but the fact that this many teachers expressed resistance would

certainly impede whole-scale adoption and potentially limit the positive impact that technology could have on teacher lessons.

Part 2: **Why this study is important**

Schools generally evolve at a glacial speed. Today they look pretty much the same as they did a hundred years ago. Producing wholescale changes within a school system is quite a monumental task, and I would argue that just about anybody who attempted to innovate significantly within a school system would attest to this statement. One notable exception is the rate at which educational technology has evolved in schools over the last several decades. Not only has the speed and functionality of devices improved dramatically, but the sheer volume of personal devices found in schools is astounding. In just a generation most schools have moved from shared computer labs to nearly a 1:1 student to device ratio. At the current rate, the vast majority of schools will function in a 1:1 environment within a decade. This rate of change alone makes a study of the impact and barriers to 1:1 significant.

This transition is not coming without a cost. At a lower-end cost of about 300-400 dollars per device, a few quick calculations show that a mid-sized school could hire a new teacher at every grade level with the funds needed to buy devices for every student. To put it in a different perspective, each 1:1 high school is essentially choosing student laptops over four new technology teachers. School funds are limited; usually at best a purchase for one item comes at the expense of another innovation. At worst, schools may be forced to cut funding from one existing source to make room for this new initiative. Furthermore, schools are transforming quickly to 1:1 environments when the research on impact is relatively mixed.

One to one technology programs have led to gains in reading, mathematics achievement, and motivation, and have led to declines in behavioral issues. However, in some cases, the large financial investment has not led to significant gains in achievement. For example, in a 2010 study by Donovan, Green, and Hartley, it was found that behavioral issues actually increased in a 1:1 environment. James Carr (2012) found that engagement increased at first with the introduction of devices, but the positive effect disappeared over time as the novelty wore off. Student achievement may also increase, but research examples point to some cases where achievement did not improve (for example Carr, 2012). In a study of middle school science and English classes, Hur and Oh (2012) found that the lessons planned with technology actually overwhelmed the students visually; the increase in electronic images hindered learning, and students ended up performing worse on the post-test. We need to make sure teachers plan technology lessons that lead to functional improvements. Otherwise, what's the point?

In general, results vary depending upon the complex environment of each teacher and classroom. Barriers may exist (both internal and external to the teacher) that prevent teachers from incorporating these expensive tools into their lesson plans. Teachers need to be trained - the technological or pedagogical knowledge base of the teacher plays a role in his or her ability to plan and implement lessons with technology (Mishra & Koehler, 2006). Furthermore, teacher beliefs about technology play a role in the ways in which technology is implemented (Brantley-Dias, 2013). Simply put, classrooms are complex environments where the teachers matter! When making the significant investment in technology, districts need to recognize that student learning is dependent

upon the teachers' ability to plan innovative lessons that they can confidently implement. It is therefore, imperative, to study planning in a technology environment further.

Part 3: Conclusions of this study connected to the literature

Several results of this study are consistent with research cited in chapter 2. The results align with other studies that have analyzed changes in computer use as well as barriers to implementation. There is very little research on the impact that 1:1 technology has on planning, but I believe the lesson planning results align with other research with respect to the rate at which teacher-practice changes in a 1:1 environment.

In an analysis of computer use across several countries, Muller, et al. (2008) found that technology is under-utilized in schools. In the analysis of math and science lessons in this study, teachers hardly planned to use the new technology over the course of a full month's worth of instruction. There was also no substantial increase in the number of technology lessons across all subject areas. I would not necessarily argue that they are "under"-utilized, as this passes unnecessary judgment on the lessons. However, the quantity of use did not change despite the increase in the availability of technology.

Many of the potential barriers cited by students and teachers aligned with those described in the literature. At the most foundational level, teachers beliefs about technology are important to whether they will plan and implement technology lessons. In short, if teachers see technology as useful, they will be more likely to plan it into their lessons (Mueller, Wood, Willoughby, Ross, & Specht, 2008). Leading up to the 1:1 rollout, beliefs can be seen as a primary barrier in that more than a quarter of teachers expressed fear that technology would just be a distraction to what they were trying to do.

However, in the open ended section of the teacher survey, just one teacher expressed the view that technology does not provide a functional improvement.

A lack of time within a "crowded curriculum" has been cited as a common first order barrier, and when considering ways to enhance lessons, nearly 20% of teachers involved in this study considered time to be a potential obstacle that they hoped to overcome. This concern did not seem to play out with the six teachers whose lessons were analyzed - they did not explicitly site time as an obstacle to planning technology lessons. However, since the number of technology lesson plans did not significantly change from before and after 1:1, it is quite possible that they continued to use many of the lessons developed before becoming a 1:1 school.

In a study of three high-technology schools, Drayton, et al. (2010) found that a steep learning curve exists when new technologies are introduced in schools. It would make sense, then, that it takes time for planning to change significantly. In this respect, my study supports existing literature that 1:1 transformation is a process, and significant change evolves slowly over time. Blau and Presser (2013) note that administrator support and professional development are needed. I would argue that both of those things were present at this site, but a consistent message over time, with continued training, will be needed to ultimately enact significant change in the way teachers plan their lessons.

Part 4: Conclusions connected to theoretical frameworks

Part of the design of this study was to analyze the fears that teachers may have in becoming a 1:1 school. Hartley and Strudler (2007) noted that teachers regularly use the word "fear" to describe their feelings about incorporating technology into their lessons, and that this serves as a barrier to using technology. Some teachers even use the word

"intimidated" when considering increased technology in their classroom (Ertmer & Ottenbreit-Leftwich, 2010). The Technological Pedagogical Content Knowledge (TPACK) Framework, first developed by Koehler and Mishra, purports that teachers must be competent in in their technological, pedagogical, and content knowledge bases in order to use plan and use technology effectively. This framework is helpful to understand barriers, as the fears in this study were often a result of knowledge deficits in these areas.

A common concern cited by teachers in this study is that the technology would not always work properly, and they would not have the capability to fix it. Research on technology implementation from the TPACK framework shows that as the knowledge base in each of the domains increases, many issues involved with technology implementation will be resolved (Mishra & Koehler, 2006). Much of the professional development at this site leading up to becoming a 1:1 school focused on pedagogy; it would be interesting to know whether additional PD designed to increase technical knowledge would have led to increased planning and implementation of technology lessons.

