THE IMPACT OF 1:1 LAPTOPS ON TEACHING AND LEARNING: HOW SEVEN SECONDARY EDUCATORS PERCEIVE TECHNOLOGY HAVING ENHANCED THEIR TEACHING AND THEIR STUDENTS’ LEARNING.

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Abstract

The purpose of this qualitative study is to investigate how teachers who have been identified as high level integrators of technology (specifically laptop technology) perceive their journey to integration, the impact of it on their teaching pedagogy, and the impact of it on student learning. Constructivist Theory informed the interpretations of findings and the literature review provides context for the study with what is documented around technology integration as well as where gaps exist that further research could inform. A qualitative approach was utilized in a suburban middle-high school to identify participant teachers’ perceptions connected to the journey to and impact of technology integration at a high level. Through the interview process and analysis of participant responses, it was found that teachers need multi-faceted supports to effectively integrate technology, that effective technology integration is conducive to student-centered teaching approaches, that effective use of technology shifts traditional teaching and learning roles and mindsets, and that effective technology integration influences teacher and student engagement. The findings of this study are presented to inform policy makers, administrators, and educators on the many ways that effective technology integration can impact teaching and learning.

Keywords: 1:1 laptop program, teacher beliefs about technology, teacher beliefs about pedagogy and student learning, student engagement, technology integration, Constructivism
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Chapter I: Introduction

Statement of the Problem

In the past ten years, technological advancements have made portable computing options more affordable and have initiated a much larger focus by schools and school systems across the country on providing computer access to students and teachers on a one-to-one (1:1) basis. Indeed, hundreds of individual schools and school systems, and entire states such as Maine and Texas have embarked on laptop initiatives with the aim of putting laptop computers with wireless capability in the hands of students on a 24/7 basis (Rockman et. al, 1998; Penuel, 2006). Further, it has been estimated that “…nearly 25% of school districts in the United States would implement some form of 1:1 computing” (Holcomb, 2009, p. 49). It is important to note that 1:1 laptop access includes up-to-date productivity tools and wireless Internet access during the school day. Such access can go beyond the walls of the school and the confines of the school schedule and can potentially transform educational environments and learning on a significant level (Holcomb, 2009; Roschelle, Penuel, & Abrahamson, 2004).

As laptop technology has become more affordable, schools, districts and states have increasingly begun to initiate 1:1 laptop initiatives that allow each student and teacher access to a wireless laptop for 24/7 use (Dunleavy, Dexter & Heinecke, 2007; Holcomb, 2009). There are a number of reasons or goals cited including: preparing students for the workforce, influencing the development of student-centered teaching practices, increasing student engagement, developing critical skills (communication, collaboration, technology proficiency, thinking, organization, and study), positively impacting student achievement and learning in all or specific content areas, and increasing the quality of instruction (Bebel & Kay, 2010; Bebel & O’Dwyer, 2010; Dawson & Cavanaugh, 2006; Holcomb, 2009; Inan & Lowther, 2010; Lei & Zhao, 2008; Penuel, 2006).
Such goals indicate the belief among supporters of 1:1 laptop initiatives that the ubiquitous presence of wireless laptops can transform teaching practice and technology use in the classroom (Dunleavy, Dexter & Heinecke, 2007; Penuel, 2006), have a deep impact on how students learn (Murphy, King & Brown, 2007), and can “…act as a catalyst for educational change toward a more 21st century learning environment” (Donovan, Hartley & Strudler, 2007, p. 263).

While wireless laptop technology has become affordable for districts and states to consider as a viable option, it is still a major cost burden that is put on individual schools, districts, or states. There is a counterview about 1:1 initiatives that raise “…critical issues about laptop-computer usage, cost, and return on investment” (Weston & Bain, 2010, p. 5). Critiques of laptop initiatives raise important questions with regard to whether the presence of computers in the hands of students and teachers produce substantive changes in teacher pedagogy or in student gains (Weston & Bain, 2010).

While there is evidence that successful implementation of 1:1 laptop initiatives have occurred (Donovan, Hartley & Strudler, 2007; Holcomb, 2009; Inan & Lother, 2010; Manninger & Holden, 2009; Murphy, King & Brown, 2007; Penuel, 2006) and that student outcomes can be positively impacted (Baylor & Ritchie, 2002; Bebel & Kay, 2010; Bebel & O’Dwyer, 2010; Dunleavy, Dextert & Heinecke, 2007; Holcomb, 2009; Inan & Lowther, 2010; Muir-Herzig, 2004; Penuel, 2006; Solhaug, 2009), research shows that teacher attitudes and capacity with regard to laptop technology pedagogy are large determinants of whether adaptive practice occurs in the classroom (Drent & Meelissen, 2008; Fried, 2008; Hew & Brush, 2007; Inan & Lowther, 2010; Kopcha, 2012; Meuller et. al., 2008; Muir-Kerzig, 2004; Penuel, 2006; Petko, 2012; Yang & Huang, 2008). The problem is that many teachers continue to utilize teacher-centered practices despite the possibilities that ubiquitous laptop access can offer for student-centered
instruction. Further, while access to computers and the Internet has increased, computers are under-used in many schools and such technology is sparingly employed in actual teaching practice (Mueller, Wood, Willoughby, Ross, & Specht, 2008; Petko, 2012). Where teachers are in terms of their attitudes towards, knowledge of, and comfort with technology and pedagogical philosophy are important considerations for policy makers and can determine whether or not teachers will change their teaching practice over time. This could be a key factor as the impact of laptop initiatives in terms of student learning and achievement is unclear.

Given that there are differing perspectives on the instructional return that 1:1 access brings for the financial investment, and in the capacity and willingness of teachers to actually use such technology in their practice, it is clear that this problem requires more research. The purpose of this study is to examine how teachers that have been recognized to effectively integrate technology in their instruction perceive their journey to such integration and its impact on their pedagogy, student engagement, and student learning. As with any educational initiative, it is what happens in the classroom that determines success and learning what factors influenced successful implementers of laptop technology and their perceived impacts can be quite instructive.

Significance of the Problem

The idea that 1:1 access “…has the potential to transform learning environments and improve student outcomes” (Penuel, 2006, p. 332) makes one interested in how teachers and students will adapt to this new reality and what the implications are for both populations. Given that there is a clear movement toward increasing the level of access students and teachers have to technology tools, this is a very pertinent topic for a study. Practitioners can also examine specific local districts where 1:1 laptop initiatives have been implemented and use the research
on implementation strategies, effective professional development, pedagogy, and student learning to gain insight into how technology (specifically 1:1 laptops) can be effectively implemented to change teaching and learning.

Qing (2007) found in her study of 15 math and science teachers and 450 secondary student views about technology that “…most teachers perceive technology integration as no more than extra workload … with little educational value for the time and effort invested” (p. 392). Conversely, the author found student attitudes toward the use of technology in the classroom to be generally enthusiastic, indicating a disconnect between the perceptions of these two populations. This underscores the importance of focusing on adult attitudes about technology integration, learning, pedagogy, and professional development so that teachers can see concrete applications of technology tools to their respective practices. As important is the idea that teachers need to see how their colleagues who have come to integrate laptop technology in their classrooms perceived their journey and the impact such integration has had on their respective pedagogical approaches and student learning.

Much of the success of technology-based initiatives is dependent on the implementation strategies, pre-existing attitudes about technology integration, student learning, pedagogy, professional development, and ongoing support for teachers and students (Penuel, 2006; Holcomb, 2009). It is clear that more research needs to be conducted around how adults view student learning and pedagogy, and how their attitudes about learning and pedagogy are key determinants of the successful integration of technology tools into the learning environment. Additionally, it is important to examine how adults develop the capacity and technological knowledge to learn how to both use and employ technology in the classroom. Understanding
how these attitudes intersect with technology capacity, knowledge, and integration will inform 1:1 initiatives and strategies across the state and the country.

**Positionality Statement**

While having a professional and personal interest in this topic, I try to keep Machi and McEvoy’s (2012) admonishment to the scholar-practitioner that “…personal attachment can also carry bias and opinion, causing researchers to jump to premature conclusions” and “…succumb to bias” (p. 19). Thus, it is important that I am able to take into consideration my positionality as it pertains to this topic and structure a study that addresses my bias as a researcher. Briscoe (2005) discussed the point that identity can be manipulated to accomplish specific objectives (e.g. to fit in or to distinguish oneself from the group). The *othering* that one engages in is dependent upon which identity/identities one decides to foreground and which to quell or background. Thus, one has to have a very good understanding of his/her identities that will most likely play a role while conducting and evaluating the research he/she undertakes. I am no different. I have identities and biases as a former teacher and current administrator that will surely have an impact on my research if not identified.

The teacher in me has always been inherently suspicious of directives that have often come without clear vision or adequate professional development. I have also been fairly cynical when it comes to ‘magic bullet’ innovations that will change education, as these do not exist. Thus, I have to be careful as a researcher to avoid the assumption or suspicion that implementation or ‘roll out’ of a 1:1 program will be fragmented and unsupported which, in turn, will bring about no change in teacher attitudes/perceptions. As an administrator for the past fifteen years, I also have to avoid the cynical assumption that teacher attitudes toward changes in their respective practice will tend to be negative, no matter how well the initiative is
implemented and supported. Many of the teachers I know are often suspicious of ‘top-down’
directives, which impact their willingness to participate fully just because it came from ‘the
administration.’ Another component that will need to be understood is that I am part of the
administrative team that brought the 1:1 laptop initiative to my school. Thus, I am fully invested
in this program as one that can transform both teaching and learning. I have to realize that not
everyone believes in the initiative as deeply as I do. As a result, I will need to be acutely aware
of my identities as a former teacher, current administrator (principal), evaluator, and proponent
of the 1:1 initiative, as these all potentially bring bias to how I conduct the study and review the
responses of teachers. That awareness will need to translate into my being objective as I develop
the study structure. Last, as I will be identifying and interviewing teachers in the building where
I am principal, I will ensure that I will not be a primary or secondary evaluator of the teacher I
will be interviewing. Further, while interviewing the participants, I will frame the questions so
as not to convey my own personal beliefs or perspectives discussed above.

**Research Questions**

The following three research questions will guide this study:

1. How do teachers identified as effectively integrating technology in their instruction
   perceive their journey to successful integration?
2. How do they perceive technology integration as impacting their teaching?
3. How do they perceive technology integration as impacting their students’ learning?

**Theoretical Framework**

In the review of paradigms and theoretical frameworks for this study, it is important to
identify a theoretical lens that can inform the review and analysis of one’s data in relationship to
a theory or theories. For this study, the researcher has selected a Constructivist lens through
which to examine the research questions. This approach can help the researcher to better interpret the role of the environment, the individual, experience, and interaction in determining and explaining how the adults in this study perceive their process to become effective implementers of technology and the impact that implementation has had on their teaching and their students’ learning. This study seeks to take a constructivist approach to frame those factors in order to give a context for learning and teaching that is well suited for understanding how educators have come to use technology in their classrooms, how it has impacted their teaching, and, ultimately, their students’ learning. In the end, Constructivism as applied to education offers a strong defense that is reflective of the integration of “…advances in pedagogy (especially built on how we learn), in technology (especially around engagement), and in change knowledge (especially around making change easier)” (Fullan, 2013, p. 15).

**How people learn: A constructivist viewpoint.** Davis & Samara, (2006) state that, “A learner is a complex unity that is capable of adapting itself to the sorts of new and diverse circumstances that an active agent is likely to encounter in a dynamic world” (p. 14). This makes the clear reciprocal link between the learner and the environment and the role each play in one’s adaptation. In the examination of Dewey, Kolb, Vygotsky and Piaget around learning and development, one can see: 1) that the idea of learning being non-linear, interactive and unable to be reduced has been around for many years, and 2) that key stimuli are necessary for growth, learning and self-organization, at the core of which require a relational interaction with the environment, adults and peers.

For Dewey, the quality of the experience a student has is a large determinant of the effect of it on learning, with quality being defined by two principles: Continuity and Interaction. The principle of continuity deals with the cumulative effect that experience has on learning. Schmidt
(2010) explains this concept by saying, “Each experience is shaped by prior experiences and in turn shape[es] future experiences … and changes the person … in ways that influence what may be learned from subsequent experiences” (p. 132). Schmidt (2010) further explains the principle of interaction by stating that, “…individuals create meaning from an experience as they interact with its physical and social settings” (p. 132). Kolb (1984), in his synthesis of Dewey, Lewin and Piaget, uses them to establish his own definition of learning as the “…process whereby knowledge is created through the transformation of experience” (p. 38). To Kolb, learning is adaptation over content or outcomes, and knowledge is constantly being created and re-created and is not something transmitted. This idea is entirely consistent with Dewey’s view of learning and the important role experience plays as well as the importance of the interaction between the individual and the environment, the cyclical and generative aspect of learning that builds upon prior experience and interaction, and the resulting self-organization, adaptation and emergence that occurs (Kolb, 1984; Schmidt, 2010). To Dewey, this is a process that is ever changing and ever present, which defies the reduction of learning as the internalization of discrete blocks of information and content delivered by a teacher (Dewey, 1915; Kolb, 1984; Schmidt, 2010). In short, learning is made – not received.

Dewey’s and Kolb’s ideas about meaning are driven by the idea that one’s interaction with physical and social settings drive adaptation, which, in turn, becomes knowledge (Dewey, 1915; Kolb, 1984; Schmidt, 2010; Zhang, 2003). This knowledge is ever changing based on continuing interaction with one’s physical and social setting (Dewey, 1915; Kolb, 1984; Schmidt, 2010; Zhang, 2010). Vygotsky takes this concept further with his focus on social-cultural theory to explain the process of learning and higher-order development as occurring primarily through social interactions with others (Zhang, 2003).
To Vygotsky, “…people learn from mediations and scaffoldings, which are offered within one’s zone of proximal development (ZPD) from more capable peers or experts. Vygotsky defines the ZPD as … the distance between one’s independent competency and the competency obtained with expert assistance or in collaboration with peers” (Zhang, 2010, p. 2). He held that “… learning could not be based on a direct association, but involves the agency of other people and is mediated by community and culture” (Boudourides, 2003, p. 5).

Boudourides (2003) characterizes Vygotsky’s emphasis on the role of the tutor and stresses that Vygotsky felt that thought development is mainly influenced and determined by language and interaction. Jorg (2009) underscores this by saying, “… we should recognize the surprising inefficiency of individual learning, of learning alone, and become more aware of the generative power of learning through social interaction as a generative process, with unexpected potentialities for the partners in that interaction” (p. 6). This embraces the idea that learning is generative and that it cannot occur in isolation, without interaction with both the environment and other humans. Thus is the case for the fact that many educators do not truly understand just how complex interaction actually is, nor how multi-layered the adaptation and learning process is in relation to the many causes that influence it. Such an idea, if embraced by educators, calls for different tactics in the classroom in order to unlock the learning potential that can occur through interaction. Such an idea also is important for school leaders to understand when building capacity within adult staff members.

Piaget developed the stages of cognitive development that have been quite influential in the understanding of the development of the human mind. He held that the development of the human intellect proceeds through adaptation, organization, and re-organization, where external events are assimilated into existing mental structures to create and accommodate new ones that
are structured and organized (Boudourides, 2003). As the child matures, the mental structures and organizational schemes become more complex and are constructed by the learner as opposed to being transmitted by the educator. (Boudourides, 2003).

While much is known about the different stages of cognitive development, much less is commonly understood about what Piaget saw as needing to happen in order for one to move from one stage of development to the next. Doll (1989) described Piaget’s equilibrium-disequilibrium-re-equilibration model in the context of Piaget’s observation that self-organization, which is key to learning and adapting, can only occur when “… there is a difficulty to overcome” (p. 67). To Doll, it is unfortunate that so much attention was paid to Piaget’s stages of cognitive development and so little on what internally occurs to drive movement from one stage to another. It is this drive and the unbalancing that occurs that is at the heart of learning, adaptation and ultimately cognitive development. Thus, the internal and social process of learning provides a lens that clarifies just how complex and nonlinear learning really is. Within this conceptualization is the implicit idea that pedagogical changes are the product of adaptation and learning through experience and interaction.

Synthesis. John Dewey stated that “It is radical conditions which have changed and only a radical change in education suffices … Knowledge is no longer an immobile solid; it has been liquefied” (Dewey, 1900/1915, p. 9). In the discussion of what learning might be, one sees the combined work of Dewey, Vygotsky and Piaget informing and bolstering the view of education and learning. This helps us to better understand the way that adults best synthesize experiences in ways that could lead to changes in pedagogy. Thus, if one takes the reciprocal experiential and adaptive aspects of Dewey and Kolb, with the centrality of social interaction viewed by Vygotsky and the disequilibrium touted as necessary for learning and development by Piaget,
one begins to hone in on a view of learning and development that is centered on one’s interaction with the physical and socially interactive environment in a manner that allows for the creation of circumstances that are difficult to overcome. In being influenced by the physical environment and the relational interactions in connection to a problem or difficulty to overcome, the learner is faced with a dissonant situation that demands self-organization, interaction, and adaptation in order to have a new understanding emerge from the old and overcome the problem or difficulty. This is the set of circumstances that influence meaning-making, adaptation and learning. With adults, this is the set of circumstances that influence one to examine and possibly change/adapt pedagogical practices.