While a significant increase in the written plans were not evident, it is interesting to note that teacher-interviews provided evidence of change primarily at the augmentation level. At this level, technology serves as substitute for existing lessons, but with some functional improvements. Teachers in this study were encouraged to incorporate technology only when it would result in functional improvements, and the augmentation level is arguably the easiest way to incorporate technology to improve lessons. For example, in many of the lessons, technology was incorporated in ways that

allowed students to watch videos at their own pace. Teachers also used technology to quickly collect data using programs like Google Forms. In these examples, the lessons are basically the same, but the learning is more differentiated in that students can work autonomously at their own pace or teachers have a better ability to figure out what students know and how to adapt future lessons. Teachers who lack confidence in their ability to work with technology may find comfort in these incremental changes.

A concern noted in the literature is that the SAMR model is vague, with multiple interpretations possible when examining lessons. When educators have just a brief description and various models created by individuals to depict the SAMR model, it is possible that one person's Augmentation, may be another person's Substitution (Hamilton, Rosenberg, & Akcaoglu, 2016). This concern became apparent to me when analyzing lesson plans. Given a brief description and a few examples as a guide, I had to decide for each lesson as to whether it should be labeled S, A, or M based on limited information. It should be noted, though, that I did have a fellow educator who is well-versed in the SAMR model double-check my notes for inter-rater reliability. We had over 95% agreement on the lesson categorizations.

Part 6 Explanation of Results

An important factor when considering why the lesson planning documents did not change significantly after 1:1 implementation may be time, both in terms of the timing in the school year as well as the short scope of time over which the study was conducted. The rollout of 1:1 began in late October, over two months after the start of the school year. The average educator at the site has been teaching for over 15 years, often the same courses year after year. After two months of teaching, the rituals and routines of the class

had already been established, including the frequency and manner in which technology lessons were planned. In other words, it is unlikely that a 15-year veteran teacher who has taught the same class for more than a decade, with a plethora of activities, handouts, and labs in the file cabinet, would shift dramatically in the middle of the year. By analyzing lessons right before 1:1 and then just 6 months after the rollout, I may have missed the full impact that it had on lessons. There is a steep learning curve to teaching with technology and a limited number of professional development opportunities over the course of a school year. Even when teachers report positive feelings toward technology, it can take several years before this is actualized in classroom practice (Suhr, Hernandez, Grimes, & Warschauer, 2010). This study covered just half a year, so it is quite possible that the true impact on planning could not be realized in such a short time.

The short time frame of the study may also account for the lesson planning results when considering barriers. The student and teacher data showed clearly that the laptops were being used regularly. It is also clear that barriers existed, particularly technical issues with the laptops and teacher fears about their own technical knowledge to support implementation. Teacher fears were realized – while the laptops seem to work, there were glitches in getting the 1:1 program started. For example, batteries and passwords were an issue. It is quite possible that teachers will ultimately plan more robust technology lessons after these glitches were ironed out, and after they feel more comfortable addressing problems. Hesitation to fully plan lessons that realize the potential of the devices seems quite likely, especially within the first six months when the study occurred.

The school's messaging may also account for a slower initial start in implementation. The explicit message from building-based and central office administration was not to change practices too quickly. The district adopted a cautious approach, aware of how traditional teaching practices historically served them well in terms of test scores and overall achievement. To ease the anxiety of faculty, the superintendent and principal both stated that the goal was not to completely overhaul pedagogy. Technology is a tool to be incorporated in times that make sense to increase the learning opportunities of our students. While the initiative was significant, administration made a point of putting the arrival of new laptops in perspective. Evidence of an administrative "hands-off" approach can be seen in that technology did not become the primary focus of learning walks and teacher evaluation during this first year. Quality teaching was stressed, but this did not necessarily include the use of technology. Teachers would be able to continue teaching exactly as they had been teaching and still receive satisfactory ratings, so one could argue that there was not necessarily an incentive to make drastic pedagogical changes in such a short time.

The professional development schedule for the 2017-2018 school year also highlights competing initiatives that may account for slow rates of change. As an administrator partially in charge of 1:1 implementation and working on this research, technology was my primary focus for the school year. However, just five of the school's professional development opportunities focused on technology integration. Meanwhile, six of the sessions focused on curriculum writing in general. Other professional learning included crisis planning, the arts and music collaborative, questioning strategies, performance tasks, literacy integration, and an analysis of assessments. It is safe to say

that 1:1 was a priority, but it was one of several priorities. In this way, one might expect that the lesson plans would change as the school provided more professional learning opportunities on technology integration. "Competing initiatives" was one of the barriers to technology integration listed by teachers in the "Hopes and Fears" data set. I suspect that change will happen over time as technology remains a district focus.

Several of the teachers in the study claimed that access to 1:1 technology changed their lesson plans, but significant changes were not revealed in the written documents. A potential explanation can be found in the process for creating lesson plans. This was discussed in chapter 4, primarily to establish context and structure of the documents that would be examined, but I think it is worth revisiting as a possible explanation for why no substantial changes were found in the documents. The Understanding by Design (UbD) units were written over the course of a four-year collaborative initiative to rethink the way teachers planned and implemented lessons. Teachers received extensive professional development in this process, as administration even partnered with the Wiggins and McTighe group directly. Consider that many of the lesson plans were written by department teams over the course of three years. It is quite likely that teachers would be reluctant to change the written planning documents during the year of 1:1 implementation after being written, re-written, and polished over time.

The long curriculum writing process may actually account for the one change that did occur in planning - the increase in the proportion of lessons at the Augmentation level. Functional improvements that move lessons into the Augmentation level may be incorporated quite easily. Examples include using Google Forms to collect student data,

or incorporating videos to supplement or differentiate learning. These types of changes may occur without completely re-writing lesson plans.

The lesson planning documents show that, for the most part, teachers used technology before and after 1:1, and they planned technology lessons primarily at the Augmentation and Modification levels. The fact that teachers self-selected to be part of the study may be significant. The data may look very different if the study included all teachers. I suspect that teachers who did not use technology at all would be reluctant to volunteer to be part of a study analyzing technology implementation. Second order barriers in terms of teacher attitudes were prevalent when analyzing the whole-school data, but none of the volunteers expressed ideas that technology may not be worth the investment. In this way, there seemed to be a disconnect between the barriers data and the lesson planning data. The self-selection of teachers may also account for the slight increase in lessons at the Augmentation levels. The volunteers already used technology to some degree, and increased technology allowed them to simply refine their skills. Functional improvements like exit tickets are easy, low-risk changes that do not require a whole lot of additional planning or technical know-how.