In relating these theories to teachers and the presence of 1:1 laptops, it is clear that the adults must undergo a learning process as they identify the functionality that laptops present and then apply that functionality to their own view of teaching and learning that may indicate a shift in their pedagogy. Teachers have myriad complex personal and professional experiences that inform their views and attitudes about teaching and learning and thus influence the practice that occurs in the classroom. The shifts in education that have occurred over the past ten years (State standards, NCLB, the Common Core, state frameworks, 21st Century Skills movement, Professional Learning Communities, Project/Problem Based Learning) could all be considered external factors that have fundamentally changed education and the teaching profession at the macro level. The introduction of a school wide laptop program for all students and teachers (and the expectation that those tools be used in the classroom) is another external factor that, together with the larger themes mentioned above creates a dissonant situation for teachers that forces them to adapt both individually and in small groups to this new reality. That adaptation challenges assumptions and meanings with regard to learning and pedagogy and informs this
complex individual and collective learning process. Thus, this qualitative study sought to assess teacher attitudes and perceptions about their journey to effective 1:1 implementation and the impact that 1:1 laptops has had on their teaching and student learning. Understanding constructivist theory on learning was key in the development of the survey and interview questions for the study. Additionally, it was essential to understand the current state of the literature with regard to the implementation of 1:1 laptops in schools.
Chapter II: Literature Review

Introduction

The purpose of this literature review is to examine what is known about 1:1 computing initiatives as they pertain to implementation strategies, professional development, teacher attitudes and beliefs about technology, classroom pedagogy and learning, and student outcomes (engagement, learning and achievement) at the Middle/High School Level. The results of the literature review reveal that, while there is evidence that successful implementation of 1:1 laptop initiatives have occurred and that student outcomes can be positively impacted, teacher attitudes and capacity with regards to laptop technology and pedagogy is a large determinant as to whether adaptive practice occurs in the classroom. The problem is that many teachers still utilize teacher-centered practices despite the possibilities that ubiquitous laptop access can offer for student-centered instruction. Where teachers are in terms of their attitudes towards, knowledge of and comfort with technology and pedagogical philosophy are important considerations for policy makers and can determine whether or not they will change their teaching practice over time. This could be a key factor in the fact that the impact of laptop initiatives in terms of student learning and achievement is unclear.

This literature review will examine current research and literature on the following topics: what is now known about 1:1 laptop programs in terms of implementation; professional development in 1:1 technology integration; teacher beliefs about immersive technology; and the impact of 1:1 laptops on classroom pedagogy, student engagement, learning, and achievement. In addition, the review will cover some counter-views regarding the promise of 1:1 laptop initiatives to impact teaching and learning. Last, a discussion of the implications raised by the
literature review as it pertains to implementation, beliefs about technology and pedagogy, and student outcomes will be presented.

**Research on the Implementation of 1:1 Initiatives**

Schools, districts and/or states that successfully implement 1:1 initiatives have an understanding that “successful implementation of a large-scale technology initiative requires more support and organization than just giving out equipment and a few articles on using computers in the classroom” (Murphy, King & Brown, 2007, p. 67). In undertaking a 1:1 initiative, it is important to understand that the quality of the implementation of a program (like 1:1 computing) plays a large role in the achievement of the goals of the program and is a challenge to undertake, as it requires a multi-year commitment of systemic planning and support in order to change teaching and learning (Shapley, Sheehan, Maloney & Caranikas-Walker, 2010). Incumbent in this is the need to understand the perspective of the teachers.

A review of 1:1 initiatives finds that implementation of 1:1 laptop programs is not consistent, even between buildings in the same district, thus indicating that implementation is a unique and multi-layered process (Bebel & Kay, 2010; Penuel, 2006; Shapley et. al., 2010). Holcomb (2009), Bebell & O’Dwyer (2009); Murphy, King & Brown (2007) and Waters (2009) underscore this idea in their discussions of unsuccessful laptop initiatives in Liverpool, NY, Matoaca High School in Virginia and an unnamed high school, citing a lack of specific implementation goals and planning as well as inconsistent professional development support as being key reasons for the underutilization of technology in the classroom and subsequent discontinuation of the 1:1 laptop programs. Thus, having a long-range detailed and comprehensive plan (developed by stakeholders) with a specific scope and sequence of differentiated and ongoing training and professional development are key pieces necessary to
inculcate a culture that supports 1:1 implementation in teaching and learning (Donovan, Hartley & Strudler, 2007; Holcomb, 2009; Penuel, 2006; Shapley et. al., 2010). Manninger & Holden (2009) further state that successful 1:1 computer environments have: dedicated leaders who communicate clear expectations and provide ample support during and after implementation, adequate support (e.g. financial, training, technical), opportunities for teachers to become comfortable with technology and have a voice in both implementation and professional development, and available instructional exemplars at the content level. Teacher input at the start is significant, as described by Murphy, King & Brown (2007) who, in their study of laptop integration in a secondary school, noted the lack of teacher input as being a key factor that may have “negatively influenced the overall success” (p. 69).

Donovan, Hartley & Strudler (2007) assert that to sustain 1:1 initiatives, it is essential that the views and concerns of teachers be incorporated into implementation strategies. In their study of teacher concerns at the start of a laptop initiative in a middle school, these authors evaluated the concerns of 17 grade 7 math, science, social studies and English teachers. While the sample size was small, they found that teachers had differing levels of concern based on their individual level of technological expertise. Those with little expertise were concerned with how to develop and integrate laptop lessons into their classroom while meeting curriculum requirements. Other teachers who had a better understanding of the how to use technology tools were concerned about the management issues arising from a more integrated technology approach. Inan & Lowther (2010), in their study involving 379 K-12 teachers, support this assertion, as they found that teacher readiness and beliefs directly influence laptop integration, saying that, “Teachers who feel ready to integrate technology, used computers more frequently in the classroom” (p. 942).
Key barriers to the integration of computers and technology into the classroom exist and must be addressed during the implementation process. Ertmer et. al. (2010) identify external and internal factors that pose barriers to teachers’ integration of technology in the classroom. External factors include student and teacher accessibility to technology, training, and ongoing support. Internal factors include teacher confidence in their knowledge and application of technology, beliefs about how students learn, and teachers’ perceived value of technology in the teaching and learning process. Kopcha (2012) identifies access issues (when technology does not work properly), teacher abandonment of technology use when setbacks occur, teacher beliefs about technology usefulness in their classrooms, difficulties in the integration of technology into specific curriculum, and elevated classroom issues. In an international study of schools from twenty six countries, Pelgrum (2001) found that the key barriers to teacher integration of technology connected to insufficient knowledge and skills with technology, difficulty integrating technology into the curriculum and instruction, insufficient teacher time for acquisition and experimentation, and a lack of instructional technology support. Wedman & Diggs (2001), in their review of teacher preparation programs and preparation of new teachers to use technology in the classrooms identify that college faculty do not model technology use and that they do not provide field experience for students to model in actual classrooms. Thus, technology is isolated from curriculum and pedagogy at the preparatory level, which perpetuates uneven integration in the school setting.

As accessibility has increased, the external factors around connectivity are no longer insurmountable (Mueller et. al., 2008) which leaves the strongest general barriers to technology integration being teacher attitudes and beliefs toward technology and their ability to connect to specific curriculum and content contexts (Ertmer et. al., 2013). These barriers have a significant
impact, as “There is a clear connection between the degree to which teachers experience these barriers and their decision to use technology for instruction” (Kopcha, 2010, p. 1110). Indeed, “…the teacher educator has the most influence on the quality and characteristics of the product: innovative use of ICT” (Drent & Meelissen, 2008, p. 197). Examining laptop integration in light of barriers to integration, readiness, and teacher beliefs has key implications for professional development around technology training, lesson design, and pedagogy.

Counter views

Despite the stated reasons or goals cited by proponents (mentioned above), critics of 1:1 laptop initiatives make the point that the gains from 1:1 initiatives are largely unsubstantiated through empirical research and that the reality is that technology use as it applies to student-centered teaching practice is underutilized (Apple, 2004; Cuban, 2001; Weston & Bain, 2010). Mueller et al. (2008) and Petko (2012), while not necessarily critics of laptop initiatives, do discuss the issue that, while access has increased to computers and the Internet, they are generally under utilized in actual teaching practice. Indeed, the mere presence of technology in classrooms does not automatically ensure that it will be used or that teaching and learning will be improved (Murphy, King & Brown, 2007). For 1:1 initiatives to succeed, teachers need to integrate more faithfully technology at a higher level into classroom teaching and learning experiences. A key aspect to facilitate that higher-level integration is through professional development.

Research on Professional Development associated with 1:1 initiatives

Professional development is a key facet to the development of successful 1:1 laptop initiatives (Holcombe, 2009, Penuel, 2006). To fully integrate 1:1 laptop teaching and learning in the classroom, teachers “…must adjust and redesign their instructional practice … while also
staying aligned with curricula and standards” (Holcomb, 2009, p. 53). Because teachers come into their respective classrooms with “…a wide range of attitudes, experiences, and skills related to teaching with technology … professional development requires as much emphasis as the technology in a school technology initiative” (Dawson, Cavanaugh & Ritzhaupt, 2006). This requires that teachers have time and training in order to build confidence in their own technological abilities, as those that are not knowledgeable, or are technophobic will likely fail to utilize laptops in their teaching (Muir, 2005).

This was a key reason given in the districts mentioned above that experienced failure in their respective laptop initiatives. Thus, one layer of professional development is necessary to develop the basic technological skills and capacity for all teachers. Without a general baseline level of understanding, teacher utilization of laptops in the classroom will be uneven as evidenced by current research in teacher pedagogy. A deeper level of professional development and training is necessary for teachers with more advanced technological skills and entails the design of computer-based lessons or student-centered projects that also address curriculum standards in specific content areas (Mouza, 2008). Last, a key facet of professional development that is often overlooked is pedagogical training (Murphy, King & Brown, 2007) that examines aspects of best practice in general and as it pertains to a laptop environment.

Approaching professional development as a multi-layered and differentiated process that is tailored to address teacher needs and concerns is key to a successful laptop initiative (Donovan, Hartley & Strudler, 2007; Holcombe, 2009). Inan (2010) is very clear when he says, “Improving teacher beliefs regarding the benefits of laptop integration should be a major goal of professional development activities” (p. 942). These activities need to focus not just on the building of basic technology understanding and skills. They also need to focus on creating connections between
teachers and their specific practice. Ottenbreit-Leftwich, Glazewski, Newby, and Ertmer (2010) frame this aspect of professional development in that, “When learning experiences are focused solely on the technology itself, with no specific connections to grade or content areas, teachers are unlikely to incorporate technology into their practices. The more content-specific the example, the more likely the teacher will see value and learn it” (p. 1332). This is a key theme in terms of teacher integration and professional development. Even when teachers find a general value in a particular technology use, unless they can see how it will specifically result in meaningful learning outcomes and work in their classrooms connected to their own beliefs about teaching and learning, they are unlikely to implement it (Ottenbreit-Leftwich et. al, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, Sendurur, 2013).

Thus, professional development needs to identify teacher attitudes and present them with opportunities for positive experiences within the context of instruction (Mueller et. al., 2008). Ottenbreit-Leftwich et. al. (2010) suggest that professional development should target teachers’ value beliefs through translation and application activities. Translation exercises highlight how students can benefit from uses of technology that bring efficiency to teaching (ex. grading programs). Application activities would show teachers explicitly how technology would work in an actual classroom. Kopcha (2012) asserts that professional development has to incorporate research-based opportunities like focused workshops, mentoring, and communities of practice, as they can have a significant role in shaping teachers perceptions about technology integration and barriers to it. Ertmer et. al. (2013) suggest that professional development planners should use and model the same technology that teachers are able to use in their classrooms.

Research also shows that the kind of time given for professional development is an important consideration (Muir-Herzig, 2004). Indeed, Muir-Herzig (2004) asserts that,
“…teachers need the time to learn at their speed and with their own learning styles” (p. 115).

One model developed for a system required 10 full days of professional development with periodic follow-up during the school year (Penuel, 2006). Another study indicated that approximately 2.5 hours of professional development time was given to teachers to focus on building their technology skills; however, this was not enough time to engage in the examination of the necessary pedagogical changes (Murphy, King & Brown, 2007). Drayton et. al. (2010) note in their study of a multi-year laptop initiative in three different high schools that, despite time devoted to building teacher knowledge and lesson development, the lack of ongoing collaborative time served as a barrier to a higher level of integration. There are key implications to this. The level of sustained and differentiated professional development is an important factor to determining the success or failure of a 1:1 laptop initiative and can also be a determinant in the level of pedagogical integration that occurs in the classroom (Holcomb, 2009; Penuel, 2006).

Teacher need sufficient time allotted for professional development so that teachers can learn how to use technology tools, apply them to their specific context and content, be able to discuss those uses with other teachers and mentors, and identify positive uses on student learning. Without a full commitment to this multi-layered approach to professional development, teacher attitudes about technology, student learning, and pedagogy could be impacted, resulting in less willingness to integrate computer technology in the learning experiences of students.

**Teacher Attitudes and Beliefs About Technology**

Teacher attitudes and capacity as they pertain to technology, student learning, and pedagogy are significant links that need to be explored. It is one thing as a teacher to have students who have access to laptop computers. It is quite another for teachers to utilize the technology in a way that transforms their practice on a day-to-day basis. The extent to which
this occurs is dependent on teacher attitudes about teaching and learning and the level of professional development they receive prior to and during implementation.

As discussed above, teachers’ level of confidence and belief in the value of technology in part impacts the extent and degree to which they will use laptop technology in the classroom. The literature supports this statement. Penuel (2006) notes that in a number of studies, the use of laptops by students was largely focused on “writing, taking notes, completing homework assignments, keeping organized, communicating with peers and their teachers, and researching topics on the Internet” (p. 336). He notes that the “…most common uses …reflect the fact that … teachers are in an adaptation stage of technology adoption” (p. 336) that focuses on adapting traditional teacher-centered strategies to incorporate productivity tools (word processing, Internet searches, PowerPoint) without utilizing student-centered strategies (project-based learning).

Hew & Brush note that, “Teachers who viewed technology as merely ‘a way to keep kids busy,’” did not see the relevance of technology to the designated curriculum” (p. 229). Fried (2008) goes further in her study of 137 college students participating in a General Psychology lecture-based course. With unstructured laptop access during lecture-based classes, she found that, “…students admitted to spending considerable time during lectures using their laptops for things other than taking notes” (p. 911). Maninger & Holden (2009), Christenson (2002), and Donovan, Hartley & Strudler (2007) all discuss variations of this theme, describing the evolution of teachers’ stages of knowledge. With more time and expertise comes a higher level of laptop utilization in the classroom (Holcomb, 2009).

Dunleavy, Dextert & Heinecke (2007) noted that the most common uses of laptops in classrooms were for online research and productivity tools, drill and practice and the use of classroom websites for communication. Drent & Meelissen (2008), in a national survey on the
implementation of information and communication technologies (ICT) found that, while two-thirds of teachers nationally were positive about the value of ICT for education, less than fifty percent of them actually reported using it in their classes. Of that fifty percent, most reported utilizing it for word processing and searching for information. Bebel & Kay (2010) found that within the 5 Berkshire middle schools they studied, there were “notable differences” (p. 49) in how teachers utilized technology in their respective classrooms. All of this speaks to varied attitudes and beliefs around the value of technology integration.

Contrary to this, a review of 11 Florida districts’ implementation of 1:1 laptops found that, along with focused and sustained professional development, teaching practices in different content areas were positively affected with evidence of “…student-centered teaching, increased tool-based teaching, and increased … meaningful uses of technology” (Dawson, Cavanaugh & Ritzhaupt, 2006). Based on their findings, Dawson et. al. (2006) found that laptop integration and focused professional development has the possibility to impact instructional practice very quickly. Additionally, given Lei and Zhou’s (2007) point that “…technology use in in constant change…” and that “…the same technology can be used differently, by different people, and in different contexts to achieve different goals” (p. 286), it is also important to consider context when implementing professional development around the different uses of classroom technology.

In addition to teachers’ beliefs about learning and pedagogy (discussed below), it is clear that readiness with regard to how to utilize technology competently is a significant influence on a teacher’s willingness to use it in the classroom (Inan & Lowther, 2010). Kopcha (2012) summarizes this best by saying, “A teacher’s decision to integrate technology is based heavily on the level of support they receive, their own beliefs about using technology for learning, and their skills with using technology for instruction” (pp. 1118). Thus, a key to increasing teachers’
integration of technology is to directly address their attitudes about the technology itself by increasing their confidence in using the technology, and their perception of its value in the teaching and learning process. Teachers’ own idea of their skills for using computers and technology in the classroom will increase with actual use (Petko, 2012). When they are shown (via demonstration, mentoring, instructional technology specialists, collaborative communities of practice, observation) the usefulness of technology in their subject area and/or content classrooms in terms of how to use it and how it benefits students, most teachers are willing to take the time to learn it (Muir-Herzig, 2004). What is key is that teachers see computers as much more than a means to conduct administrative tasks and lower level computing (e.g. word processing). To do this, teachers have to acknowledge that computers can serve as a cognitive tool in knowledge construction and as a tool for learning and incorporate it as a tool for learning in the classroom (Mueller et. al., 2008).

Yang & Huang (2008) identify that teachers’ beliefs about technology will have an impact on their technology integration, but that those beliefs can change with technology use. Thus, teachers’ beliefs or attitudes about technology can change as long as they are willing to use it in their practice. Key in changing teacher attitudes and beliefs about technology integration is providing teachers with positive experiences and sufficient mentoring and modeling of content specific applications (Drent & Meelissen, 2008; Mueller et.al., 2008; Inan & Lowther, 2010). As Mueller et. al. (2008) state:

The need for specific positive experiences with technology in the classroom indicates that teachers need to see that an innovation has the potential to improve learning or instruction before they are willing to endorse it …Teachers need to see positive outcomes and successful practice – they need to actually experience positive events” (p. 1532; 1535).
Positive teaching experiences with computer integration can lead to a teacher having a more positive perception of his or her competent use of the technology as a learning tool which can, in turn, impact the pedagogical approaches employed (Drent & Meelissen, 2008).