Part 7: Limitations of the Study

The research presented many more questions than answers, and my hope is that similar research is carried out on a much larger scale. The study was limited in scope in terms of the number of participants, lessons, site, and time frame. Several limitations were evident in the data collection process for determining the impact of 1:1 on lesson planning.

The secretary sent out a request for volunteers to the high school faculty, and six teachers volunteered to participate in the study across four different subject areas. The small n-value limited the conclusions that I could make about lesson planning. In contrast, approximately 70 teachers and about 250 students provided data regarding barriers. I intended for the planning portion of this study to involve a limited number of participants; however, the fact that I relied on volunteers is, I believe, more limiting than the total number of participants. The volunteers seemed to be comfortable in the ways in which they use technology, and therefore may not have been a representative sample of the faculty as a whole. Four of the teachers who volunteered claimed to use technology regularly before 1:1. They signed up to use the laptop carts often, and the purchase of laptops simply allowed them to continue the use of technology in their rooms more conveniently, not necessarily more often. One of the remaining teachers mentioned that she does not use technology regularly, but the laptops now allow her to incorporate supplemental activities into her lessons (for example videos). In other words, the laptops did not become the primary learning tool, they simply allowed for students to enrich their learning at home or when time permits. The final teacher only used technology twice per unit to collect formative assessment data, and the ubiquitous student devices simply eliminated the need to reserve a laptop cart.

Another limitation is the disconnect between the data sources. It is not possible to directly connect the site-specific barriers to the impact on lesson planning. Given the structure of this study, it was not possible to make direct connections between the overall barriers and the ways in which these barriers may have impacted the lessons of the six teachers who volunteered.

An additional limitation inherent to this study is the homogeneity of the site and people involved. All but two of the teachers in the school are white, with just one Asian teacher and one teacher of Middle Eastern descent. The six teachers whose lesson plans were analyzed are all white, veteran teachers with about 15 years of teaching experience. The study occurred in just one high school, and the students of the school are also predominantly white, upper class, high performing students. It would be difficult to generalize the impact of 1:1 from this school to a school with high levels of diversity. The results also may not be generalizable to situations where teachers are newer or the school has higher faculty turnover rates. Additional studies on a larger scale with more diverse populations are needed.

Part 8: Recommendations for Future 1:1 Initiatives

Research for this dissertation indicated several important factors in successful 1:1 initiatives, perhaps most importantly professional development and administrative support (Ware & Stein, 2014 and Blaue & Presser, 2013). I would argue that these two criteria were in abundance at this site. The teachers received professional development at the beginning of the school year, through "lunch and learn" courses throughout the year, and then via extended day training after school. The high school has two instructional coaches to support the increase of teachers' technological and pedagogical knowledge bases. While one could easily argue that a smaller teacher to instructional coach ratio would be ideal, the fact that a district budgets for *two* instructional coaches in one building is significant (and probably 1 or 2 more than you will find in other 1:1 schools). Administration supported the initiative by allotting funds for the devices, setting aside

time and resources for professional development, and working to garner community support. Dr. Puentedura, creator of the SAMR Framework, even delivered professional development for the district. Additional staff and funding was channeled into the technology department to support the increased technology in each building.

Given the level of professional development and administrative support, why did teacher planning remain relatively unchanged? Why were there still so many barriers? Many of the possible reasons are covered in detail in parts 6 and 7 of this chapter, but I still hesitate to question the success of the initiative – at least so early in the process. The explanation of results and the limitations of the study outline why it is difficult at this point to draw definitive conclusions. However, I would recommend future administrators and practitioners learn from my experience and do things a bit differently. Generally I, recommend that districts first collaboratively determine and then communicate the specific educational needs of a 1:1 initiative, calculate the existing barriers to supporting and implementing technology in every classroom, and then design professional development that will ultimately support the stated educational goals and then overcome the existing barriers. I also believe that developing a common language around a framework such as the SAMR model will support high level implementation. All of these recommendations were done to a certain extent, but the timing of these actions and then explicit connections between them are crucial. I believe changes in timing and explicit connections can minimize barriers, cost, and develop focused, coherent pedagogy around technology.

The rationale for the 1:1 initiative, based on the work of Alan November (2007), was to support teachers' efforts to accomplish the following instructional goals: 1) Build

student capacity for critical thinking, 2) develop new lines of inquiry, 3) make student thinking visible, 4) broaden the perspective of students with authentic audiences from around the world, 5) create purposeful work, and 6) access "best in the world" examples of content and skills from around the world. While technology is not explicitly stated, it is perhaps the most important vehicle for helping to meet these goals. District messaging behind the 1:1 initiative was clear, and the professional development was focused on meeting these goals. However, the pre-assessment and formative assessment elements of good instruction were missing in terms of teaching the teachers. Administrators did not assess how often and in what ways technology was already being used, and perhaps more importantly the teachers were not part of this process. The need for 1:1 technology was not established, nor was there a clear pathway for teachers to identify their own deficits and how technology could be used to improve their teaching.

I propose the following courses of action as important elements of the improvement process. The school district first identifies the pedagogical goals for the year. Teachers, with the support of principals, identify one area of focus with the following problem of practice: "*How can technology be used to improve my teaching in this identified area of need*?" In the case of this site, teachers may consider the technology resources available that could connect their students to exemplar examples from around the world, or perhaps various sites or apps that may help make student thinking visible. In this manner, teacher practice is not only individualized, but technology is presented as an essential part of the path toward improvement. Administration and the instructional coaches will also have an identified way to support instruction in every classroom. By identifying common pedagogical goals, teachers will

point each other in the direction of technology that will support their learning. Conversations will change, and ultimately teachers will plan lessons differently.