Teacher Attitudes and Beliefs About Learning and Pedagogy

As important as teacher attitudes about technology, teacher attitudes and beliefs about learning and pedagogy are key to the type of laptop integration that occurs in his/her classroom (Baylor & Ritchie, 2002; Mueller et. al., 2008; Penuel, 2006). “The adoption of educational innovations can only be explained when also educational beliefs of teachers are taken into account” (Trondeur, Hermans, van Braak, & Valcke, 2008, p. 2542). In his synthesis of 30 studies on 1:1 laptop integration, Penuel (2006) articulated the point that teachers will use technology more often if they can connect it to the curriculum and feel prepared to use technology in their respective subject area. Additionally, the degree to which teachers use technology with students reflects their beliefs about the potential that laptops have for learning as well as the individual teacher’s beliefs about effective teaching practice and students’ ability to complete complex tasks individually and collaboratively (Shapley et. al., 2010; Penuel, 2006). Teachers who are comfortable with student-centered or constructivist methodologies and who believe that students can complete more sophisticated project-based assignments may be more likely to utilize laptops with students more often (Trondeur et. al., 2008). Conversely, if a teacher does not believe that students can do the work, or in the “…potential role of technology in learning, and the availability of high-quality digital content” (Penuel, 2006, p. 337), then he/she will not be as likely to use laptops. Inan (2010) puts it best by saying, “The most important influence on laptop integration [is] the unique impact of teacher beliefs over and above the other … variables” (p. 941).
Teachers who value a teacher-centered classroom structure use technology according to those values, as opposed to those who believe in a student-centered approach to learning who have a higher chance of utilizing laptops for individual or collaborative project-based learning (Bebel & Kay, 2010; Drayton et. al., 2010; Trondeur et. al., 2008). Petko (2012) underscores this as he found that teachers use ICT for functions that fit into their own pre-existing pedagogical beliefs. However, Trondeur et. al. (2008) found that, while teachers’ educational beliefs tend to be associated with their use of computers in the classroom, with use of computers and ICT over time, they often change their practice and adopt more student-centered beliefs. Mueller et. al., (2008) concur saying that a teacher’s pedagogical philosophy can be altered after the integration of computers and through the experience of positive outcomes of computer integration. This viewpoint is consistent with the idea that teacher beliefs about learning, effective ways of teaching, and computer integration practices are related (Kim, Kim, Lee, Spector & DeMeeter, 2013). These authors also assert that the more sophisticated the teacher’s beliefs about learning and knowledge, the more student-centered approaches are employed, and, thus, the more seamless integration of technology with a focus on learning is utilized.

Lei and Zhao (2007), conducted a yearlong study of technology uses and their impact on student learning outcomes (measured by GPA) in a 237-student middle school in Ohio that had embarked on a 1:1 laptop program in 2003. They found that “…the key issue concerning technology use is how it is used, by whom, and for what purposes” (p. 285). They differentiate between how much technology is used in classrooms from how it is used. This is an important distinction in that much of the literature focuses on how much is used as opposed to how and when and for what activities teachers strategically utilize it. To the authors, this second focus is essential in order to find what uses seem to garner the best results for student learning and in
terms of pedagogy. “Technology use is technology in-context. Examining technologies from this angle allows us to discern the different uses of the same technologies so that the nature of different technology uses can be better understood” (p. 286). The findings of the study underscored that quantity of use was not necessarily conducive to student achievement. Rather, the largest benefit to student achievement came through subject-specific applications (E.g. Geometer’s Sketchpad, science probes) and pedagogical applications of technology that stressed student construction (E.g. creating websites, utilizing desktop publishing) over tasks like note taking. Interestingly, the authors found that the most impactful uses of technology were the least utilized by teachers, which underscores the impact the teachers’ pedagogical beliefs and approaches can have on 1:1 initiatives.

The previously asserted connection between teacher attitudes and beliefs about the value of technology, student learning and pedagogy, make it an essential aspect of 1:1 laptop initiatives at the outset. Understanding the impact of teacher beliefs on how they view the role technology integration plays with regard to their respective classroom instruction is more important than looking at external barriers or factors. Additionally, the focus with regard to teacher integration of technology in the classroom needs to be on quality over quantity. This requires a deep look at the purpose of technology in the classroom at a very specific level. What is clear from the research is that how laptops are integrated even within buildings varies greatly based on teacher beliefs about technology, pedagogy, and student learning, as do the gains in student learning and achievement.

**Impact on Student Learning and Achievement**

Student engagement, learning and achievement are the ends upon which laptop initiatives focus. The reason for schools, systems and states to begin laptop initiatives is grounded in the
idea that students who have access to both laptop technology and pedagogy that incorporates that
technology into the learning environment will experience growth in their respective level of
engagement, their learning or acquisition of key skills, and a subsequent increase in academic
achievement. Analyzing current scholarship that explores the extent to which laptops influence
student engagement, learning and achievement is key to understanding its impact and potential in
these areas. Understanding the linkage to adequate teacher preparation and adapted pedagogy is
equally important.

Gains experienced by students were highest in terms of perceived levels of engagement,
motivation, organization and increased technology use (Bebel & Kay, 2010; Bebel & O’Dwyer,
2010; Holcomb, 2009; Inan & Lowther, 2010; Penuel, 2006; Solhaug, 2009), however these
studies relied primarily on information obtained through teacher and student self-reporting and
an examination of tardy and absence rates, discipline incidents, and classroom observations to
support the assertion of increased student engagement. Thus they lack objective measures of
learning (Fried, 2008; Lei & Zhao, 2007). In terms of skill development/learning, studies noted
student increases in skills like accessing data, critical reflection, processing information,
technology literacy (word processing, online research, presentation tools), collaboration, and
writing/communication skills (Dunleavy, Dextert & Heinecke, 2007; Holcomb, 2009; Penuel,
2006; Solhaug, 2009). Baylor & Ritchie (2002) note that student higher order thinking skills
(HOTS) can increase based on three variables: 1. The strength of school wide technology
leadership, 2. The amount of technology used by students in creative situations, and 3. The level
of constructivist methods of technology use utilized by teachers and students. However, both
Penuel (2006) and Holcomb (2009) assert that better measurements of skill outcomes need to be
developed in order to more accurately assess (beyond self-reporting) the impact of 1:1 laptop initiatives on 21st Century Skill development.

From a student achievement standpoint, the literature is inconclusive beyond writing gains, and often contradictory. Dunleavy, Dextert & Heinecke (2007) in a pretest-posttest quantitative study for math and science noted a marked increase in science state assessment for students (most specifically boys) in laptop classrooms verses those who were not. For mathematics, there was no statistically valid impact at all. Baylor & Ritchie (2002) note that technology can improve scores on national and state tests; however, when used towards specific curriculum goals, increases in student learning may not translate to national or state tests. Thus, the gains are harder to quantify at the curricular or class level. Penuel (2006) notes that of the studies he reviewed, the only measurable improvement found was in writing and that it is unclear “what the potential is for one-to-one initiatives to improve student achievement in core subjects” (p. 341). Holcomb (2009) utilizes Maine’s Educational Assessment scores to assert the strong influence 1:1 laptop initiatives can have on student reading and all aspects of writing and, to a much lesser extent, mathematics. However, she also cites examples from laptop initiatives in districts in Texas, Maine, New York, Virginia and California that experienced no gains whatsoever in state assessments, even after multiple years of implementation (Holcomb, 2009). Weston & Kay (2010) assert that “evidence compiled over the last decade shows a diminutive effect of 1:1 computing on teaching, learning and student achievement across schools, districts, and states” (p. 6). Muir-Herzig (2004) identified that students who have access to technology integrated into the curriculum have a positive change in grades, GPA and attendance. As mentioned above, Lei and Zhou’s (2007) qualitative survey utilized pre and posttest surveys and GPA analysis to conclude that the quality of student interaction with technology is paramount
and that the most popular uses of technology were not ones that resulted in increased student achievement.

The result is that, from the perspective of student learning and achievement, there is inconsistency in the benefits of computer and/or ICT integration. Skill development and content and/or curriculum based learning is hard to quantify, as it is often based on self or teacher reporting. Utilizing state or national achievement assessments or other measures like attendance and student GPA’s are difficult to point to computer integration as being the main causal factor in student improvement. Given the difficulty in statistically ‘proving’ the benefits of computer integration to student learning and achievement, it may be necessary to look at it in terms of how the educational experiences change as a result of increased teacher implementation of higher level uses of technology in the classroom. If one were to quantify the elevation of teacher practice in terms of the creation of activities/experiences where technology redefined the activity, then perhaps the increased learning could be inferred.

Discussion

The review of the literature around implementation strategies underscores a series of implications. One such implication is the need for a systematic process to be developed that identifies the key goals and/or outcomes of a 1:1 laptop initiative. Imperative in this process is the idea that the viewpoints of all stakeholders need to be taken into account before and during implementation, especially those of the teachers who are charged with implementing 1:1 laptops into the content and curriculum. What is paramount for facilitators is the understanding that “…simply providing each student with a laptop is not enough. How teachers choose to use the laptops is very important” (Holcomb, 2009).
Bebell & Kay (2010) state that, “It is impossible to overstate the power of individual teachers in the success or failure of 1:1 computing” (p. 48). This is confirmed by the research discussed above that asserts the importance of the teacher’s beliefs in determining the pedagogical approach and the level of computer integration in the teaching and learning experiences of students. Consequently, a successful implementation program must recognize that teachers need a number of skills in order to successfully integrate 1:1 technology consistently into their instruction. The first is a solid understanding of their respective content and curriculum. The second is a working familiarity and comfort with technology tools (e.g. word processing, internet search engines, PowerPoint, Excel, Google Docs). Third is the ability to see the connection between the technology tools and their use in their specific context (grade level, subject, and/or content area) via high quality content. Last is the ability to design meaningful integrated lessons that go beyond simply using technology for productivity (although such use does have merit contextually) and focus more on student-centered learning. Without a comfort level, teachers will not utilize technology consistently. For all of these skills or abilities, focused and sustained professional development that provides: training both in technology and content applications, and effective pedagogy is a must, along with time to experiment and collaborate. This requires more time and money beyond that being spent on laptops alone. Planners and policy makers need to be willing to invest in this training for multiple years to have any hope of implementing laptops meaningfully.

As important, planners and administrators need to understand the nature of change in education. In general, “…most efforts to improve education fail to effect teaching, learning and achievement across schools, districts, and states” (Bebel & Kay, 2010). Change is cultural and ample time and energy needs to be put into examining and identifying teachers’ pedagogical
philosophies as they/it apply to effective teaching and learning. This is a key step for any school wide or system wide change. The enemy of effective laptop implementation, or any reform for that matter, is uninspired use or implementation in the classroom, as witnessed by the failed initiatives mentioned above. Without teachers understanding why such reforms or innovations are necessary or having the requisite skills needed, implementation that changes practice and transforms learning will never move beyond adaptation level. Thus, a keen focus on both technology and pedagogical training is a key component of an effective implementation design. The implications of this are also barriers to effective implementation: schools and systems do not simply have the money to invest in focused and ongoing training and professional development. The danger (as witnessed by a number of schools/districts) is that implementation will be uneven and varied. Further empirical research is necessary to identify more clearly the results of implementation, training and collaboration on changing teacher beliefs about pedagogy and student learning.

Based on the literature, other than notable increases in motivation, engagement, and writing, there is conflicting information as to the impact that laptops have on student achievement and learning. The body of research in this area is relatively small, and is vague in terms of measuring (beyond self reports) the impact of laptop initiatives on the development of cognitive skills and learning across content areas. Further research is needed in this important area as it is one that could reveal more meaningful benefits to a more broad environment of learning in schools that can be ascribed to laptop integration (Spires, Oliver & Corn, 2011).

**Summary**

Over the past twenty years, the availability of computing options to schools has created the possibility of a transformation in the mode and delivery of education. At first, schools
focused on making computers available to students and teachers in the form of static computer labs that could accommodate one class at a time for the length of a school period. Research has shown that such a model does not result in a long-term increase in technology utilization for instruction by teachers (Adelman et. al., 2002). Rather, Penuel (2006) asserts that, “…in order for technology to make a powerful difference in student learning, students must be able to use computers more than once or twice a week” (p. 331). The next iteration of computer access for students has allowed schools to increase the availability of technology through mobile laptop carts that allow more classrooms, teachers and students the ability to utilize computing at the same time. While allowing more students to utilize computers during the same period, such use remains episodic based on availability, which limits the long-term impact of such devices on teacher practice and student achievement.

With more recent focus on providing ubiquitous 24/7 computer access to students and teachers, and the prospect that more affordable options will continue to be made available, it is important that the academic community puts a priority on researching the key factors that impact 1:1 laptop initiatives: implementation strategies (assessing teacher attitudes, capacity, and professional development), pedagogy, student engagement, learning, and achievement. All of these topics lend to a greater understanding as to whether or not laptop initiatives are worth the price of admission. In terms of implementation strategies, it is important that teacher attitudes at the onset of 1:1 laptop initiatives be explored in order to determine the capacity teachers feel they have to understand the different classroom options that 1:1 technology gives them. Further, it is also important to understand the role professional development plays in building teacher capacity. Linking implementation strategies with focused and ongoing professional development
aimed at building technical capacity and providing specific exemplars for how teachers can apply technology to their specific contexts is essential for school leaders to consider.

Given that 1:1 implementation is a reality at the building, district, and state level, the idea that such access “…has the potential to transform learning environments and improve student outcomes” (Penuel, 2006, p. 332) makes one interested in how teachers and students will adapt to this new reality and what the implications are for both populations. Local interest in this topic is evident, as a number of Massachusetts schools have implemented a 1:1 initiative (Chromebooks, iPads, or MacBook Airs) and it will be beneficial to examine research around 1:1 laptop implementation strategies, professional development and student outcomes. Equally significant are the lessons one can learn from studies that examined other 1:1 laptop initiatives. The fact that there is some controversy about the efficacy of laptop initiatives makes the study of existing literature on the matter even more imperative. The examination of the literature to analyze trends and gaps in scholarship as they pertain to the key facets of laptop initiatives can benefit building and system administrators, teachers and, ultimately students.

Due to uneven or insufficient implementation and training related to 1:1 implementation, many teachers still utilize teacher-centered practices despite the possibilities that ubiquitous laptop access offer to transform teaching and learning. Where teachers are in terms of their attitudes towards, knowledge of and comfort with technology and pedagogical philosophy are important considerations for policy makers and large determinants as to whether or not they will change their teaching practice over time. This may be a causal factor to the fact that the impact of laptop initiatives in terms of student learning and achievement is unclear. Currently, there are gaps in the research of 1:1 initiatives for which more research is needed. Research does not provide a clear picture that student achievement automatically improves with access to 1:1
laptops for a number of reasons. The most significant gap in the research is with regard to the impact of 1:1 laptop on student achievement within and across content areas and on the acquisition of key cognitive skills across content areas. Additionally, research about the relation between teacher beliefs and ICT integration is scarce (Trondeur et. al., 2008), which makes it difficult to establish empirically how those interact and influence one another.

Also significant is the gap in research that measures the link between specific pedagogical practices/tactics as they apply to computer integration and specific outcomes. This would be even more helpful to practitioners if it were delineated by grade level and/or subject/content area. Additionally, it would be beneficial to examine how high-level integrators of laptops utilize the technology in the classroom. Research in these areas would provide much more insight and help to determine if 1:1 laptop initiatives have the transformational promise they are believed to hold. Such insight could benefit students, teachers, administrators and policy makers.
Chapter III: Methodology

Introduction

This qualitative study explored the perceptions and experiences of teachers who have been identified as having effectively integrated technology into their classroom instruction that has significantly impacted student learning. Specifically, the aim was to explore how these teachers have used the opportunity to enhance their teaching and their students’ learning with the advent of their school’s 1:1 laptops initiative. The research reviewed above indicates how important the classroom teacher is in the success or failure of a 1:1 laptop program. Further, the literature review demonstrates the need to further explore the impact of 1:1 laptops on student learning as there continues to be a debate over the impact on student learning and achievement.

There is a dearth of information that provides the specific lived experiences and approaches of teachers who have successfully implemented laptop technology. Understanding how teachers who have been identified as effectively using laptops for the benefit of their teaching and their students’ learning can add to the discussion, including how their use of the technology has impacted their classroom practices and, in turn, student learning. This is especially true given the increasing presence of these programs throughout Massachusetts, the country, and the world. Using the lens of Andragogy and Complexity theory provides a perspective to better understand how the teachers adopted the technology to improve their instruction and their students’ learning.

Research Question

The following three research questions guided this study:

1. How do teachers identified as effectively integrating technology in their instruction perceive their journey to successful integration?
2. How do they perceive technology integration as impacting their teaching?

3. How do they perceive technology integration as impacting their students’ learning?

Research Design

This study looked to closely examine seven teachers who were identified as effectively integrating technology for the improvement of their instruction and their students’ learning. As such, a qualitative approach is appropriate, as it focuses on the perceptions and experiences of individuals in response to the opportunity to integrate the use of technology in their instruction with the advent of their school’s 1:1 laptop initiative. Many of the studies found in the literature review on the topic of student learning and achievement were quantitative and based on students’ standardized test scores, attendance, discipline data, GPA’s, or responses to teacher/student responses on Likert-scale surveys. That type of approach does not yield the rich lived-experiences that allow one to see the nuances and detail that is found when one actually talks to the practitioners. Merriam (2002) underscores the constructivist idea that meaning is socially constructed by people as they interact with and within their own world, saying that, “…the world … is not the fixed, single, agreed upon, or measurable phenomenon that it is assumed to be in positivist, quantitative research” (p. 3). Rather, Merriam (2002) points out the position that one’s interpretation of reality is contextual and changes/adapts over time and that qualitative researchers are interested in those interpretations over time to learn how “… individuals experience and interact with their social world” (p. 3). Creswell (2012) maintains that qualitative research is appropriate when there is a need for a complex, detailed understanding of an issue, which can only be established by talking directly with people, and allowing them to tell their stories. Such is the case with this proposed study, which is dependent on the experiences and interpretations of the participants with respect to 1:1 laptop integration/implementation and its
impact. The topic of laptop technology in the classroom is one that is highly contextualized with regard to the perceptions and practices of each teacher making the pedagogical choices for how that technology will be utilized. Thus, for this study, having the ability to examine the lived experiences and perspectives of teachers around the implementation and impact of a laptop program on their classroom pedagogy and their students’ learning was most appropriate.

**Research Tradition**

There are a number of qualitative approaches one can utilize including grounded theory, phenomenology, discourse analysis, narrative analysis, ethnography, and case study (Merriam, 2002; Thomas, 2006). The approach described by Merriam (2002) that is best situated for this study is the basic interpretive study that is focused on “… how individuals experience and interact with their social world and the meaning it has for them” (p. 4). Merriam (2002) describes the key characteristics of interpretive qualitative research designs, citing: the focus by researchers on understanding how the subjects make sense of their experience, the primary role played by the researcher in the collection and analysis of data, the inductive approach utilized by the researcher to identify recurring patterns or themes, and the end product that uses rich descriptions to convey what was learned. Data are collected through interviews, observations, and/or analysis of documents. (Merriam, 2002)

Thomas (2006) discusses the importance of the researcher using an inductive approach with regard to the data collected from qualitative inquiry as opposed to a deductive approach. The inductive approach has the researchers gather raw data to identify, interpret, build, and discover themes, categories, or theories (Merriam, 2002; Thomas, 2006). Thus, the inductive approach allows “… research findings to emerge from the frequent, dominant, or significant themes inherent in the raw data, without the restraints imposed by structured methodologies”
(Thomas, 2006). This is as opposed to a deductive approach that tests to what extent the data conforms to prior assumptions or hypotheses. Given that the goal of this study was to understand how teachers identified as effectively integrating technology for the improvement of their instruction and their students’ learning perceived the impact it has had on their pedagogy and student learning, it is clear that a basic interpretive study utilizing inductive analysis to identify common or recurring themes between practitioners was most appropriate.