In addition to collaboratively identifying pedagogical goals that include technology, it is important for teachers and administrators to collaboratively identify potential barriers to planning and implementing technology before launching a 1:1 program. I believe this should occur at least two years prior to the initiative. In this study, the school identified barriers to implementation, but the information largely became available after laptops were in the hands of students. Administration should conduct a comprehensive analysis of potential first and second order barriers as part of the process for creating a plan to eliminate barriers before the rollout. The plan should center around the TPACK Framework, with an in depth analysis of the technological, pedagogical and content-specific needs for using technology effectively. Furthermore, the difficulties with using cart-based devices in specific classrooms could be studied as a way to identify and correct first order barriers before moving forward with whole-scale change. Once barriers are identified, differentiated PD and peer support over the course of a year before adopting a 1:1 environment will put teachers in a position to productively use technology immediately upon adoption, eliminating the steep learning curve cited in research (Suhr, Hernandez, Grimes, & Warschauer, 2010).

After collaboratively identifying teachers' specific PD goals and existing barriers, administrators and a group of teacher-leaders should develop a flexible 3-year professional development plan. Two important points in that last statement are: 1) teachers should be involved in the process, and 2) the skeletal map should be flexible but long-term. Flexibility is essential in that a feedback loop should be devised so that

teachers and administrators can continually monitor and adjust progress toward goals. While the plan should first address immediate barriers, it should be grounded in the overarching district and teacher goals. In this study, administrators collaborated with instructional coaches to launch the first year of professional development, but there were several missed opportunities. Professional development was not individualized to the needs of each teacher, nor was it planned well enough in advance of the rollout. Instructional coaches and administration became aware of teacher needs and barriers in real-time. Technical and pedagogical knowledge was certainly addressed, but only after the machines were in the hands of students. It is quite possible that the machines may be obsolete by the time some of the teachers become comfortable using them.

A final recommendation for leaders of future 1:1 initiatives is to ground the rollout in a framework used to evaluate the planning and implementation of lessons. I believe that this study was too narrow in scope to conclusively argue that planning did not change after all students received laptops. But if a district spends the amount of money that could be used to hire one new teacher at each grade level, I think it is fair to argue that the manner in which teachers plan and implement their lessons *should* change. The district needs to monitor the frequency and manner in which technology is being used before implementing an expensive 1:1 initiative. The goals of the rollout, including the PD planned to support the goals, should be based on this preassessment. The framework can then be used to monitor the impact that 1:1 is having on teachers, both in their implementation and the manner in which their lessons are planned.

Part 9: Recommendations for Future Research

When considering lesson planning and barriers, the findings in this study raise more questions than answers. Few would argue that lesson planning is an important part of teaching - in general terms, this seems to be clear. However, the relationship between lesson planning and the changing classroom environments as schools move toward 1:1 integration is not clear and warrants further study. It would be interesting to see the impact on planning over time with a greater number of participants across more diverse schools.

This study suggests that the quantity of written technology lesson plans does not change significantly within the first year of 1:1 adoption. The teachers in this study who incorporated technology regularly into their lessons continued to do so; teachers who rarely used technology continued to plan lessons without technology. This leads to the most obvious questions for further study, "Why did the number of lesson plans incorporating technology not change significantly?" It is possible that timing was significant, both in terms of the length of the study and mid-year implementation. This study spanned just the first year of implementation. Would lesson planning show more changes over time? Research shows that a steep learning curve exists in terms of implementation. Does it follow that the same learning curve exists in terms of lesson planning? Additionally, the laptops were introduced several months into the school year - How important is the time of year at which devices are introduced?

The frequency of lessons at the Augmentation level of the SAMR Framework did increase. Would this result be replicated in the first year of implementation in other studies? What accounted for this increase? Perhaps this is the most accessible level of the

SAMR framework, since teachers can make functional improvements to their lessons while maintaining control of implementation. Is this part of a natural transition as teachers adapt their lessons to include more technology? Perhaps administrators can leverage this as a way to increase technology lesson plans. Maybe professional development geared toward lesson planning at the augmentation level can serve as a springboard toward increased modification and redefinition lessons. This is worth further study.

This study suggests that barriers impact the lesson planning process, but this connection is not fully established. Barriers to planning technology lessons could be inferred from the whole-school teacher and student data, but it is unclear exactly which barriers were most significant in the context of planning. It is also unclear which, if any, barriers connected directly to the six teachers who volunteers for the study. I was able to establish that, after six months, their written lesson plans did not change significantly, but I was not able to establish why. Was it due to a lack of technical or pedagogical knowledge? Did their planning process change in ways that were not yet reflected in their written lessons? Does a continuum exist for change, and if so – what does this look like?

This study explored the professional development and lesson planning context, but did not establish any kind of connection between PD opportunities and lesson planning. Did the professional development opportunities described throughout the pages of this study impact how teachers thought about their lesson plans in the first year of implementation? What PD opportunities significantly alter the way teachers think about their lesson planning in a 1: 1 environment? Related to this, how should administration support teachers if they are to expect changes in the way teachers plan lessons?

Finally, further research is needed using the SAMR model as a guide for improved lesson planning. The SAMR model is generally used as a guide for 1:1 lesson implementation, but it is worth studying the relationship between lesson planning and higher levels of SAMR implementation. In particular, the development of a practical model for lesson planning may help educators adapt to a 1:1 environment. Ultimately, the whole point of adding technology to classrooms should be to increase learning opportunities. A functional improvement should result from the expense. Otherwise, what's the point? Further research is needed to understand the relationship between lesson planning and high level implementation in a 1:1 environment.

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Appendices

Appendix 1.1: 2017-2018 Professional Development Timeline

Date	Type	Hours	Focus
Monday, 8/21/2017	Inservice	7	District Kick-Off Lesson Planning
Tuesday, 8/22/2017	Inservice	7	1:1 Technology
Wednesday, 8/23/2017	Inservice	7	Art/Music--Art Collaborative UbD Work--Explicit Literacy Instruction (NEWSELA) Special Education
Wednesday, 9/6/2017	Extended Day	2	Special Education NEWSELA
Wednesday, 9/20/2017	Extended Day	2	Crisis Planning
Monday, 10/9/2017	Inservice	7	Personalized Learning
Wednesday, 10/18/2017	Extended Day	2	Ubd Work

Friday, 11/3/17	Inservice	3.5	Ubd Work
Wednesday, 11/15/17	Extended Day	2	Ubd Work
Wednesday, 12/6/17	Extended Day	2	Technology Integration
Monday, 1/15/18	Inservice	3.5	EduPlanet Launch
Tuesday, 1/24/17	Extended Day	2	Literacy Integration
Friday, 2/16/18	Inservice	7	Technology/STEAM
Wednesday, 2/21/18	Extended Day	2	Literacy Integration
Wednesday, 3/21/18	Extended Day	2	Technology/STEAM
Wednesday, 4/25/18	Extended Day	2	Grades 9/10--Tech. Sharing
Friday, 5/4/18	Prom	3	Crisis Planning
Wednesday, 5/16/18	Extended Day	2	Reflection and Goal Evaluation

Appendix 1.2 Additional sources of Information Regarding Potential Barriers

Necessary Information	Data Source	People Involved	Importance to the Study
Student technology learning opportunities (curriculum)	K-12 Curriculum Map outlining technology classes and learning opportunities; published documents	Materials available online; curriculum coordinator	A potential barrier is lack of student technology readiness
Administrative Support	Notes from discussions and meetings; Notes from PD planning meetings and technology rollout	Principals and central office administration	Research shows that administrative support is necessary for successful 1:1 implementation (cite)
Teacher technology PD Opportunities	Notes regarding PD opportunities; schedule of PD days and extended day PD; records of teacher collaboration	administration - notes from meetings with administration, instructional coaches, and the curriculum coordinator	Research shows that professional development is necessary to removing both first and second order barriers (cite)
Academic redesign plans	Meeting notes; published documents online; PowerPoint used in school board meeting	administration – notes from planning meetings with administration	Administrative support and context; technology as necessary part of future vision of high school program
Technology budget, staffing, infrastructure, etc.	School business office notes and published documents; interview	Technology director; Business manager	Steps taken to remove first order barriers; Background

	with technology director		information about technology; investment
Technology Rollout Plan	Meeting notes; emails; published rollout plan	administration; central administration	Smooth rollout and effective plan are necessary to remove implementation barriers
Professional Development session before start of school year (in-service days)	Copies of sessions; notes regarding content and goals	Administration; instructional coaches	PD and administrative support are essential to 1:1 success; ability for teachers to overcome barriers
Information about students who are not bringing their laptops to school or bringing them uncharged.	Teacher survey along with survey results	administration; teachers	This is a common level 1 barrier. Planning lessons around devices is obviously challenging when they are not reliably brought to school.
Content and impact of the "Lunch and Learn" PD sessions	Copies of the PD sessions; notes from implementation	administration; instructional coaches	The six-week PD course provides valuable information about how to implement lessons with technology. The course will also be aligned to district instructional goals.
Content and impact of the Lunch and Learn sessions	Teacher questions and expert responses from Lunch and learn session *("Students will walk into your classroom with laptops in two*	Instructional coaches, teachers, administration	Evidence of teacher learning, evidence of perceived barriers

	weeks. If you could get advice from an expert, what questions would you ask him or her? What concerns or challenges might you pose?")		
Content and impact of PD on SAMR model	Copies PD materials; notes from PD session	Administration	The SAMR model will be used to gauge success of the initiative

Appendix 1.3: Sample Weekly Lesson Plan

Course: Academic Biology I	Unit: Chemical Basis of Life				
Periodic properties would life be different if					
	Monday	Tuesday	Wednesday	Thursday	Friday
Standard Addressed	3.1.10.A2, 3.1.12.A5	3.1.10D, 3.2.10C, 3.3.10B	3.1.10D, 3.2.10C, 3.3.10B, 3.3.12B	3.1.10D, 3.2.10C, 3.3.10B	3.1.10D, 3.2.10C, 3.3.10B, 3.4.10A, 3.5.10D
Knowledge and Skill Focus (From UbD Unit--After the lesson, what should students know and be able to do?)	Recognize and use proper terminology for atoms and bonding. Create atomic structure that shows electron arrangement for atoms that are ionically or covalently bonded.	Explain why water is a polar covalent compound and how its polarity lends itself to hydrogen bonding, cohesion and adhesion. Cite examples of how waters solvent ability and high surface tension occur and why they are necessary for living things.	Cite examples of how waters' capillarity and ability to expand when frozen occur and why they are necessary for living things.	Demonstrate knowledge of basic chemistry and water polarity. Cite examples of how waters' high specific heat occur and why they are necessary for living things.	Demonstrate knowledge of basic chemistry and water polarity. Cite examples of how waters' high specific heat and heats of vaporization and fusion occur and why they are necessary for living things.
Relevancy (Why is this knowledge and skill	Continue to address relevancy with your students through				
Sequence of Student Learning Activities	Glucose HW. Go over sec. 2-1	demonstrations with 3 liquids	Demonstration with capilary tubes	polarity. Eyecheck Sec. 2-3 HW II. Go	over Sec. 2-3 HW II. Show water
Formative Assessment: Type of Tool	Sec. 2-1 HW Q's and wks.	Water property demonstrations.	Water propery demonstrations.	property demos.	property demos.
Formative Assessment: Highest Level of Complexity	Skills and Concept Applying (Req	Skills and Concept Applying (Re	Skills and Concept Applying (Requi	Skills and Concept Applying (Requires t	Skills and Concept Applying (Requir

Appendix 1.4: Student Technology Survey

Please take a few minutes to provide us with your honest feedback about your school issued computer.
Your email address will be recorded when you submit this form.

How has having your own computer impacted your ability to

negative impact
no impact
somewhat positive impact
very positive impact

Learn new material in class
Review/study material at home
Get feedback from teachers
Be more interested and engaged in learning
Stay focused
Work/collaborate with other students
Organize your class materials
Complete homework
Apply more creativity in class assignments
Learn new material in class
Review/study material at home
Get feedback from teachers
Be more interested and engaged in learning
Stay focused
Work/collaborate with other students
Organize your class materials
Complete homework
Apply more creativity in class assignments
How often do you use your school issued computer during school?
Many times a day
A few times a day
Once a day
Once every few days
Once a week or less
In which subject(s) do you use it the most frequently?
English
Math
Science
Social Studies
Health and Wellness
Family Consumer Science
Art
Music
Business
Tech Classes
Other:
Are there any computer based tools or strategies you particularly enjoy using during school? (for example: I like taking notes using google docs)
Your answer
Are there any computer based tools or strategies you wished you were asked to use more often during school? (for example: I wish we used quizlet to review vocabulary more often.)
Your answer
How often do you use your school issued computer at home?
Many times a day
A few times a day
Once a day
Once every few days
Once a week or less
How often do you have web based homework assignments?
Daily

A few times a week
About once a week
Less than once a week
Have you had any challenges or concerns with completing web-based homework assignments outside of the school day?
Yes
No
If you answered yes to the question above, please explain.
Your answer
Have you had any technical difficulties with your computer?
Yes
No
If you answered yes to the question above, please explain.
Your answer
Is there anything you would like some instruction on regarding your school issued computer?
Your answer
Is there anything else you would like us to know about having your own school issued computer?
Your answer
Send me a copy of my responses.