**Participants**

It is essential that the participants of this study were able to provide rich and detailed information “… from which one can learn a great deal about issues of central importance to the purpose of the research.” (Patton, 1990, p. 169) Thus, participants of this study (7 full time classroom teachers from different content areas) were purposefully selected (Merriam, 2002) from a middle-high school (grades 6-12) in southeastern Massachusetts based on criterion sampling (Miles & Huberman, 1994). The reason for the number of teachers was to ensure that all members participated in the entire project and to ensure that their rich lived experiences were investigated and documented fully. The school implemented a grades 7-12 1:1 laptop program in 2014 where every student received a Macbook Air. Teachers were given Macbook Airs in 2011. The purpose of this study was to examine the perceptions and experiences of those teachers identified as having effectively implemented 1:1 laptops in the classroom. Thus, it was necessary to identify who these teachers are within the building. The criteria for purposeful selection centered on the SAMR model (see Figure 1) developed by Dr. Ruben Puentedura that has been utilized by the school to identify transformative experience utilizing technology. This model identifies the different levels of technology integration from the basic substitution to the higher order use to redefine learning tasks that were previously inconceivable before 1:1 laptops.
Grade 7-12 Subject Supervisors, who oversee the implementation of technology in their respective content areas will be asked to identify teachers within their departments who are consistently implementing 1:1 laptop technology at the modification or redefinition level. Additionally, the school system sponsors an Apple training module for teachers called *Apple Core* that is a semester long sequence that has teachers develop units of study that integrate activities that are at the modification and redefinition level. Teachers have been exposed to the SAMR model since 2012. Teachers who had been identified as having utilized the SAMR model to develop consistent activities that lie within the modification and/or redefinition level of implementation were targeted for participation in this study.

*Figure 1.* SAMR Model

Targeted participants were seven regular education teachers in different content areas who have been identified as effectively integrating technology for the improvement of their
instruction and their students’ learning at the classroom level and teachers who have completed the Apple Core program. The goal was to have as much variance in the content areas taught, race, gender, and years of teaching experience as possible. As the researcher was also the principal of one of the schools in the study, it was of utmost importance to differentiate the role as a researcher as opposed to their supervisor.

**Recruitment and Access**

To recruit participants, the researcher contacted the Superintendent of Schools for the specific district targeted for the study (Appendix A). The researcher provided specific information about the goals and methodology of the study in order to receive permission to conduct the study in the district’s grade 6-12 building. Upon receiving permission, the researcher contacted the Subject Supervisors and the Apple Core trainer and shared the goals and purpose of the study, along with the criteria for possible subjects. Once the researcher received names of possible participants, he sent a recruitment letter (Appendix B) to each individual introducing the purpose of the study, along with an invitation to participate in up to two semi-structured interviews. The letter clearly identified that the purpose of the interviews was solely connected to the research study and in no way was evaluative or connected with their respective job or job performance evaluations. The researchers also specified that the interview site and times would be based on their comfort and convenience. Pseudonyms were also be utilized for each participant, the school district, and town in order to protect the confidentiality of the participants and the district. All of these caveats were be focused on providing a setting where the participants were comfortable speaking candidly about their experiences and perspectives.
Data Collection

Creswell (2013), Rubin and Rubin (2012), and Seidman (2013) inform the process by which identified purposefully sampled participants will be interviewed to provide the data for the study. As Rubin and Rubin (2012) state, “In the responsive interviewing model, you are looking for material that has depth and detail and is nuanced and rich with vivid thematic material” (p. 101). The data collection consisted of two semi-structured face-to-face interviews per participant in order to provide the rich descriptions of their perceptions of the impact of the 1:1 laptop program on their pedagogy and student learning. As opposed to an unstructured interview, the semi-structured interview is connected to a specific topic or research question with a limited number of open-ended questions prepared in advance with room for follow-up questions or prompts that can provide depth, nuance, and richness to the teacher responses (Rubin & Rubin, 2012). Additionally, participants were invited to share documents and online resources including lesson plans and student work samples as examples of their use of 1:1 laptops in the classroom setting. For any documents used in the dissertation, it was ensured that all names or identifying words were redacted.

The interviews were approximately 45-75 minutes in length depending on the participants’ responses to follow-up questions and prompts (See Appendix C & D). Rubin and Rubin (2012) discuss the general structure of a responsive interview where the interviewer introduces him/herself and the topic being studied and its significance both to the field and to the individual teacher involved. This was followed by a progression of questions that were core to the study. The overall point of this approach was to make the interviewee comfortable and to establish trust and rapport through small talk, listening, and empathy (Creswell, 2013; Rubin & Rubin, 2012; Seidman, 2013). Most of all, the interviewer needed to “… communicate that you
are interested in what they are saying and trying to learn from them” (Rubin & Rubin, 2012, p. 109). Thus the first interview started with a preliminary conversation that introduced the purpose and importance of the project, background questions around the number of years of teaching experience and subjects taught, and an overview of the informed consent process for participation in the study. Subsequently, questions were asked about the participants’ teaching style, philosophy, and technology perspective before the laptop initiative. Further questions then asked the participant about the other factors that made it possible to integrate technology into the classroom and the perceived impact on the participants’ teaching and assessment approach, as well as student engagement and learning. It should be noted that the researcher made sure that any responses, follow-up questions, and/or prompts were not judgmental so as to convey any potential bias to the participants.

Prior to the second interview, each participant was asked to bring 2-3 exemplary lesson and/or unit plans, projects, handouts, and student work samples that resulted from implementation of 1:1 laptop technology in the classroom setting that they feel are illustrative of how they have used 1:1 laptops to enhance their teaching and their students’ learning. The questions were open-ended and asked the participants about how they came to develop the plans, projects, and assessments as they did, and how they consider this to be a change in their respective pedagogy and impact on student engagement and learning.

**Data Storage**

All interview data was collected using QuickTime on this researcher’s Apple Powerbook. Additionally, the interviews were also recorded on an IPad to serve as a back-up copy. All audio files were stored on the laptop hard drive and on a flash drive and were be transcribed verbatim by a transcription service (Scribie), as were any digital pictures or electronic copies of teacher
and student work. The back-up drives and any hard copy artifacts (lesson/unit plans, handouts, student work samples, projects, research journals) were kept under lock and key. Additionally, a master list of the types of information gathered was kept to track and locate key information from the study (Creswell, 2013). The only one to have access to the research data was this researcher. All coding occurred on separate documents from the transcripts.

**Data Analysis**

All interviews were recorded digitally on an Apple Macbook Pro and an IPad. Each interview was transcribed by the transcription service *Scribie* and notes were taken by the researcher with special attention was given to noting pauses and intonations in speech along with nonverbal expression (hand gestures, shrugs, etc.) that could assist with interpretation (Rubin & Rubin, 2012; Seidman, 2013). During the transcription process, memo notes were kept to record the researcher’s thoughts or ideas as well as notable quotes emerging from the interviews (Creswell, 2013; Rubin & Rubin, 2012). Codes were developed to identify the participants and all artifacts provided by the participants were stored in a locked compartment.

In approaching the analysis of the data as part of an interpretive study employing a general inductive analysis, Thomas (2006) provides guidance on the underlying strategies and principles to which one can refer when analyzing collected data: 1) the objectives of the study/evaluation guide provide a focus for the analysis but the actual findings come directly from the raw data; 2) the main focus of the analysis is through category development from the raw data that contains key themes constructed by the coding process; 3) the findings of the study result from multiple interpretations and decisions by the researcher; 4) different researchers/evaluators may develop findings and conclusions that are not identical; 5) the trustworthiness of the findings can be assessed in a similar fashion to other qualitative analysis
Thomas (2006) summarizes the main purposes of a general inductive approach that informs the data collection and analysis process, saying that, “… the researcher begins with an area of study and allows the theory to emerge from the data” (p. 238). The approach allows the researcher to condense raw text into a summary format, describe links between the core meanings derived from the texts and the research objectives, identify the most significant themes/categories that are best connected to the research objectives, and describe those themes that are most significant (p. 241). This provides a framework for the researcher when developing the sequence of data analysis.

The transcribed text went through two cycles of coding (Miles, Huberman & Saldana, 2013) that will follow the process outlined by Thomas (2006). Specifically, the transcripts were closely read and labeled by the researcher multiple times in order to gain a deep understanding of each participant’s responses and emerging categories and themes (Thomas, 2013). Seidman (2013) recommends performing this initial step on paper before utilizing any computer resources or programs. Following the close reading of the transcripts came the first cycle of coding that assigned codes to “data chunks” from the interview texts (Miles, Huberman & Saldana, 2013).

In Vivo coding was employed at this stage in order to “capture” the voice and words of the participants in the creation of meaningful patterns (Creswell, 2013; Miles, Huberman & Saldana, 2013; Thomas, 2006). Multiple codes simultaneously existed within a single passage, and it was incumbent on the researcher to identify commonalities between the In Vivo and researcher generated codes for each participant (Miles, Huberman & Saldana, 2013; Thomas, 2006). This leads into the second cycle coding that occurred.

While the first cycle of coding summarizes segments of text in the voice of the participants, the second cycle involves “… pattern coding … to group those summaries into a
smaller number of categories, themes, or constructs” (Miles, Huberman & Saldana, 2013). Miles, Huberman & Saldana (2013) caution the researcher at this stage against the identification of patterns too quickly, as further reading, analysis, and reflection may reveal that initial patterns may not be as compelling or other hidden patterns surface. The point is to be flexible and willing to reconfigure patterns/themes and consistently cross check them in order to identify three to eight compelling categories/themes that are the most important in relation to the research questions (Miles, Huberman & Saldana, 2013; Thomas, 2006). Throughout this two-cycle process, the researcher utilized jotting to record inferences, reactions, relationships, doubts and mental notes that arose from the review of the transcript data (Miles, Huberman & Saldana, 2013). Additionally, analytic memos were employed in order to allow the researcher to document deeper reflections and synthesis and capture “… thoughts that occur throughout data collection, data condensation, data display, conclusion drawing, conclusion testing, and final reporting” (Miles, Huberman & Saldana, 2013, p. 96).

As a result of these two cycles of coding and an iterative review of the transcripts, the researcher developed a limited set of themes in response to the research questions. The themes provided a succinct overview of the findings as borne out through the coding conducted by the researcher.

**Trustworthiness**

Given the focus of data collection on a semi-structured interview format with the participants, care was given to ensure trustworthiness with regard to the data collected and analyzed. Thomas (2006) itemizes member/stakeholder checks that can help the researcher elevate or enhance the credibility and trustworthiness of findings. These steps include: summarizing data immediately with the subject at the completion of interviewing, sharing
written interview transcripts with subjects, sharing preliminary drafts with relevant sections with members for review and commentary (p. 243). For the purposes of this study, each participant had the opportunity to review all written transcripts before analysis. Member checks “… enhance the credibility of findings by allowing participants … to comment on or assess the research findings, interpretations, and conclusions” (p. 244). Further, each participant had the opportunity to review and comment on the drafts being prepared that analyze and synthesize the data. Last, participants were given the opportunity to provide additional insights around 1:1 laptop implementation and its impact after they have had time to reflect on the interviews.

**Protection of Human Subjects**

The interview subjects for this qualitative study were middle and high school teachers who are teaching in their respective content areas full time. Further, these teachers were identified as effectively integrating technology for the improvement of their instruction and their students’ learning at the classroom level. The research questions focused on the perceptions and experiences of teachers who have been identified as having effectively integrated technology into their classroom instruction that has significantly impacted student learning.

The researcher initially started the process to protect the human subjects of the study by sharing with prospective participants the purpose of the research and its intended benefits. Prospective participants also received a detailed description of the selection process, how the interviews would be structured and proceed, the amount preparation that this process would entail, and the anticipated time commitment necessary for the completion of the study.

One of the main issues that could have concerned participants was that they would be interviewed by their principal in connection to their practice with laptop technology. The researcher took steps to protect the participants. To reduce the trepidation of the participants
with respect to the researcher being the school principal the point was be stressed that these teachers had been identified as effective integrators of technology, which was not pejorative in nature. Further, the researcher assured the participants that the discussions during the study would in no way be associated with the evaluation process under which teachers operate. Additionally, steps were taken to protect the anonymity of each participant through the use of pseudonyms. In addition to pseudonyms for the participants, the researcher generally described the school in which the teachers work and used a pseudonym for the institution (Creswell, 2012). The researcher also ensured the accuracy of each participant’s interview statements through digital recording and transcription. As mentioned above, these written transcripts were be shared with the teachers to elicit their feedback and validation that what was transcribed is what they said.

Limitations

Given the limited nature of this study that examines the perceptions of educators in a specific school setting in southeastern Massachusetts around 1:1 laptop integration and its impact on pedagogy and student learning, the transferability/generalizability of the findings are limited. Further limitations to the study concern the specificity of the topic, the changing nature of educational technology and the tools being utilized, and the small sample size that limit the ability to identify ubiquitous trends or conclusions.
Chapter IV: Presentation of Research Findings

This section presents the findings and analysis stemming from the interviews with study participants. A brief presentation of findings in relationship to each study participant and then an analysis across study participants will be provided. Specific findings that indicate points of comparison and contrast between the participants will be discussed along with a summary of the overall findings. All of the interview data was analyzed in relationship to each of the research questions:

1. How do teachers identified as effectively integrating technology in their instruction perceive their journey to successful integration?
2. How do they perceive technology integration as impacting their teaching?
3. How do they perceive their technology integration as impacting their students’ learning?

Study Context

This qualitative study sought to gain the perspectives and perceptions of several teachers in the selected school district regarding the integration and impact of 1:1 laptops on their teaching and on student learning. The site for the study was a suburban South Shore Massachusetts high school with a co-located Middle and High School with approximately 750 Middle (grades 6-8) and 1050 High school students (grades 9-12). The co-located middle and high school run a primarily college preparatory curriculum and are designed for a wireless 1:1 computer environment. Each classroom in the school is equipped with an interactive short-throw projector, document camera, audio assist technology, and an Apple TV device. Additionally, every grade 7-12 student has received an Apple MacBook Air that he/she keeps and can bring home for the duration of his/her educational tenure in the schools. The site was chosen primarily
for the presence of its 1:1 laptop program and the infrastructure that allows for a wireless environment throughout the school and school day.

As discussed in the Methodology section (Chapter III), the participants completed the Apple Core program run by the Apple Core Coordinator and were identified by that coordinator and/or their respective Grade 7-12 Subject Supervisors as consistently implementing 1:1 laptop technology at the modification or redefinition level according to the SAMR model (see above). The list of possible candidates meeting the above-mentioned criteria was 9 middle or high school teachers. These teachers were sent a letter describing the research project and requesting their consideration for participation (Appendix A). There were ultimately seven teachers who agreed to take part in the study (note that the names used below are not their real names):

Middle School teachers:
- 1 ELA teacher (Marta)
- 1 Mathematics teacher (Rose),
- 1 Science teacher (Sophie)
- 1 Social Studies (Mark)

High School teachers:
- 1 ELA teacher (Marge),
- 1 Mathematics teacher (Sarah),
- 1 Social Studies teacher (James)

All of these teachers participated in both semi-structured interviews (Appendix C and D) where they were free to share their perspective on the various interview questions tied to the study. These interviews were all recorded, transcribed, and shared with each respective participant.
Coding

Following the interviews and transcriptions (using Scribie, which is a paid transcription service) a two-cycle process was used to categorize and recognize emergent themes from the participant’s responses. Initially, in-vivo coding was conducted that used direct language from the participants as they pertained to the research questions. Additionally, interview notes were taken by the researcher and analyzed. Pattern coding was utilized to identify, from the language used by the participants, emergent common themes within each research question. This particular cycle was useful to identify deeper meaning across participant responses with regard to each research question and with regard to the identification of key findings discussed in Chapter V, their connection to the literature review, and to the theoretical framework of Constructivism.

Participant Description

The following section introduces each participant in the study. Its purpose is to provide the reader with an understanding of each teacher’s background, level of experience with technology, their respective teaching philosophy, their first personal experiences with technology, and their perceived journey to technology integration as teachers. The names given to the teachers in this summary are not their real names.

Rose (Math). Rose is a middle school mathematics teacher who is in her third year of teaching, all at the middle school in the district where this study occurred. She has taught seventh grade pre-algebra and eighth grade algebra and is currently teaching sixth grade math at the “moderate” and “honors” level. As a teacher, she “has never known life without technology” and came to the school and teaching the same year that the co-located building opened and the 1:1 laptop initiative was started. Thus, she has been integrating technology tools into her classroom instruction from the start. Her teaching philosophy is centered on the idea that, “…”all
students can achieve” and that, “…students learn best when they’re comfortable and they’re given opportunities that suit their abilities…” She also stated that, “I want everyone to feel comfortable … like they’re involved and it’s their classroom and it’s their ideas…” [because] “…not every student learns the same way.” Along those lines, she described her desire to run an inclusive classroom, saying, “I don’t like seeming like a dictator in my class. I want everyone to feel like they’re very involved and it’s their classroom and it’s their ideas.”

Sarah (Math). Sarah is a veteran high school mathematics teacher who has taught for 12 years, 8 of which have been at the study site. Prior to coming to this school, she taught primarily Algebra, Trigonometry, and MCAS mathematics review. Coming to this school, she initially taught Geometry and Pre-Calculus at all levels as well as a Fundamentals of Business course. For the past two years, she has primarily taught Calculus (AP, Honors, and College level) to upperclassmen. In her prior and current schools, she has been an integrator of technology in the classroom and interested in finding ways to engage students with one another around the subject matter. Her teaching philosophy is focused around the idea that, “…students learn best through a variety of methods … small groups, practice individually and in small groups, projects, discovery learning as well, project based learning.” Sarah pointed out that her practice when she began teaching did not reflect this key point, saying, “I was very lecture focused when I started.” She learned over time and experience that, “… kids respond much better when they work and learn from another.” She discussed coming to the realization philosophically that, “… the biggest thing is kids learning from one another. And hearing it through someone else’s voice besides mine … I don’t give them everything they need necessarily.” Interestingly, before technology access became ubiquitous, Sarah felt that, with regard to having students explore and teach themselves, she “… wasn’t very good at it.”
**Marta (English).** Marta is an 8th grade English teacher at the research site. She has taught that grade level exclusively at this school for the past 17 years with an additional 3 years of experience at a different school where she taught 7th and 8th grade. She taught for 3 years, took 7 years to raise her children and came to her current position in 2000. Marta is also the director of the Middle School mentor-mentee program to support new teachers to the school. Her first experience with technology was that she had none other than typewriters when she was a student both at the secondary and postsecondary levels. It wasn’t until she came back to teaching in 2000 that she experienced technology personally and professionally. Thus, she had a transition with regard to how she integrated technology into her already established teaching practices. Marta’s philosophy is multi-faceted an centered her desire to, “… engage students and get them to love learning and to be thinkers.” She tied this overarching goal to her focus on helping students gain a foundation around reading, writing, speaking, listening and critical thinking skills so that students can make connections and communicate them (text to self, text to world, text to other texts). Marta also focuses on creating a safe environment, encouraging her students to, “…put their thoughts out both verbally and in their writing and be comfortable doing so.” Last, she articulated the importance of meeting students, “… where they are … you have to be flexible and meet them where they are in order to help them succeed.”

**Marge (English).** Marge is a high school English teacher who has taught for eight years, the past seven of which have been at the research site. Having grown up with access as a high school student to Google News and interactive programs like *The Oregon Trail*, she has been able to see the bridge between her own initial experience with educational technology and her current practice which has helped her to envision ways to integrate laptops meaningfully into her practice. Marge summarized her teaching philosophy as being focused on helping her students
feel, “… comfortable to be uncomfortable, especially when you’re teaching books, literature, concepts of the human being.” Without the ability to be comfortable talking and writing about uncomfortable subjects or topics, Marge doesn’t feel one can push students to take risks or challenge their assumptions. The overall point to Marge is to make literature relevant to students so they can, “relate what we're doing to their world in some way. How does this impact them?” A last key plank in Marge’s philosophical platform is the focus on writing and finding ways to, “…get them to understand why the literature is important. And I push myself to push that, because I know that that's probably the more difficult aspect of the job.” Her utilization of technology has focused on finding resources to allow students the ability to connect the literature to the world around them.

Mark (Social Studies). Mark has been a middle school Social Studies teacher for twelve years after teaching for three at another middle school. His experience with The Oregon Trail and the Logos program in elementary program, as well as having received a certificate of excellence in technology in school made technology for him, “… always fun for me to use. I was kind of drawn to it early.” His teaching philosophy has evolved over time but is centered on finding multiple ways to present and expose students to the material. “I've always felt that giving them... direct instruction, self-paced, getting into different kind of those multimodal type of a thing to do, to try to expose them to different ways of learning has always been the best way.” Over the past two years, he has focused more and more on self-paced mastery activities as an avenue to engage students. His utilization of instructional technology has been centered on the use of Google Slide Decks and running a “gamified” classroom in order to achieve those two focus areas.
James (Social Studies). James is a third year high school Social Studies teacher who also spent four years abroad as an English as a Second Language (ESL) instructor. His Social Studies teaching career began at the research site the same year that laptops were given to all of the students in the building. His approach to teaching is centered on the idea that, “Student's learn best when they're … actually grappling with a challenging question that they're actually curious about or interested in. Sort of working through something that they want to know more about that's connected to their life in some way or that they feel is relevant or that they feel is interesting.” Thus, his practice has been focused on presenting students with questions that do not necessarily have a right answer and presenting them with sources that disagree that, “…emphasize this idea of history as an interpretive discipline.” His utilization and integration of technology has been focused on finding ways to provide access to “different perspectives.”

Sophie (Science). Sophie has been, other than one year of student teaching, entirely at the research site middle school for the past five years. Interestingly, she also cited The Oregon Trail as a program she used in elementary school as providing her with an influential exposure to instructional technology. With regard to technology, she sees herself as having “… one foot in the traditional ways of your and one foot in the digital information age.” Her philosophy is focused on the idea that “… students learn best through different experiences and at their own pace.” Further, her practices and teaching style, “… encourages students to be independent, advocate for themselves, go back to something they were given if they don't understand it quite yet, revisit something, and problem-solve when they're stuck. This has helped them find answers to questions through provided material, but at their own pace.” Her perspective with regard to the impact that technology access has had on her teaching is that it is “completely different” now.
It was interesting to note that, while all but one of the teachers (Marta) had had experiences with technology in elementary school, none of them noted the utilization of technology tools in their high school classrooms. Of the participants, only one (Rose) discussed an experience in their respective college where technology was utilized in the classroom beyond the submission of assignments and the use of projectors in class. In other words, other than one exception, none of the teachers had experiences where instructional technology was deeply utilized as a teaching and learning tool. Those experiences have come to them as teachers at the research site.

Emergent Themes

With regard to the research questions, several common themes were identified from the coding process that are significant factors in the participant’s perception of their journey to successful integration, its impact on their respective teaching and student learning. The following sections present these themes according to the research questions. Following these sections, I review the challenges with regard to 1:1 laptop integration discussed by the interviewed teachers.

Research Question 1: How do teachers identified as effectively integrating technology in their instruction perceive their journey to successful integration?

The following emergent themes were identified upon review of the interview transcripts for the seven participating teachers.
All of the teachers espoused a similar approach to teaching and learning.

Seeing where education is going and the possibilities technology integration presents were key factors to integration.

Consistent access to reliable technology, professional development, and collaboration were keys to full integration.

Administrative support and teacher’s trust to experiment were essential.

**All of the teachers espoused a similar view of teaching and learning.** As mentioned above, the teachers interviewed were identified as high-level integrators of technology in their classroom activities and represented different academic areas (Math, Science, Social Studies, and English). They also represented high school and middle school perspectives. Given this, they were consistent with the belief that students learn best through different, multi-modal experiences that often involve cooperative learning. As Sarah stated, “Kids respond best when working with one another.” Additionally, the teachers were clear with their views that authentic learning occurs when students are engaged and provided with experiences that give them choice, are self-paced, and push them to make connections to their own lives and experiences. Marge underscored this when she said, “They need to relate what we’re doing to their own world in some way.”

Underpinning these beliefs and practices is the desire of all of the teachers to push students to be independent thinkers and to get them to used to, as Mark put it, “different ways of learning.” James articulated that this ethic of engagement is best seen when kids are “…grappling with a challenging question and … working through something that they want to
know more about that’s connected to their own life or in some way that that they feel is relevant or that they feel is interesting.” Marge further articulated a common desire of all of the participating teachers that students feel comfortable in and out of their classrooms taking risks, sharing perspectives or opinions, by saying, “I like to call it a place where they feel comfortable being uncomfortable. If they aren’t comfortable being uncomfortable in your classroom and taking risks, and talking about things that might be uncomfortable, you’re not gonna [sic] be able to push them as far.” Thus, for the teachers, the point of the varied activities and approaches is to engage students in the material and push them to make personal meaning from it.

**Seeing where education is going, and the possibilities technology integration**

_**presents were key factors to integration.**_ In discussing their respective journeys to integration, the teachers all expressed a desire to explore and stay current. As Marta said that is reflective of their comments, “We have to stay current in our own practice and continue to push the envelope in terms of what can we get these kids to do?” As mentioned above, all of the teachers espoused to some extent practices aimed at engaging students through choice, self-paced inquiry that pushed them to connect the material to their own lives/experiences/perspectives. Mark reflected this when he said,

It makes it easier for me to give them the opportunity, like I said, for those choices … it's allowed me as a teacher to actually let go of the reins a little bit more, which has kind of been more the direction, from what I've seen that education's going, let the kids take control of what they're learning and dictate that stuff.

This common meaning-making approach has a clear connection to the participants’ reflective approach to their teaching and to the possibilities that 1:1 laptop technology has in
promoting their espoused approaches to teaching and learning. Sarah underscored this by saying:

Standing in front of the classroom was not where education is headed. Teaching is going out the window … where you just have someone from the front of the room. I think the technology allows [students] more creativity, more choice, … so they’re doing more ownership of their learning.

Mark characterized the possibilities of technology integration with a lens on engaging a traditionally unconnected group of students, saying,

I think we are now able to tap into a handful of kids that that’s kind of their thing where if you give ’em the avenue to be creative with technology, they can go down that road with it. I think we tap into a huge group of these kids, now that we have it, whereas before, it was more pen to paper and some kids just turned off.

James saw the possibilities with regard to the gathering of useful resources to engage students in the analysis of the grappling questions he likes to use with them, saying, “Here’s how you can do it on the web and not be responsible personally for finding those things, but allow the students to reach out and pursue that.” During the interviews, all of the teachers took time to articulate their desire to examine and improve upon their teaching approaches and made the connection to what technology can offer to help them better implement their teaching approaches and better attain their goals for student learning.

**Consistent access to reliable technology, professional development, and collaboration were keys to full integration.** One key facet discussed by every teacher on their journey to successful integration was their faith in the reliability of the technology and the ability for every student to connect to the network at the same time. This overarching trust in the
technology infrastructure came only after moving into a brand new building that was designed and built for a wireless 1:1 environment. Meaghan characterized the change in her perspective with regard to reliable technology, saying, “The old school was … where all you could think of were the bad things that could happen. But then we got here.” The importance of this level of reliability cannot be overstated, as a key barrier to technology integration occurs when the teacher does not have faith in the infrastructure supporting a particular activity or project.

Access to high quality professional development was also noted by each teacher as a factor in his or her journey to integration. The participants all noted sustained professional development support as being key in helping them to learn how to use the technology tools. This approach to PD took different forms, which resonated with the teachers in different ways. Marta noted, “Just the district putting out all of the options has been so helpful sending us and keeping us ahead of the curve, and keeping us current.” Having access to topic-specific workshops on Google suite topics (Google Docs, Google Classroom, Google Sites, Google My Maps), BriteLink, Smart Notebook software and the Schoology Learning Management Platform (LMS) were specifically referenced by the participants as being helpful. Additionally, each participating teacher was able to attend the annual Massachusetts Computer Using Educators (MassCUE) technology conference, which offers three days of presentations and workshops on technology integration topics. For three years, the school system offered teachers the option of attending a “Tech Camp” after school ended in June for which they were paid. This offering had local teachers presenting and working with their colleagues on a number of technology tools and applications.

At the onset of the school year that laptops were initially distributed to students, the school system paid for Alan November to address the staff on the many different ways that
laptop access could fundamentally change their teaching. James, after hearing and seeing Mr. November’s discussion of the possibilities found in Google Sites said, “My mind was blown.” Last, the system offered the semester long Apple Core class (mentioned above) taught by an Apple certified trainer. For Sarah, “The Apple Core class exposed us to all the different software, or all of the different packages that Apple has from Garage Band to iBook, iTunes … using those in the classroom.” For James, “Having access to professional development … to go to something like MassCUE, … I would have these different moments where I would get exposure to something and say, ‘Oh, that’s cool,’ That would completely work with what I want to do.” The result of the varied PD opportunities that were available was that each of the participating teachers had different access points to technology integration tools, ideas, and/or applications that resonated with them.

A last key resource in the journey to integration stressed by all of the participating teachers was the importance of collaboration. For some it was tied to formal opportunities during department or faculty meetings to meet with colleagues and discuss different ways they were utilizing technology tools in the classroom. For Sarah, the Apple Core class, “… had different projects related to different [software] packages and then we were presenting them in class and it was neat to see how different teachers incorporated them into their class and how we could make use of that in math classes.” Another formal opportunity specifically mentioned by high school teachers was utilized during a portion of nearly every faculty meeting, called “Tech Share.” This activity had 6-8 teachers in interdisciplinary groups each present for 3-5 minutes a specific technology approach, tool, or application that they found to be useful in the classroom. Each tool was described with related links on a Google Doc that every teacher could access. Thus, each teacher was able to talk about 6-8 different approaches to integrating technology
while also being able to access those utilized by nearly 100 teachers. While the formal collaboration opportunities were seen as being very useful to the participants, they all discussed the power and importance of the many informal collaborative discussions they had vis a vis technology integration. Sophie said,

Talking to teachers, informally, all the time has helped us try things and problem solve. At the lunch table, I’d be like, ‘What did you use for an infographic?’ And you just find a website and then you just try it, and then it’s done. So communication I think, has made it possible.

Sarah noted the importance of the, “… little conversations to hear how they were using it in their classrooms.” Mark summed up the sentiment of the participants best by saying,

Honestly, it really does come from that base of just working side-by-side with (two other social studies colleagues), and just experimenting on things, finding thing, talking it out and then going from there.

Thus, reliable technology, consistent and varied access to focused PD opportunities, and the importance of formal and informal opportunities for discussion, modeling, and collaboration were all noted by the participants as being key factors in their journey to integration.

**Administrative support and teacher’s trust to experiment were essential.**

Administrative support was reported by the participants as being essential to their effective integration of laptop technology into their practice. One aspect of this support was in encouraging and financing the teachers’ participation in the multiple PD opportunities. Another aspect of administrative support was in their presentations and modeling during meetings of effective technology integration practices. Rose characterized this by saying, “My department head has really demonstrated this to us and I’ve always thought it was great.” Active
administrative encouragement to teachers to experiment and take risks with different approaches in the classroom utilizing technology were noted by all teachers as significant to their implementation. Marta said, “I had people in administration and tech saying, ‘Go for it. Who wants to try this? Will you show others?’” Mark described the importance of this encouragement,

I think the biggest thing that allowed me to get to this point is that, at every level, I’ve had an administrator or a department head that was like, “Go ahead and do that. Go ahead and take the risk at it. Take a shot at it. If it doesn’t work, not a big deal. They were happier that I was taking the risk at trying something different that wasn’t in the norm. It’s allowed me to be more creative. It’s allowed me to find different ways to do things.

As important as the encouragement was the trust between the participants and the administrators that was described. Mark characterized this trust by saying,

It definitely gave me the space. That if I knew that if I go and try this… when it came to evaluations that was always my biggest fear. If this thing bombs, what’s that gonna [sic] mean for my evaluation? Across the board they were all like, ‘Don’t worry about it. I understand you’re taking a risk, you’re trying something new. If it doesn’t work, that’s fine.’ So that was a huge part of it, having that kind of support.

James described the impact of this trust by saying,

Having the social studies department heads just say, ‘You’re not being judged on it. Experiment. Try it out,’ has been really positive. That has helped me on the path to being comfortable with using it, the exposure to interesting ways of using it. But also the space to try stuff.
Thus, administrative rhetorical and financial support to participate in PD opportunities, the clear support for technology integration through demonstrations/modeling, active encouragement to experiment in the classroom, and the ubiquitous trust that the participants had in their administrators were all noted as being key elements in their respective journey to technology integration. Marge summed up the impact of administrative encouragement and trust on her shifting practice, saying, “It was [administrators] saying, ‘If it doesn’t work, at least try it.’ You have to believe that that’s gonna be okay or else you’re never going to change anything.”
While each teacher had individualized and unique aspects of the journey to their high-level integration of 1:1 laptop technology into their practice, there are clear themes that emerged among them as they each addressed the above-mentioned research question. They all strive to utilize student choice, collaboration, and self-paced learning in their practice to make content relevant. They all have reflected on where teaching is headed and how technology can assist them in their teaching and learning approach. They all underscored the importance of reliable technology, consistent and focused PD, and the presence of formal and informal opportunities for collaboration. They last articulated how essential administrative support and mutual trust was in this process.

**Research Question 2: How do the identified teachers of this study perceive technology integration as impacting their teaching?**

While each participating teacher was in a different place with regard to their teaching practice and their professional growth, there were common themes that became evident with regard to the impact of laptop technology on their teaching approaches and creativity, their willingness to give up control, “fly blind,” and not be the expert, and in the efficiencies technology provides.
The four themes identified from a careful review of the interview transcripts were as follows, as presented in Table 2 and discussed below.

Table 2

*Themes: How do teachers identified as effectively integrating technology in their instruction perceive the impact of technology integration on their teaching?*

| Technology integration spurred changes in teacher pedagogy and creativity. |
| Technology pushes teachers to cede control, give students more freedom, and “fly blind.” |
| Laptop technology provides a number of efficiencies. |

**Technology integration spurred changes in teacher pedagogy and creativity.** With every teacher interviewed, there was a common perception that the integration of laptop technology has had a profound effect on their pedagogical approaches and teaching practices. Additionally, each teacher discussed the fact that the presence of such technology and their journey to integrate it into the classroom environment has pushed them to be much more creative. Marta echoed this when she said, “It’s fully changed the way I teach and present materials. It’s made me a more creative, more efficient, more engaged teacher with my students in many ways.” Sophie echoed this by saying, “I think my teaching philosophy shifted from a direct instructor class setting where I almost felt like it was herding a group, to get to the end of that PowerPoint or the end of the lecture in order to do an activity. Now, direct instruction, though meaningful is so much smaller in the grand scheme.”

In Marta’s case, she specifically identified her teaching of grammar where she said, “I think I was far more lecture-based. Not as active and engaging.” Her discussion of her practice with regard to grammatical concepts before and after the integration of laptop technology
provides a lens that is reflective of the other teachers’ pedagogical changes and creativity. Before 1:1 laptops, she would introduce a grammatical concept and/or rule on the chalkboard, students would practice the application of it on a worksheet and have some form of written assessment. With the introduction of laptop technology, she has completely changed her practice. Now she assigns grammar videos for homework that teach the concept. In class she has them use NoRedInk, which has them apply the concepts with an interactive program. During that time, she circulates to each student and monitors their mastery by analyzing the data. If she sees that students are struggling with a concept (ex. Subject-verb agreement), she can provide “just-in-time” instruction and then further analyze the data to determine if students have demonstrated mastery. At the end of the grammar unit, she has the students create their own Screencast grammar tutorial and post it for the class and then gives them a written assessment. As a result, students have multiple access points to the concepts with multiple ways to demonstrate their understanding and mastery. This type of pedagogical change and deepening of student understanding, along with pushing students to create products that demonstrate their understanding was a common progression with all of the participating teachers.