Appendix 1.5: Detailed Lesson Plan Information

Teacher A:

The unit took 5 weeks of instruction, for a total of 25 days. The subject area is English; the teacher taught 9th grade students. Students used technology in 3 weeks out of 5 weeks. The estimated number of days that technology was used was 13 days out of the 25 days. Of the 13 days using technology, 6 were at the modification level and 7 were at the augmentation level. I estimated that in week 5, 3 days were spent using technology and all of these were at the augmentation level. This means that a of the 13 total days using technology, 10 were at the augmentation level and 3 at the modification level.

Lesson	Notes and Keywords	SAMR Category w/ explanation
9/19	Newsela article. Differentiated reading opportunities w/ the computer adjusting reading to match the student's grade level. Data from the program allows formative and summative assessment opportunities with information about Lexile scores,	**Modification:** The students have choice in what they read and the work automatically provides students w/ a story at their reading level. The teacher also has access to information that he couldn't have had before students used technology. He is able to quickly determine comprehension based on

	time, accuracy, etc. Options and choice increases.	quiz questions along with some information about the activity, such as the amount of time it took a student to read the article and answer questions. Students are also able to move up or down reading levels depending upon need. The lesson would be possible without technology, but technology was used to transform what is possible in the classroom. This transformation in how the teacher is available to students, both in terms of reading and ability to access information, moves this lesson to the upper levels of SAMR. Since students are not creating a product, it remains at the M level.
9/20	Newsela article. The lesson is similar to the previous day's lesson, with the same use of technology.	**Modification:** See above notes.
9/23	Newsela Article assignment	**Modification:** See above notes
10/16	STAR 360 Assessment - The STAR 360 test is a computer-based assessment that provides detailed information to the teacher about student reading level generally, as well as specific content strengths and weaknesses. Formative assessment tool.	**Modification:** Learning opportunities are transformed because the teacher/student get instant data on performance, reading level, strengths/weaknesses, etc. The teacher and student can customize learning opportunities based on the data.
10/17	Nearpod activity. Students answer questions and get instant feedback. Furthermore, the teacher is able to see all students'' work at once to make selections, see misconceptions, formatively assess work, ask questions, etc. It provides more information to both the teacher and student about performance and how to make real-time adjustments to learning opportunities.	**Modification:** Learning is transformed in that the potential of learning with computers is evident in this lesson. Students are able to get instant feedback on their work, and the teacher is able to quickly monitor the learning of all students and adjust instruction in real-time.
10/18	Newsela Article	**Modification**: See notes above
10/19	Google scholar research activity – students learn basics on how to look up information and do	**Augmentation** – Students would be able to look up this information in the library, but there is a functional

	research online. Queries, citing, etc.	improvement in the amount of information available to students, and the ease at which they can access information.
10/20	Review editorial information in google classroom. Students are writing and reviewing information in Google classroom. The functional improvement is the increased ability for students to collaborate. The teacher is also able to quickly see student work, to formatively assess student understanding.	**Augmentation –** Students would be able to do this assignment without technology, but Google classroom provides a functional improvement in terms of increased ability to collaborate/communicate with each other and the ease at which work can be shared.
10/23 10/24 10/25 10/26 10/27	Students worked through a paper. They created the outline, then a draft, peer reviewed work, and then assessed their own writing. The work was done in Google Classroom. The teacher was able to send out assignments quickly. Students were able to collaborate online and the teacher was able to monitor progress and provide feedback online; formative assessment	**Augmentation.** The work can be done without the computer, but google classroom provided functional improvements, primarily the ability for the teacher to see their work in real-time and provide feedback (w/o students turning in their papers). The students are also able to see each other's work and provide feedback any time w/o trading papers.

April 2018: After 1:1

The unit took five weeks of instruction for a total of 25 instructional days. Technology played a prominent role in instruction and student work during the first two weeks. Technology was not used in weeks 3 and 4 and was used for about half of the lessons in week five. The estimated number of days that technology was used was 13 days out of the 25 days. In the first two weeks, 4 of the 5 lessons were at the augmentation level. I estimated that this is 8 out of the 10 days at Augmentation and 2 days at modification.

Lesson	Notes and Keywords	SAMR Category w/ explanation
Weeks 1 and 2 – **all ten days** Lesson 1: Trading Cards	The teacher and students used Google Slides and the internet. They researched Gods, Goddesses and monsters and then used a template provided by the teacher to create trading cards similar to "magic" cards. The functional advantage was the information and examples available to students and	**Augmentation**: Students would be able to look up this information in the library, but there is a functional improvement in the amount of information available to students, and the ease at which they can access information. The teacher was also able to provide feedback in real-time. The students benefited from the

	the teacher's ability to formatively assess student work and give real-time feedback.	template and ease of getting information but the learning improvement primarily revolved around the teacher's ability to see and respond to information.
Lesson 2: Quiz	The students used Google forms. This allows the teacher to quickly grade and sort the results. The teacher has an improved ability to look for patterns in the results and adjust instruction based on the assessment.	**Augmentation**: There is a functional improvement, but primarily at the teacher level.
Lesson 3	Students used the internet to search examples of movies and heroes; they used Verso, an online discussion tool. It allows increased collaboration, and also promotes diverse viewpoints as other answers are not available until the student shares his/her own thoughts.	**Modification:** The tool allowed the lesson to be modified, increasing the learning of the students. The web provided increased resources and Verso increased communication/collaboration
Lesson 4:	Students used Storyboard, an online tool that allows students to create a comic strip. It generates interest by allowing customized characters. The primary benefit was increased interest and the differentiation allowed by student ability to customize their work. Differentiation increases because the program can be adapted to different ability levels.	**Augmentation**: The software allowed the material to be presented differently. The learning did not necessarily increase, but the capability to differentiate could increase interest and ability to engage in the activity.
Lesson 5	Close reading. Students use google classroom for this activity. The teacher described the advantage to doing it this way because he can see student thinking by quickly being able to see student responses. Feedback; Formative assessment strategy for adapting future lessons.	**Augmentation:** The close reading activity could have been done without technology, but the primary benefit is to the teacher in formative assessment.
Week 5 (3 days)	Storyboard was used for much of this week, Comics were used to summarize and adapt/differentiate the material. Students could create a storyboard w/o technology but the functional improvement here was that it was easier to organize, there	**Augmentation**: The software allowed the material to be presented differently. The learning did not necessarily increase, but the capability to differentiate could increase interest and ability to engage in the activity. The