Technology pushes teachers to cede control, give students more freedom, and “fly blind.” A powerful impact that laptop integration has had on the participating teachers is with regard to their willingness to be flexible, give up control, give students more freedom, and “fly blind.” Every teacher made a particular point of this impact on them and how laptop integration has pushed them to cede control of both content acquisition and interpretation to the students. The result of ceding control of the mode of content delivery/acquisition and assessment is a pedagogical approach Marta characterized as an embracing of “controlled vagueness.” This approach is one that removes teachers from being at the center and replaces them with the
student. Each teacher reflected this shift in their respective thinking with regard to their role in the learning process.

Marge said,

I’m much more willing to give up my own spot where I’m giving them the information all the time … I feel more open to allowing them to explore their own ways that it is impacting them. I feel more open to allowing them to explore their own ways that is impacting them rather then me always being the one bringing, “Look this affects you because of this.” They can find that out and giving up that control factor that so many teachers love, you start to feel more comfortable with… they’re going to come up with something. Maybe someday I’ll be like, “I have no control!’ And it’ll be a good thing.

Sophie said,

That is the big thing that happened with computers. You start to let go of the reins. It's not all about "Yes, I wanna get to certain parts of the lesson that day and there are some things I want to informally check in with you about daily", like a "do now" or a small quiz on what we just did but not feeling like you need to know when something's gonna end all the time. Because when you get into projects … it's about them figuring out what the important material is and how to get the important material from here to there.

Mark stated,

It makes it easier for me to give them the opportunity … for those choices … It’s allowed me as a teacher to actually let go of the reins a little bit more, which has kind of been more the direction, from what I've seen that education's going, let the kids take control of what they're learning and dictate that stuff.

James said,
… And it's so nerve-wrecking to be that open ended with it, but the fact that they ran with it and it allowed for different students with different abilities and interests to be drawn to the thing that they wanted to do … it opens up the opportunity to give students greater freedom to determine their path of getting somewhere. It opens up the opportunity of having students be the ones that find the different perspectives in the different sources rather than me on the front end, putting them in front of them and saying, "Compare these." It opens up just greater choices for them, "I wanna look into this tied to this main idea," that they can do that. And from a teaching perspective to allow that.

With each of the above-mentioned teachers, a clear shift has occurred that has pushed them to find ways to step aside and provide students with opportunities to make meaning for themselves. Such an approach has resulted in much more open-ended types of projects that require students to develop their own approach and interpretations. Marta reflected this by saying, “Sometimes I keep it so wide open, where you have an essential question and you’ve got your guidelines and give them, ‘Here’s your proposal plan. You guys make the decisions. You have to hit these certain criteria, but… you have the freedom to show me what you know in whatever type of way you want to.” This pedagogical shift has also had an impact on the mindset that students must employ with regard to their own learning that will be discussed below.

Another facet of giving up control discussed by the teachers was with regard to them knowing exactly how the open-ended assignments or inquiry-based activities were going to turn out. As James discussed, “there's a degree to which I'm doing it blind now, and then need to go back and refine, where I can't show them an exemplar because we haven't done it before, and I don't completely know what an exemplar looks like because I sort of have an idea of what I want them to do and what would look really strong, but I'm seeing where it goes.” Because of the
broad range of access and directions that students can take, the teachers have had to develop some level of acceptance that they do not have specific exemplars or products yet to guide students around the creation of products. Additionally, each teacher discussed the reality that, with the ever-changing applications and programs available to students, they have embraced the idea that it is acceptable for them to not know the technology going into an activity. The understanding of the technology is in the hands of the students. In both cases, the participating teachers have embraced the idea that, in many ways they are, as James phrased it, “flying blind.” Sarah reflected both of these points when she said,

The projects… I didn’t know how they were going to turn out. I didn’t know enough about the software myself I didn’t feel like, to help them. And they figured it out or knew it on their own. So, assigning something that I wasn’t going to be a great resource on they knew how to either find the tools or use the tools to make it effective for them. But if they didn’t know how to use it, I wasn’t a great resource for them… But they were so quick about it that it wasn’t long. They knew it from other classes or they knew how to figure it out. They were also great at helping one another. Someone would ask a question aloud and someone else would tell them how to do it before I could even pretend to know what I was talking about.

Sophie encapsulated a similar perspective with regard to her needing to be an expert in the technology applications. In discussing her use of a new application call instaGrok (a tool that allows students to create concept maps that can be customized and shared), she pointed out that she had discovered the application on a blog and decided to try it out with her classes without really knowing how to use it herself. She left that to the students, stating that, “My new thing is "All right, we're just trying this out, don't need to use it forever. Let's stick with it and tell me if
you figure it out. I don't have an answer right now, you might need to start over, see if you figure it out … You problem solve because we're not masters at all of this stuff. We're just trying it, we're learning how to when something goes wrong, fix it to accommodate whatever the assignment is.” Thus, a consistent impact on the teaching practices of the participants has been the need to develop a flexible approach to their instruction that allows them to take instructional risks and experiment with assignments, activities, and technology applications for which they do not know the outcome. While each teacher discussed the freedom that this outlook has given them, they have all characterized it as being “nerve wracking” or “unsettling.”

**Laptop technology provides a number of efficiencies.** From the perspective of the participants, laptop technology access allows teachers and students to do things that, heretofore, were never accessible in a classroom setting. Specifically, it allows access to information, saves time, allows for the archiving of exemplars, as well as communication to/with kids with respect to discussions, questions, and feedback.

With regard to the access to information, the presence of laptop technology has expanded the ability of teachers to have students find resources and to broaden the exposure to different perspectives. As stated by Marge,

*Before technology, if you wanted to do anything to try to relate it to the world today, you would really have work to get access to outside sources. Now, if something comes up in a classroom environment and someone says, ‘What about this?’ You can kind of stop everything and say, ‘Let’s explore that for a second.’”*  

In discussing the analysis of the presidential inauguration speech she said, “[Before] it was scrounging through newspapers for three days leading up to it trying to find stuff. Now, I could live stream to them the presidential inauguration and have them read different types of writing about it.
James and Mark discussed the issue of trying to give students different perspectives around a particular historical topic (ex. The Opium Wars or The Growth of Islam). In the past, they had to find print sources available and photocopy them for each student, which was very time consuming. Thus, each student would have at best one to two examples of how different countries viewed the Opium Wars. These would be the only sources available to students. Now, students can access Google Sites real-time in order to find perspectives they think are pertinent or illuminating without artificial limits to their access to information. Marge discussed her unit on slavery that has students reading Frederick Douglass and *The Adventures of Huckleberry Finn*. Her desire was to have the students gain an understanding of where modern slavery exists and how it is manifested in order to compare that to the perspectives and defenses for slavery present over 150 years ago. Sarah discussed another aspect with regard to access to information, where, “we can miss a class on snow day and I… with video I can still … direct them where to go if I’m going to be out or, … even if there’s an assignment for homework, there’s so many more resources for them. None of this expansive access would have been possible without the presence of laptop technology in the classroom.

All of the teachers interviewed discussed the amount of time that the ubiquitous access to laptop technology has saved them and their students. In terms of preparation, the teachers discussed the efficiency of being able to scan one document or set of questions and distributing that to students electronically through the learning management system (LMS), as opposed to physically cutting and pasting and photocopying the same information up to 120 times. Additionally, Marge and Marta discussed class activities where they had students create a collage to reflect the key theme for a given novel (ex. Symbolism in *The Old Man and the Sea*). In the past they used collected newspapers and magazines (used by multiple classes of students) and
physically cut out words and images to paste onto poster paper. These activities would take up to six classes and were limited to what the students were able to physically find in the limited stock of resources. With laptop technology, they now have students use Glogster to create in a fraction of the time interactive posters, or Infographics that allow students unlimited written and visual resources to create their posters. Rose and Sarah discussed how they are able to use Desmos to have students in online groups create and annotate visuals where they apply coordinate geometry to pictures with a graph superimposed on it. In the past, students had to hand-draw such depictions, which took more time and space.

Another important efficiency discussed by the participants that technology allows is the ability for teachers to efficiently archive notes and student work from year-to-year. In the past, student projects (dioramas, posters, tri-fold projects) took up an inordinate amount of space, which made it difficult to transport, grade, and store. The same was true for work completed on the board. Marta said, “I tried to vary presentation but it was very labor intensive. It was a great deal of prep time. Great deal of paper resources over and over again. And you could never save. I would have the greatest things on the board. I didn’t have a cell phone. I couldn’t even take a picture of it. And you’d erase it all.” The advent of laptop technology has made it possible to have digital copies of student work and class notes for years on end. This has helped teachers with their own pacing and planning, and allows them to utilize past examples of similar projects to give students exemplars to help focus their own work. The ability to archive class notes gives them a very efficient means to help students who missed class the ability to catch up to the rest of the class.

A last efficiency discussed by the participants that technology allows is in the area of communication. As Marta said, “I can communicate with my students and parents 24/7, on
various platforms, whether it’s email or Schoology, and they can reach me as well.” Such access allows them the ability to address student questions or misconceptions beyond the class period. Additionally, the ability to construct and run online discussions on particular topics was cited by the teachers as being a highly efficient means to have every student participate and share their perspective. Assessment was an area highlighted by a number of the participants who cited the ability to create formative assessments that students can take online and receive instant feedback on their performance. As Marta said, “Grading online has made me more efficient and the immediate feedback for students. If I give an online quiz, they click the submit button and they’ve got their answers. They know and then can ask questions and the learning is deeper and more immediate as opposed to years ago, it would take me several days to get 120 quizzes done.”

Rose discussed the same efficiency and how she has expanded on it, saying, “I display it for all of them to see the whole class statistics … “if it’s multiple choice question that I gave them it breaks a, b, c and d down and show the percent of students that answered … then I have them come up with reasons why certain students got it incorrect and where they think their reasoning or their math strategy went wrong and how they avoid it the next time around.” James discussed the importance of being able to give real time feedback on student writing, citing an activity he runs where students in online groups give focused writing comments via Google Docs at the same time.

Thus, from the perspective of the participants, there were a number of common themes that arose from the examination of the impact that laptop technology has had on their respective teaching practices. Each teacher was able to articulate concrete pedagogical shifts that he/she undertook as a result of the laptop technology. With their increasing willingness to move away from more traditional modes of content delivery and need to deeply understand every
technological option available to students came an increasing ability/willingness to develop creative approaches to teaching and learning. These creative approaches were centered on the teacher taking a step aside and giving students more freedom to find resources, interpret their significance, develop conclusions, and utilize the technology to develop unique ways to demonstrate their understanding/mastery. Marrying these pedagogical shifts with the numerous articulated efficiencies allowed by the access to laptop technology indicates a profound effect that such access has had on the participants’ teaching.

**Research Question 3: How do they perceive their technology integration as impacting their students’ learning?**

With regard to the perceptions of the participants of the impact of technology integration on student learning, there were common themes arose. In particular, each teacher discussed the changes that occurred in terms of the mindset that the students needed to have once the pedagogical shifts discussed above occurred. Additionally, they were very clear in articulating their respective perceptions that technology integration and the instructional/pedagogical shifts it has spurred engages students and allows for personalized learning to occur much more so than before such integration occurred. Last, the participants discussed, as James described, the “democratization” of the classroom that technology integration makes possible. All of these factors connect to a more rich learning experience for students. The four themes identified from a careful review of the interview transcripts were as follows, as presented in Table 3 and discussed below.
Table 4

*Themes: How do teachers identified as effectively integrating technology in their instruction perceive the impact of technology integration on student learning?*

| Technology integration has helped push students to shift their mindset about learning. |
| Technology engages students |
| Laptops allow for personalized learning |
| Technology “democratizes” the classroom |

**Technology integration has helped push students to shift their mindset about learning.** All of the teachers in their interviews discussed the idea that technology integration has made it possible for teachers to push students to be active learners. Classroom instruction that was, heretofore based on a more teacher-centered model of direct instruction and drill inculcated a passive learning model for students, where they were conditioned to parrot or regurgitate facts and information provided to them by the instructor. As discussed above, the participants have noted a shift in their pedagogical tactics that are much more student-centered. As a result, they identified the fact that they employ more creative means to bring students to the content and assess their understanding and mastery. This creativity has resulted in more open-ended projects that embrace the idea of “controlled vagueness.” For students used to receiving and regurgitating, this requires a significant shift in how they view their role in the learning process. Marge discussed this idea, saying,

So rather than me bringing them three articles. They can go out and find their own stuff.

So rather than an entire class only seeing my three, what I think more... I get to see more of what they think … It's still difficult. It's still difficult and you're always worried that, especially in a world of rubrics, and "I wanna know exactly what you want from me" that
they're not going to rise to the challenge, but I would say that kids generally, if given choice, what I've seen, do rise with challenge … They'll say, "Well what do you think about his? And what should I do with this?" And that's when you become the teacher and you're like "Well, this can fit in to your project like this or you could look at it like this" and kinda working as a partnership with them in a different way than you would've as a "This is what I want you to do. Here's your three steps. Do it."

Interestingly, the mindset shift that students must embrace with this shift must also be embraced first by the teacher who must first be willing to step aside from the role of “sage on the stage” and allow students to use the technology tools available to them to find and assess information, develop their own conclusions and/or perspective and articulate them through original work that may be much different than what would be found on a traditional pen and paper assessment. Sophie summarized this point by saying, “So it's maybe shifting what they're capable of doing that still presents their understanding.”

Marta said, “Sometimes I keep it so wide open, where you have an essential question and you’ve got your guidelines and give them, ‘Here’s your proposal plan. You guys make the decisions. You have to hit these certain criteria, but… you have the freedom to show me what you know in whatever type of way you want to.” These mindset shifts can be very difficult for some students to navigate, which was recognized by the participants. Specifically they identified that they have traditionally found that students have been very reluctant to try something and struggle at it before eventually succeeding. Building a classroom environment that embraces, as Sarah put it, “productive struggle” where struggle and failure is seen and welcomed as a key part of the learning process is an important aspect of the participants’ perceived success in transitioning to a technologically integrated classroom. Marge underscored
this by saying, “If you’re pushing them, it has to be okay for them, for it to not go the way that they think it’s supposed to go. You [can] show them something and then you say, ‘play with it’ and that’s how we learn this kind of stuff versus a step-by-step, first go to this, then go to this.” Importantly, they were consistent in identifying the fact that, when presented with choice, they found that their students, while sometimes enduring struggles, usually rose to the occasion. Helping them shift from a passive to an active learning mindset was a key impact on student learning perceived by the participants.

**Technology engages students.** All of the teachers made very clear their perception that technology integration and the pedagogical tactics they have employed that embrace such integration deeply engages students. Specifically, they cited the ability for students to find and assess their own sources of information and connect their learning to themselves and the world around them to make it relevant. Marge said, “I think of how I can make it [content] more relevant because that’s what I think that this gives me more than anything else.” James stated, “I most like to use the technology for, which is just access to different perspectives. That’s usually at the end of a lesson where, can you find differing viewpoints or do your Google search with, say, commands for Japan and China and then, see how what you find is different, connecting it to the present.”

Marta highlighted a project she developed that was aimed at using a technology tool relevant to students to reflect on key themes from *Animal Farm*. She said,

> This was the end of Animal Farm just... We had finished our test and I just said, "I wanna try something fun with you, guys, something different." And so I said, "Let's do a meme." [chuckle] And I showed them some examples and said, "Using your knowledge of George Orwell's Animal Farm, create a meme. Keep it appropriate for school but really
think of your literary terms. Think of setting, plot, character, symbolism, metaphors, and
the seven commandments in the novel lend itself." I gave them two links to create the
meme, it's makeameme.org or Imgflip, or they can use it in Google Drawings. Some kids
liked to create it there. So they find a picture, they create the text box and make their own
original meme with their own witty thoughts. And I said, "This is perfect," because it's a
satire, there's mockery, and that's what we get in these memes.

Another aspect of engagement noted by the participants that technology elevates was
student interest and motivation. Mark discussed how technology has allowed him to efficiently
gamify his class and to utilize Google Slide Decks with built-in incentives, which have, from his
perspective, elevated student engagement exponentially. Mark gave another example from his
Middle Ages unit on the manor, where he allowed students to use Minecraft to construct a
Medieval Manor to demonstrate their understanding of that aspect of Medieval society. He said,
“… It’s … another avenue to show that understanding and play into their strengths a little bit
where... I've had kids that are just, they've told me they sit down they play Minecraft for a couple
hours and they just love doing it.” Rose discussed the success of an online Digger Project that
had students using coordinate math to determine if two people beginning a tunnel on either end
were going to meet and how they knew the result. Marta discussed how she used Infographics to
elevate student interest and engagement during the writing process, saying,

I think years ago it was essay, after essay, after essay, after essay, and pulling in these
alternative types of innovative assignments that don't have to be these long essays, but
come like you said, little vehicles. Right now I'm teaching the persuasive essay. Yes, they
are writing a five-paragraph essay. They're going through the steps, research, a graphic
organizer, an outline. But in the midst of all that, they're creating an infographic, also. So
now I pulled up examples of infographics. You take your research, let's hit the data and put it in visually. They are having a ball with that because it's making research a bit more fun.

Another important area noted by the participants that impacted student engagement was the increased ability to give students choice and freedom. Marge noted this when she said, “They get so much more invested when it’s their own. As long as they have some sort of interest in our society and their place in society, you can find ways to engage them using the technology.” James highlighted this by saying,

And so again, there's a bit of choice, too. They can choose what theater of the Cold War they would be most interested in. There was the Space Race, the Arms Race, Congo, Cuba, things like that. All relevant content but they could sort of, choose where they wanted to go. They can also, I allowed 'em to go outside, if they really had strong technical skills. "Here's some places to look into pick something that you're interested."

It's all relevant to the content, but there's still choice involved, what they choose to research, where they go to find information. And then it's also the collective knowledge of the class where different people are finding information on the things and we're all sharing in the same spot.

Sarah discussed the utilization of a project where students had to create an online children’s story that conveyed the concepts of position, velocity and acceleration. Additionally, she discussed her creation of a highly successful project that engaged students at the end of the school year, saying,

I asked them to create an iBook chapter on a topic that we had done … and it incorporated videos, it incorporated review questions but interactive stuff. Pictures,
graphs…they worked with a pair, or partner if they wanted to. Since the beginning this has changed. I had a minimum of three pictures, now it’s up to ten. At least a couple of videos … they had to make at least one of their videos for… and they could borrow one [YouTube/Khan Academy] or make both of them. They had to do sample problems with solutions, interactive review, a minimum length, a minimum number of jokes … math related. A cartoon. The funnier the better. They have to do an about the author section telling me about themselves, truthful or not truthful, and why they chose that topic and a bibliography.

For these teachers, the types of assignments that allowed students freedom and choice beyond the expertise of the teacher engaged them with the activity and, ultimately in a deeper examination of the content and related themes.

A last important facet of student engagement facilitated by technology integration was the ease by which students could engage in collaborative learning and discussion. All of the participants noted the ease by which students can now collaborate with one another on an assignment of a project outside of class through discussion boards, Google Docs, Face Time, and Instant Messaging. James said, “Point to collaborative work. Technology allowed them to do the research and visualize the changes together and pull it all together as a group to address a tough question.” Marge noted her use of an online annotation tool as a means to better engage student with English texts, saying,

“I just used Owl Eyes on here, which is a program that has the books and the domains. They can go on, and they can engage with the text, answer questions that I put there, highlight and annotate it, and then everyone in the class can see what they've done. Then they're engaging with the text, which is what all an English teacher really wants in the
world anyway, [chuckle] but they're on their computer but it also gives them the ability to, let's say, "Oh, I don't know what that means." You can quickly look it up, which is a good and a bad thing, as I know about my Kindle, because I'll be like, "Oh I don't know what this is, and I'll look it up and then I'm off. They can't mark up the school books. They can mark these up."

All of the participants also noted that it was no longer necessary for them to be the experts with regard to the technology and that students were far more effective at figuring out the technology and teaching it to one another. Rose said, “They were also great at helping one another. Someone would ask a question aloud and someone else would tell them how to do it before I could even pretend to know what I was talking about.” James stated, “Oh, I'd say I have rarely found myself in a position where I have to teach them the tech. It's usually the opposite way, where you put it in front of 'em, they figure it out, and they sort of teach you, in not a lot of time.”

A significant example given by James pulls together all of the themes related to engagement that technology integration augments. His assignment, which had his AP World History students trace the spread and change in Buddhism over time, had students utilize an online technology tool (Google My Maps) collaboratively to create small group projects that then could be examined by the entire class. Thus, students were engaged through an activity that allowed student choice and collaboration and resulted in a deeper engagement with the content that led to a deeper understanding of how Buddhism spread and changed over time. As James said,

I learned about Google My Maps, which is basically a Google Doc but working with a map. So being able to sort of incorporate space into working dynamically, and then
adding images and descriptions of different places. For AP World History one of the things that they're responsible for is understanding how Buddhism changed as it spread. From its origins in Northern India and then making it's way across the silk roads, and into Indonesia. And so one of the things that I did is to create a project where they had to map different pieces of Buddhist art and use the art itself as a vehicle for analyzing how Buddhism changed and adapted to the local culture, but also be able to visualize that with the Google My Map, where they could plot it and timeline it all at the same time. And so they could work dynamically or work collaboratively as a group where they split up the assignment, and then could find images from a different place in a different time. They were responsible for analyzing how it reflected syncretism, basically the blending of Buddhism and the local culture. And then they could see this spread, both in terms of space and time and use their analysis of the different pieces of Buddhist art. I tried it two years ago and it sort of worked and then I refined it where I narrowed the focus of the pieces of art that they should choose from which helped with timing. And then the Exit Ticket was to go back over to what you put together as a group and explain how it tells a story of how Buddhism adapted to different places as it moved. They were working in small groups, groups of four, but they're all looking at the My Map as they individually do their own research on different pieces of Buddhist art in different places. And then bring it together to tell the full story. Here's what it looked like in Northeast India where it comes into contact with the old Greek legacy of statues. It moves from footprints, to depicting the human form. And all of a sudden it goes over here and all of a sudden you have fat happy Buddha, with minions in China, reflecting Confucianism. But the point being it was sort of... They were working collaboratively, the technology allowed them to
do the research but also visualize the changes working together. And then pulling it all together as a group based on what they did to really address a tough question and answering it with some analysis and thoughtfulness. A real specific piece of the AP World History curriculum, in terms of content, and technology just being a cool avenue of getting there.”

Thus, the participants all noted how technology integration and the pedagogical choices it afforded both them and their students elevated student engagement. This engagement was seen through the increased ability of students to find relevance with the content and themes. It was also evident in the ability of the teachers to create activities that allowed student choice and found ways to further motivate them to explore and make meaning. Last, the participants noted the huge boon technology integration has been to promoting productive student collaboration. The result has thus been a deeper level of student engagement on many levels.

**Technology integration allows for personalized learning.** An important theme that emerged from the interviews and participants’ discussions of the impact of technology integration on student learning was the ability to create personalized learning opportunities for students. It should be noted that all of the teachers discussed the importance of providing varied experiences, choice, ways to make the content relevant and engaging to/for the students as part of their respective teaching practices. All of the teachers identified that technology integration has allowed them to better achieve those goals, which personalizes the learning experience for the students. James stated,

… it opens up the opportunity to give students greater freedom to determine their path of getting somewhere. It opens up the opportunity of having students be the ones that find the different perspectives in the different sources rather than me on the front end, putting
them in front of them and saying, "Compare these." It opens up just greater choices for them, "I wanna look into this tied to this main idea," that they can do that. And from a teaching perspective to allow that.

He went on to discuss a specific example of this student-driven “path of getting somewhere,” saying,

There's an example from our interwar year unit where I took all the constraints off and we started with this question that they were going to be assessed on, what I wanted them to demonstrate that they knew; How did the German democracy fail, and what did it mean for Germany? And I allowed them to do a project that could be any means of their choice. Some of them created a digital timeline. Some of them created like a crash course video ... Some of them did a journal entry from the perspective of someone experiencing it. But the fact that they had their computers and they had knowledge of the technology, they could choose the vehicle that they wanted to demonstrate that they knew this. To show me in the way that they felt most comfortable and interested in doing. And that's only possible with the computer, right?

Sarah discussed the benefits of allowing projects that engage student choice and creativity by saying,

I can assign more projects and I feel more comfortable giving projects as assessments than I did before … I’m able to take some more risks and give more open ended assignments … it allows me to see student’s creativity in a way I hadn’t been able to before … I like to get to know my students and I do it other ways … I might not have known that they were good at this or good at that.

Rose articulated her perspective, saying,
I feel like they feel more in charge of their learning when they have their laptops. They’re able to explore more with their learning instead of just thinking “If I don’t get this worksheet right I’m not good at math.” So there are so many opportunities for them to realize that they’re good at math.

In giving this freedom to personalize the learning demonstrations/products, James noted,

They went in places that I would never have been able to predict, mind-blowing places, where... [if] that had been a test, it would have been what I felt were the right answers, that these are the things that I have come up with, and here's the end point that you're gonna show me you've arrived at, or how close you are to that point. By opening it up and letting them create they brought it to places well beyond that and what I would have come up with.

Thus, the importance of leveraging technology tools to create opportunities for students to engage in a personalized approach and a personalized method of demonstrating their respective understanding was a key theme identified by the participants with regard to the impact of technology integration on student learning.

**Technology integration “democratizes” the classroom.** A last theme that was common to all participants and connected to their respective perceptions of the impact that technology integration has had on student learning is through a development that James characterized as the “democratization” of the classroom. All of the teachers discussed the ways that laptops have allowed them to have all of the students in their classes participate in a discussion. They all noted the Learning Management System (LMS) utilized by the district (Schoology), which has a teacher curated discussion board feature. They noted how their use of discussion boards effectively pushes all students to contribute to discussion prompts and respond
to one another. This brings more diverse student perspectives on a given topic for discussion than with more traditional discussion tactics. James noted that,

… even the simplest things about … getting a response from everybody … with a discussion where they can open up, they can post to a starter question, whereas doing it as a student teacher, maybe you have 'em talk it out with their partner and then share out but you're calling hands and you're choosing and selecting, and generally wouldn't get to everybody. Something as simple as having their computers in front of them where everybody responds, I can see everybody's response and they can see everybody in the class' response. Little things like that I actually think it's, it's a small thing that makes a big difference.

Marta also discussed how the functionality of the LMS allows for greater student voice. She said,

The discussion page on Schoology is a perfect example of that. Whereas, when you run a discussion you get the four or five kids and you might not have time to talk to 25 of them or hear from 25 of them but they have a voice in that discussion page. It's a thread there that they can see. They have to post before they see somebody else's and then they can comment. And that's part of their life. But it's also safe. They're not out there on the web. They're on my page. And so, that has also helped in terms of reaching all kids and having them all feel like they can give their opinion.

Mark noted, “You can't hide in the shadows and be completely passive through the day, at least on my end. That I can avoid calling the first hands that go up because everybody has a chance to hear their voice heard, everybody has to participate, but also everybody has a chance to express themselves.” Thus, the ability to have every student contribute was noted as a major contributor to the class and individual student learning.
Another key value-added aspect of this functionality is the creation of a safe environment for students to communicate their thoughts and perspectives. With more traditional participation tactics, students who are shy or do not feel comfortable voicing their respective thoughts in class do not in turn participate in class wide discussions. Rose noted that posting feature, “…Has allowed some students who are less likely to participate in class to participate in a way that they’re more comfortable with.” She discussed a specific application she used called Padlet that, … lets them anonymously type out their thoughts and their ideas without anyone seeing their names. I used it this year a few times where I would show them a quick video. It was… this was with my 6th graders and it was a hot dog eating contest and then they had to use Padlet.com to come up with a math word problem that goes along with the hot dog eating contest that would also include ratios and equivalent fractions. And so they all were typing their ideas and… it was just… and it was early in the year and some of my students were still really shy and uncomfortable. But the things that I was getting on the Padlet displayed were so… some were so brilliant and I had no idea that those students had those kind of thoughts ‘cause they were just feeling a little shy. So it was a great opportunity to kind of like break the ice and let everyone feel comfortable…

James noted that,

“… I have a couple of students that have real sort of social anxiety and something like being able to post, as opposed to raise their hand to have their position heard is a benefit. I had one girl say, “I'm horribly shy, and I don't feel comfortable talking in front of people.” And I have a couple of students that have real sort of social anxiety and something like being able to post, as opposed to raise their hand to have their position heard is a benefit.
Sophie added, “I think that this allows for students nervous to talk to, add in to a discussion post on Schoology.” Rose discussed the interactive benefits found in the Schoology discussion board, citing an example of where she had students in pairs examine through the discussion board two examples of student work on a given concept, both of which are incorrect. She said,

And they have to first figure out how each student got it incorrect and … how you actually solve it correctly… how both of those students could have avoided it, and it just starts a long discussion. They are building off of each other’s thoughts and carrying on exactly what you are hoping they would talk about with the right math concepts and vocabulary. So it’s really cool to watch and it’s completely hands free. It’s not me telling them what to say, what to do, how to solve it…

As Sarah noted, the benefit of a safe way for kids to communicate with her and with one another is especially important for those students, “… who are shy or suffer from social anxiety. This allows them to have a voice.” Such an ability pushes those students to contribute and not be passive, and it provides each teacher with every students’ perspective and thoughts on a topic, which was never a practicality before technology integration. As James said, “Before, I'd end up calling on the hands I see.” Having everyone feel comfortable sharing their thoughts, analysis, perspective with the teacher and/or their peers (both with their name and anonymously) and having everyone able to see one another’s posts thus makes everyone more active participants in the learning, which, thus, democratizes the classroom.

**Effective technology integration requires balance and has its struggles.** From the interviews, it is clear that technology integration has its difficulties as well as benefits. The participating teachers discussed, along with many strengths and benefits, some of the struggles they have with technology integration and management. An important point made by some of
the participants as it pertains to technology integration is the importance of content, curriculum knowledge, and up-front planning by the teacher. While all of the teachers discussed how they have become more comfortable with “controlled vagueness” and allowing more open-ended ways for students to learn and demonstrate their understanding and mastery, they also identified the need for some level of clarity with regard to the content expectations and criteria for these types of assignments/projects. All of the teachers discussed that the work they have the students conduct needs to have a focus in order to balance the freedom, creativity, and choice that technology allows students with rigor and accountability to the content standards. To some of the teachers this has been a struggle, especially with projects they are trying with students for the first time. James encapsulated the struggle with trying different approaches to student projects and assessments, saying,

  It's one thing to have an idea and let 'em run with it, but to really tighten everything, so that I'm clear on what I expect and what's gonna be a really strong piece of work, whatever the assignment is, is still coming together as we do it, which I think is less than ideal … But just be detailed in the beginning about what my expectations are for what the iMovie should look like, what's it's going to be assessed on and graded on, and that while they're free to have fun with it, it's gotta be true to the objectives. Really sort of holding 'em accountable for, sort of, what they produce. The risk with the iMovie is that, in being creative, they get silly. That happened a couple times. You sort of, bring 'em back to … what they're gonna be evaluated on, what the expectations are for the project.

Sarah said,

  I’ve found that they need very specific guidelines and directions sometimes, especially for what I expect to see, what I want the outcome to be as far as the math goes. The
creative stuff I don’t need to use guidelines for strictly but… I need to be more clear with what I expect to see for them to show me and go through the rubric, what I’m going to be grading them on and that needs to be laid out, especially with the math portion of it. That’s what I’ve learned… they need to specifically show me these concepts to show that… its mastery…

Marta discussed her approach to find the balance between student choice and creativity and accountability, saying,

I start with the curriculum and the standards and skills and then I try to meet these 8th graders where they are and pull in some kind of pop culture and social media pieces. I know the curriculum. I know I can find the sites. I’m teaching problem solving, critical thinking. I find by using rubrics and pushing high expectations, that holds them still accountable, and pushes the rigor still. If you have a really good detailed rubric for them to follow, it still might give them that choice. But a five versus a zero, whatever your scale might be, is far different. And the kids... Kids know it. And they understand. If you show some modeling and you show some samples before hand, and you say, "These are the expectations," then that's where you try to hold the rigor, and hold the accountability, and keep them moving forward in their foundation and their skills.”

Thus, the importance of having a solid understanding of the curriculum and criteria for assessment is key, as well as the communication of that criteria through directions, rubrics and exemplars (if they exist). Last is the importance of consistent oversight one must conduct during the activity or project to ensure that students are creating work that is both creative and rigorous.

Another aspect identified by the participants was in finding the balance in-class between, as Mark put it, “Analog and digital practices.” He said, “And they do ask for that every now and
again. They're just like, "Okay, can we just please take a break from it?" I'm like, "Absolutely, sure. That's fine." I still believe the kids need to use their hands. They still need to write. I haven't abandoned it or anything like that.” Sarah described her journey with this issue, saying,

I still do a mix of teaching and I think it’s finding that balance, seeing what works best ‘cause all classes might not be the same. And then with the AP class, the pressure of, of time and getting all that material in. And so, I need to work more on figuring out how to get that all in and still allowing them to have a struggle on their own.

Marge described summarized the importance of this balance by discussing her methodology at the start of each book she uses with her students, saying,

I still make them handwrite notes. At the beginning of each book there's certain things that they need to know because we go through movements, and I just truly still believe that there's a stronger link between your brain and the handwriting because it slows you down. It makes you have to think about what you're writing rather than... I personally can transcribe without thinking. I can look at something and not even think about it when I'm typing it.

Marta discussed the importance of balancing online research and interaction with actual face-to-face interpersonal discussions within the classroom. She said,

There are days where I say ‘no computers’ and we sit in a circle and we might read right out of the book, and we are face to face, talking. The kids need the balance … if we don’t do some of that, and they don’t learn those social skills of ‘Let’s sit and talk and look each other in the eyes and actually get tone. I’m always striving for that balance.

The teachers discussed other struggles and changes they have identified as a result of student access to laptop technology. Marge summarized the largest changes in terms of cheating
and engagement. She said, “The issues come with … plagiarism, cheating, and access to what's going to entertain them, I guess, are the three big things that I've seen change. Additionally she said,

I think that's where the struggle ensues with engagement. A psychologist (she later identified as Sherry Turkle) said, "It [laptops in classrooms] gives you the satisfying thought that you can put your attention at anywhere that you wanna put your attention at anytime." You could be at a meeting, you're listening to something, and then the next part doesn't apply to you, so you don't have to listen to that, and it applies to a classroom too. It can affect engagement...

Marta, who identified what needs to occur from a management standpoint in order to discuss what can become classroom management issues, discussed this aspect of classroom engagement and management also. She stated that,

… one thing I will say for the laptops is the management piece of it. I think teachers have to be really cognizant of how they manage it, and maybe I'm speaking because I'm the teacher of 13-year-olds. Rules, in a sense. Putting their computers at 45 or closing their computers at certain times. Because they don't have the self-discipline yet. And they love to get on the games or something different Along with the laptop use and what-not, I think it's... You have to be solid in terms of, "How much are we gonna be using it? When?" And be disciplined enough to have them closing it and not playing, and aware. And I guess that is good teaching... It's hard at times though. We have to be really cognizant of how they manage it. You have to be very solid in terms of how much they will be using it. And be disciplined enough to have them closing it and not playing. And being aware.
It is important that the participants recognized both the benefits and the challenges and struggles that the presence of devices like laptops present in a classroom setting. Finding the balance between creativity and rigor, the “analog and digital” activities occurring in the classroom, and identifying where laptops are key to student learning and where they can serve as a significant distraction were all issues that are significant to classroom teachers who are charged with integrating such devices meaningfully. The take-away from these issues is clearly a need for the teacher to be deliberate, thoughtful and clear with expectations, criteria and with regard to when and how laptops should be used in the classroom setting.