	was more information, and the images were readily available to students. Also, the teacher referenced having access to their work and being able to give real time feedback.	mentioned being able to give real-time feedback.

Teacher B

9th grade English. Four weeks of lessons in September and four weeks in April. The teacher came from a 1:1 school and fully embraced the 1:1 initiative, claiming that he did activities and established routines early on in anticipation of becoming a 1:1 school in October.

The unit before 1:1 is about the Hero's Journey. Students did not have laptops yet, but the teacher regularly used carts. At times, students were able to use their phones (for example, to complete an exit ticket in google forms)

Lesson	Notes and Keywords	SAMR Category w/ explanation
9/5	No technology	
9/6	No technology	
9/7	No technology	
9/8	Newsela text set and EdPuzzle. Newsela allows differentiation of text according to grade level; increased access to materials and data. EdPuzzle allows students to watch a video and answer questions as they go. It is self-paced and provides the teacher and student w/ instant feedback.	Modification – The lesson is transformed and allows learning that would otherwise be impossible w/o technology. Differentiation and formative assessment have a powerful impact on engagement potential learning.
9/11	Students typed lessons and viewed a video on a topic.	Substitution – all of the activities could have been done w/o laptops. Could be handwritten and a clip could have been shown by the teacher w/ the same impact.

9/12	Read and annotate text on the laptop.	Substitution – No change or functional improvement to learning. The same lesson could have been done w/o technology.
9/13	Exit tickets are done using google forms. Students wrote text and submitted digitally; provided formative assessment and differentiation opportunities difficult w/o technology	Augmentation – the exit tickets provide data that the teacher and student can quickly use to differentiate learning
9/14	Exit tickets are done using google forms. Students wrote text and submitted digitally; provided formative assessment and differentiation opportunities difficult w/o technology	Augmentation - Three day lesson w/ 9/13 – see above
9/15	Exit tickets are done using google forms. Students wrote text and submitted digitally; provided formative assessment and differentiation opportunities difficult w/o technology	Augmentation - Three day lesson w/ 9/13 – see above
9/18	Students watched various movie clips in groups, discussed them, and then reported back to groups. This activity would not have been possible w/o technology. Differentiation, increased conversation, self-paced.	Augmentation – technology provided a functional improvement, but did not necessarily transform the possible learning.
9/19	Students used laptops in the library for a scavenger hunt activity. QRC codes were used to present new clues and access to resources.	Augmentation – a scavenger hunt would be possible w/o technology, but the way technology was used provided increased access to resources.
9/20	Students learned how to research using Google. Google scholar, key words, resources available, etc.	Augmentation – Students would be able to use the library but the internet and google research provides increased access to resources.
9/21	No Technology	
9/22	Nearpod activity devoted to examining the reliability of a source. Students worked in groups of three to answer questions. The teacher is able to	Augmentation – Functional improvement but primarily at the teacher level as the lesson increased ability to see what students know and make instructional shifts.

	formatively assess understanding	
9/25	Research on cultural values	Augmentation – increased access to resources.
9/26	Research on cultural values	Augmentation – increased access to resources.
9/27	No technology	
9/28	Exit tickets using google forms	Augmentation

Lesson	Notes and Keywords	SAMR Category w/ explanation
4/2	Reading and annotating Fahrenheit 451 online using electronic text	Substitution – replacing pencil paper activity with technology.
4/3	Reading and annotating Fahrenheit 451 online using electronic text	Substitution – replacing pencil paper activity with technology.
4/4	Reading and annotating Fahrenheit 451 online using electronic text	Substitution – replacing pencil paper activity with technology.
4/5	Close reading online followed by exit ticket using google forms. Formative assessment opportunities	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/6	Close reading online followed by exit ticket using google forms. Formative assessment opportunities	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/9	Online reading coupled with entrance tickets to assess understanding of previous day's reading.	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/10	Online reading coupled with entrance tickets to assess understanding of previous day's reading.	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/11	reading assignments online along with exit tickets for formative assessment	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/12	No Technology	
4/16	No Technology	

4/17	No Technology	
4/18	reading assignments online along with exit tickets	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/19	Online reading; padlet activity that provides quick formative assessment	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/20	Online reading; padlet activity that provides quick formative assessment	Augmentation – Functional improvement is mainly at the teacher level with increased formative assessment through google forms.
4/23	Students did research online, typed an essay, and then completed an assignment in google slide	Modification – Students were able to do research at their desks to find and organize information.
4/24	Students did research online, typed an essay, and then completed an assignment in google slide	Modification – Students were able to do research at their desks to find and organize information.
4/25	Students did research online, typed an essay, and then completed an assignment in google slide; formative assessment opportunities	Modification – Students were able to do research at their desks to find and organize information.
4/26	Reading an assignment online and completing questions through google forms as formative assessment	Augmentation – benefit was mainly at the teacher level

Teacher C

Both sets of lessons are from an English 9 course. The class was taught in conjunction with Geography, so some of the topics overlap. The first set of lessons are from an introductory unit at the beginning of the year called The Forces that Shape Us & Overcoming Obstacles. The teacher presented me with five lessons from this first unit and then lessons from a longer unit in April from a unit titled Economics, Government,

Lesson	Notes	SAMR w/ explanation
8/28	No Technology	
8/29	Google classroom was used to access and read NewsELA articles. The reading and questions are differentiated based on reading level.	Modification: Technology is used in a way to enhance the lessons that would otherwise be impossible. Students get readings and questions tailored to their needs and the teacher gets important information about student progress.
8/30	No technology	
8/31	Students typed responses to an assessment on the themes of geography	Substitution: Typing responses as opposed to writing them.
8/31	No technology	

and Power. In order to balance the lessons before and after I used just one week's worth of lessons from the second unit.

Lesson	Notes	SAMR w/ explanation
4/9	Students completed an Entrance ticket using Google forms. This allows the teacher to quickly compile results. They were made visible and then the teacher and students discussed misconceptions. The readings were done digitally since books were not available	Augmentation: Technology was used to quickly identify misconceptions, show the results and then address them in class. This could have been done w/o technology through a show of hands or quick count, but technology made the work visible, quicker, and easier to organize.
4/10	The entrance ticket was done with Google forms and then students were placed in groups based on understanding and misconceptions.	Augmentation: See above.
4/11	Students read the works digitally, as books were not available.	Substitution
4/12	No technology	
4/13	Exit tickets using Google forms	Augmentation: See above

Teacher D

Sept 2017: Before 1:1

The lessons cover 15 instructional days from September 11 to September 29th . Students used their laptops for four of the fifteen lessons. All four lessons were at the augmentation level. Videos on topics were used to enhance instruction. They were posted to the google classroom site that the teacher uses so that students could access the videos during class time and at home. In this way technology increased engagement, but also served as a tool for differentiating lessons in that students could access the material and re-watch as needed. The teacher described herself as fairly traditional in terms of technology use. This seems to be evident in that the lessons after becoming a 1:1 school were very similar to the ones prior to becoming 1:1, and the laptops were used to post videos on the class's google site and have them available for watching and re-watching for studying and to answer homework questions. This type of lesson was listed as an augmentation because of the opportunity to increase engagement and differentiate by re-watching or serving as a resource for the material.

Lesson	Notes and Keywords	SAMR w/ explanation
9/11	Students used their computers for internet research. Students had a specific topic to investigate, using resources available on the web.	**Augmentation**: The topics were presented differently. Students had the unlimited resources of the web available at their fingertips.
9/13	Videos are posted onto the google classroom site. Students are able to watch and re-watch the videos at home in order to answer questions. The videos are engaging and show examples and models that would otherwise not be available to students.	**Augmentation:** The topic was presented differently by having the video available. Students are able to watch and re-watch the video in order to be able to answer questions.
915	Videos are posted onto the google classroom site. Students are able to	**Augmentation**: The topic was presented differently by having the

	watch and re-watch the videos at home in order to answer questions. The videos are engaging and show examples and models that would otherwise not be available to students.	video available. Students are able to watch and re-watch the video in order to be able to answer questions.
9/19	Research based homework assignment. Videos posted online to enhance student understanding.	**Augmentation**: The topics were presented differently. Students had the unlimited resources of the web available at their fingertips.

Lesson	Notes and Keywords	SAMR w/ explanation
April 10	Videos are posted onto the google classroom site. Students are able to watch and re-watch the videos at home in order to answer questions. The videos are engaging and show examples and models that would otherwise not be available to students.	**Augmentation**: The topic was presented differently by having the video available. Students are able to watch and re-watch the video in order to be able to answer questions.
April 13	Videos are posted onto the google classroom site. Students are able to watch and re-watch the videos at home in order to answer questions. The videos are engaging and show examples and models that would otherwise not be available to students	**Augmentation**: The topic was presented differently by having the video available. Students are able to watch and re-watch the video in order to be able to answer questions.
April 16	Videos are posted onto the google classroom site. Students are able to watch and re-watch the videos at home in order to answer questions. The videos are engaging and show examples and models that would otherwise not be available to students	**Augmentation**: The topic was presented differently by having the video available. Students are able to watch and re-watch the video in order to be able to answer questions.
April 24th	Videos are posted onto the google classroom site. Students are able to watch and re-watch the videos at home in order to answer questions. The videos are engaging and show examples and models that would otherwise not be available to students	**Augmentation**: The topic was presented differently by having the video available. Students are able to watch and re-watch the video in order to be able to answer questions.

How did 1:1 impact planning?

- Students have laptops and access to tutorials when time permits.
- In the past, multiple people sharing carts was a constraint.
- Most used when we can't offer something as an experience, so they can use simulations or research that give data sets that students can work with.
- Set in routine with time

Barriers?

- Not tech savvy, being able to troubleshoot effectively
- Time available given curriculum demands, esp. with AP and Keystone exams

Teacher E

Social studies lessons. It was difficult to determine any kind of detail from the written lessons, so I relied on the conversation with the teacher to determine the quantity and quality of technology lessons. The teacher self-reported that he used technology every single day using the laptop carts before and after 1:1 implementation. He created a classroom site that contains various videos with questions. Students are expected to watch videos at home and answer questions before coming to class. He also reported to have several different technology options available so that he can adjust instruction in real-time based on how students are doing. Technology seemed to have significantly impacted his instruction overall, but he said technology was always available in the form of carts. With 1:1 the teacher simply didn't need "a back-up plan, just in case…" The ten lessons before and after were coded at the Augmentation level.

How did 1:1 impact planning?

- More engaging lessons

- Flipped classroom
- Ability to bring more resources to the classroom daily; take students to see things through videos that they otherwise wouldn't be able to
- Create a classroom site that students visit daily to complete assignments and answer questions that the teacher can then use for formative assessment
- More resources available at our finger tips, so he can adjust what he is doing in the classroom in real-time based on student interest
- The teacher no longer has to plan a back-up in case the carts are not available

Barriers?

The teacher said that he experienced no barriers to implementation before or after 1:1. He described himself as a huge fan and said that it was a relief not having to worry about getting the cart, but that in general technology availability was not a concern before the school went 1:1

Teacher F

The math teacher claimed to use the laptops once per unit as a formative assessment tool. The teacher uses google forms to collect data on how well the students understand the material and then plan the remaining lessons accordingly. The students answer several multiple choice questions using the laptops. The data is then quickly sorted based on student and question to get a snapshot of where additional instruction is needed. The teacher stated in no uncertain terms that the 1:1 initiative did not impact planning. The math department had access to plenty of technology when needed. The teacher added that

technology wasn't needed in her class, suggesting a second order barrier in terms of mindset.

Appendix 1.6: Teacher Survey Results