Summary of Findings

The thematic findings of this study came from seven current practitioners in the middle or high school setting across subject areas. These individuals were identified by their supervisors as being high –level (on the SAMR Scale) integrators of instructional technology in their respective classrooms. These individuals all discussed the factors that made it possible to integrate instructional technology at a high level that included their own philosophical approach to teaching and learning, seeing where education is going and how technology integration presents many opportunities for student learning and engagement, reliable access to technology and PD, and strong administrative support to experiment with the technology integration in the classroom. Every participant spoke strongly about the impact that technology integration has had on their respective teaching practices, spurring changes in how they approach teaching and especially in terms of ways that students can demonstrate their learning and mastery. Every participant discussed how he/she has become more willing to cede what has been traditional control held by the classroom teacher and to “fly blind” in order to allow students more freedom to explore and create. Last, a number of key efficiencies with regard to easy student access to
information, time saving activities, the ability to archive student-produced exemplars and class notes, and easy ways to communicate with and give timely feedback to students were cited by all of the teachers as having an impact. The participants all discussed their impression that technology integration has had a profound impact on student learning. They discussed the mindset shift that students have undergone as a result of the utilization of technology integration to expand student creativity and choice in the classroom and with assessments/projects. The pedagogical approaches technology integration has influenced, the personalized learning opportunities that have influenced the strong level of student engagement as a result of the access to technology, the were strongly noted by the participants.

While the advantages and benefits of technology integration were identified, there have also been struggles undergone by the participants with regard to how much and how often laptops should be used in the classroom, issues with divided attention, and with the ongoing struggle to find the balance between creativity and rigor. Throughout the study, the participants were clear with how the utilization of technology tools has had a profound impact on their teaching and with student learning.
Chapter V: Discussion of Research Findings

This chapter provides a discussion of the major findings, and an analysis of the findings in relation to the theoretical framework and literature review. Further, a discussion of the limitations and significance of the study, as well as next steps, implications for practice, and final conclusions is presented.

Revisiting the Problem of Practice

This study examines how seven high-level implementers of technology perceive their journey to implementation, and its impact on their pedagogy and student learning. With the increasing number of school districts across the country that are initiating 1:1 laptop initiatives (Holcomb, 2009) it is important to examine how such devices are being used in the classroom by teachers. The potential of such devices in the hands of students both within and beyond the confines of the school can potentially transform educational environments and learning on a significant level (Holcomb, 2009; Roschelle, Penuel, & Abrahamson, 2004). Supporters of such initiatives feel that ubiquitous access for students and teachers will help schools to better prepare students with the critical skills for the 21st Century workplace, increase student engagement, and be a catalyst to fundamentally transform the teaching and learning environment (Bebel & Kay, 2010; Bebel & O’Dwyer, 2010; Dawson & Cavanaugh, 2006; Holcomb, 2009; Inan & Lowther, 2010; Lei & Zhao, 2008; Penuel, 2006). Critics of these initiatives question whether the presence of such access actually results in substantive changes or transformation of teacher pedagogy and, ultimately, student learning gains (Weston & Bain, 2010). Supporters of 1:1 initiatives state that student learning outcomes can be positively impacted by them (Baylor & Ritchie, 2002; Bebel & Kay, 2010; Bebel & O’Dwyer, 2010; Dunleavy, Dextert & Heinecke, 2007; Holcomb, 2009; Inan & Lowther, 2010; Muir-Herzig, 2004; Penuel, 2006; Solhaug, 2009).
Both critics and supporters both seem to agree on the importance that teacher attitudes and capacity with regard to technology are significant determinants as to whether pedagogical practices in the classroom and, thus, student learning, are impacted (Drent & Meelissen, 2008; Fried, 2008; Hew & Brush, 2007; Inan & Lowther, 2010; Kopcha, 2012; Meuller et. al., 2008; Muir-Kerzig, 2004; Penuel, 2006; Petko, 2012; Yang & Huang, 2008).

Given the differing views of the impact of 1:1 laptop initiatives on the actual pedagogy utilized in the classroom and, subsequently, the impact on student learning, further research on teachers who have been recognized as effective implementers and integrators of such technology can prove to be beneficial. More specifically, research on how those teachers perceive their own journey, how their pedagogy has been impacted, and how they perceive the impact on student learning could provide important insight into how technology can be implemented and integrated effectively.

**Review of the Methodology**

This qualitative study explored the perceptions and experiences of seven teachers who were identified as having effectively integrated technology into their classroom instruction. The aim was to explore how these teachers have used the opportunity to enhance their teaching and their students’ learning with the advent of their school’s 1:1 laptops initiative. Data collection consisted of two semi-structured interviews with participant middle and high school teachers at a co-located middle-high school. Subject supervisors and the *Apple Core* coordinator identified each participant as consistently implementing 1:1 laptop technology at the modification and/or redefinition level on the SAMR scale. The research questions driving the study were the following: How do teachers identified as effectively integrating technology in their instruction perceive their journey to successful integration? How do they perceive technology integration as
impacting their teaching? How do they perceive technology integration as impacting their students’ learning? These research questions drove the formation of the semi-structured interview questions asked of the each participant.

To ensure validity of the study, care was given to ensure trustworthiness with regard to the data collected and analyzed. Member checking (Thomas, 2006) was utilized throughout the research process. Data sharing and summary occurred with each subject. During each interview, summarizing occurred through researcher restatement of key points made by each participant to assure that the interviewer was hearing the specific points being made by each participant. Additionally, before analysis began, each audio recording and the ensuing transcript was shared with each respective participant for his/her review. Preliminary drafts were also shared with the participants with the provision of the opportunity to comment on the findings and interpretations that occurred. Each participant had the opportunity to share additional comments, insights, or points after they had the ability to review the transcripts and ensuing interpretations and conclusions. The reason for this level of transparency was to take all reasonable steps possible to confirm with the participants that the interpretations and conclusions were based on authentic and credible data. All interview recordings, transcripts, artifacts and drafts were saved on a laptop, a external hard drive, and on a cloud-based storage account. The data and findings are transferable, as the problem of practice can be applied to schools, school districts, and teachers undertaking and experiencing 1:1 laptop initiatives and how that technology is implemented and integrated in the classroom.

The sample size was determined by the number of teachers who were identified by the Subject Supervisors and Apple Core coordinator and by the identified teachers who volunteered to participate in the study. While the sample size of seven teachers was limited, the teachers
involved in the study provided different perspectives as there were middle and high school teachers representing the subjects of English-Language Arts, Mathematics, Social Studies and Science. A limitation of the sample size was that the participants were identified as high-level implementers of 1:1 laptops in their respective classrooms. The perspectives of lower-level implementers were not garnered in the study.

Transparency was consistently utilized to protect each subject. This was specifically important, given that the researcher was the high school principal in the co-located school that was the research site. Thus, the purpose of the research, its intended benefits, and the interview instruments were shared openly with the participants. Additionally, each subject was assured of their anonymity during the study and in their ability to review and comment on all aspects of their interview responses and conclusions being drawn by the researcher. Further, the focus of the research was on teachers identified as being effective, high-level integrators of 1:1 laptop technology in the classroom, which is not pejorative. Last, each participant was assured that his or her participation was not connected to the evaluation process, nor was any participant directly evaluated by the researcher during the study’s duration. The level of transparency and steps taken to protect the subjects was documented and approved by the Institutional Review Board.

**Discussion of Major Findings**

Through a review of the participant transcripts and artifacts, and the emergent themes resulting from the two semi-structured interviews and data collection, overarching themes emerged as major findings. These four major findings are as follows:

1. Teachers need multi-faceted supports to effectively integrate technology.
2. Effective technology integration is conducive to student-centered teaching approaches.
3. Effective use of technology shifts traditional teaching and learning roles and mindsets.
4. Effective technology integration influences teacher and student engagement.

Teachers need multifaceted supports to effectively integrate technology. All of the teachers discussed that a key ingredient to their respective ability to effectively integrate technology was the support they received along the way. This support had many layers and forms, beginning with a clearly defined system wide commitment to the building of technology infrastructure and the provision of laptops for all teachers and students. All of the participants cited the importance of each student having laptops and being able to trust that the technology and connection to the Internet would function reliably. Further, the participants cited the focused PD approach taken within the school system to provide numerous access points for teachers to build their understanding of basic functionality and content-specific approaches that could be utilized. The PD available to the teachers took many forms that included outside PD opportunities (e.g., MASSCUE conferences), the semester long Apple Core program, paid “Tech Camp” at the end of the school year, faculty-wide sharing of successful technology practices, department-level sharing in meetings and content-based PLC’s, and individual participation in national conferences and individual PD workshops. Another key area of support identified by the participants as being a key factor in their effective integration of technology was found in many informal discussions with colleagues around the topic of technology integration. Last, cited by every participant was support communicated by their department and building leaders that allowed him/her to trust that he/she could experiment with different approaches and uses of technology in the classroom without fear. The participants reported that these types of supports were essential to the effective integration of technology for the participants.

Effective technology integration is conducive to student-centered teaching approaches. This was a consistent theme among all of the participants who, in the discussion of
their respective teaching approaches, cited the importance of student-centered activities geared to create learning experiences that better allow students to relate the content to their own lives and experiences. While each teacher’s articulation of these points were not exactly the same, they centered on building a classroom environment that pushes every student to contribute and has a focus on collaboration/interaction, self-paced learning, independence, and creativity. These goals allow teachers a number of options designed to push students to think independently, make connections, and demonstrate their understanding/mastery in a variety of ways. The ultimate goal is a deep level of student engagement.

The participants all discussed how 1:1 laptops were key to either augmenting their student-centered approaches or to help them shift away from more traditional teacher-centered practices. Integrating technology allowed all of the participants to have students all participate in discussions to share ideas. Additionally, the ability for students to access information and collaborate in and out of school to build their knowledge base from one another and work on project-based activities was elevated exponentially from the perspective of the participants. Last, the number of different platforms available to students to create multi-modal representations of their knowledge, understanding, and synthesis of content-based material/themes/content at the group and individual level has allowed for a much more personalized learning environment. The ability for teachers to efficiently communicate with students, provide targeted feedback, and archive student exemplars has, in their view, freed up more class time for more student-centered learning. Thus, for the participants who all espouse student-centered philosophies and approaches, technology integration has been a boon.

Effective use of technology shifts traditional teaching and learning roles and mindsets. An important overarching theme connected to the successful integration of
technology into teaching and learning practices is that teachers and students have to be willing to move away from the traditional roles and mindsets ascribed to them. As mentioned above, the participating teachers all discussed that giving up control was essential to their successful integration of technology. Specifically, they discussed that they had to get used to the idea of not knowing exactly how to use the technology or where students would go with open-ended assignments. Additionally they pointed out the need to accept a certain level of trial and error with regard to the discovery of effective methods to utilize technology to actively engage students. Last, they identified that the unfiltered student access to information reduced their role as a fact-giver and “sage on the stage” and increased their role as a facilitator and coach. This mindset of, as James described, “flying blind” is fundamentally different from the traditional role and view of teachers as being the content experts who control a lesson from bell-to-bell.

For students, the mindset shift was the opposite of what teachers had to navigate. As opposed to giving up control, students had to acclimate to the fact that they were given control by the participating teachers. This control allowed them to, depending on the teacher, use technology tools to gather information/sources, navigate activities at their own pace, work collaboratively, and develop their own products to demonstrate mastery. All of these adjustments were the result of, as the teachers reported, more open-ended assignments that did not provide them with a clearly delineated and articulated set of step-by-step directions. As the teachers discussed, students imbued with a traditional passive style of learning desired specific directions and a clear articulation of what answers the teacher wanted from them were needing to shift their mindset. Thus, for both teachers and students, the integration of technology forced a redefinition of traditional teaching and learning roles and mindsets.
Effective technology integration increases teacher and student engagement. All of the participants agreed that the presence of ubiquitous access to laptop technology in and out of the classroom has resulted, from their perspective, in elevated engagement for their students and themselves. For the teachers, the ability to develop open-ended and inquiry-based activities for students that actively challenge them to gather and assess information and develop creative products to demonstrate their learning pushes them to become more creative as teachers both in how they present and assess content. The presence of a variety of technology-based methods to present information differently, engage all students in discussion, encourage collaboration, provide instant feedback, and allow for a greater variety of student-created products has pushed each participant to, as Marta put it, “stay current” and expand their repertoire of teaching and assessment practices and tactics. To each participant, this reality is intensely challenging and professionally engaging. From the participants’ perspective, the level of student engagement has increased as they have increasingly been empowered to be creative in how they determine how they will demonstrate their learning individually and collaboratively. To the participants, the students are more engaged and find the subjects being taught to be more relevant without sacrificing rigor.

The Findings in Relationship to the Theoretical Framework

This study was informed through the framework of Constructivism. This theory (or collection of theories), specifically the perspectives of Dewey, Kolb, Vygotsky, and Piaget around learning and development has helped to provide a lens through which one can view the participating teachers’ individual and collective experiences and perspectives with regard to the effective integration of technology in the classroom. As mentioned above, a key aspect of
Constructivism is the idea that learning is a dynamic, adaptive process that entails a reciprocal link between the learner and the environment (Davis & Samara, 2006).

Dewey and Kolb identify that knowledge is not transmitted (Schmidt, 2010; Kolb, 1984); rather, learning is the result of the interplay between the continuity of experiences, how one interacts with those experiences in their physical and social settings, how one then integrates prior experiences and interactions and, ultimately, experiences self-organization, adaptation and emergence (Dewey, 1915; Kolb, 1984; Schmidt, 2010). This cyclical interaction does not occur through the delivery of discrete blocks of information and content; rather, it is a generative process that defines learning as something that is made by the learner, not received (Dewey, 1915; Kolb, 1984; Schmidt, 2010).

Vygotsky stresses the importance of human-to-human interaction for the creation of experiences to learning and higher-order development (Zhang, 2003). This embraces the idea that learning is generative and cannot occur without interaction with the environment and, most importantly, with other humans (Jorg, 2009). Piaget identifies the stages of cognitive development as children mature into adults. A key facet of his approach is that, through the process of adaptation, organization, and re-organization, a person develops and constructs increasingly complex structures outside of what is being transmitted by another person or educator (Boudourides, 2003). To move from one stage of development to another, one needs a “difficulty to overcome” (Doll, 1989) or unbalancing that pushes one to engage in what he called the equilibrium-disequilibrium-re-equilibrium process that is at the heart of cognitive development and learning (Doll, 1989).

These wings of Constructivism converge like tributaries to a larger river. Through interaction with one’s physical and socially interactive environment the creation occurs of
circumstances difficult to overcome face the learner. These dissonant circumstances push the learner to apply learning and adaptations from past experiences, which incurs self-organization, interaction, and adaptation, which then creates new meanings and understandings that are applied to the dissonant situation to create newer meanings and learning. For the learner, this process is a never-ending recursive cycle that reflects Dewey’s statement that learning is not “… an immovable solid; it has been liquefied” (Dewey, 1900/1915, p. 9).

The above-described cycle applies directly to the shared experiences of the participants of this study, who discussed their respective journeys to effective technology integration and the impact that such integration has had on their teaching and on their perception of student learning and engagement. Each teacher’s journey reflected their respective interaction with their environment where they applied past learning and experiences to a new situation. At the start, that is connected to the experience of teaching a classroom full of students; each teacher had to integrate their individual content knowledge and personal educational experiences with what they had learned in their respective educational program and apply that to the dissonant situation where they had to apply those past individual experiences to a classroom environment. From those experiences and interactions with students and colleagues over years came the development of overarching pedagogical philosophies, as those teachers continually revisited their past and current experiences with students and colleagues to develop and articulate a general pedagogical philosophy around their teaching pedagogy and student learning.

From the interviews, it was clear that every teacher reflected this non-linear, interactive, recursive, and dynamic process to adapt. Using the lens of effective technology integration, as was applied for this study, one can clearly see the link between Constructivist theory and the meaning-making that occurred with each teacher in response to a dissonant extrinsic situation,
namely the introduction of laptops to every student and teacher and the problem of how to integrate their functionality into meaningful instructional teaching and learning activities developed by each teacher. As discussed above, the participants all had to apply their own prior experiences with learning, teaching, and with technology (which varied greatly). Those experiences shaped their current view of teaching, which had to undergo a careful examination as they began to create new teaching and learning experiences with students using the available technology. Those new experiences and interactions with students and colleagues along the way pushed the participating teachers to reconcile their previously held notions of teaching and learning with the new experiences and interactions that the technology availability was affording. From this came new understandings expressed by each teacher as they adapted to a new reality in their respective classrooms and articulated new meanings with respect to teaching and learning. Those new understandings have resulted in effective utilizations of technology that have resulted in pedagogical shifts. Interestingly, those shifts (as discussed above) have resulted in the participating teachers handing over more power and control to students to create and demonstrate their own individual and collective meaning-making with respect to the subject matter. Such an open-ended process for the participants and their students is Constructivist in that their very well articulated meanings were *made* by the participants and not taught to them. Thus, when discussing the mindset shift that the teachers and, ultimately the students, all underwent with the integration of technology (e.g. “flying blind”), it is very clearly compatible with and reflective of the insights that the lens of Constructivism provides.

**The Findings in Relationship to the Literature Review**

The findings of this qualitative study have a number of strong connections to the literature as discussed in Chapter 2. Specifically, the findings of the study were consistent with
the literature around effective implementation of 1:1 initiatives, the importance of varied and
targeted professional development, and the significance of teacher attitudes and beliefs about
technology, pedagogy, and learning.

Ertmer et. al. (2010) identifies significant external and internal barriers to the successful
integration of technology in the classroom. External factors are tied to accessibility, training,
and ongoing support. Internal factors include the level of confidence teachers have in their
ability to integrate the technology, their beliefs about pedagogy, student learning, and the overall
value that technology integration adds to the teaching and learning process. As stated above,
“…the teacher educator has the most influence on the quality and characteristics of the product:
innovative use of ICT” (Drent & Meelisen, 2008, p. 197). Thus, the success of 1:1 laptop
technology initiatives is dependent on the teachers faithfully integrating technology at a higher
level into the teaching and learning experiences (Murphy, King & Brown, 2007).

The findings of this study support the importance of access to technology that functions
reliably in the classroom setting. This includes hardware, software, and dependable class-wide
access to the Internet. Additionally, the study participants (as discussed above) were unanimous
in discussing the significance of multi-layered formal and informal system, building, department,
and content area wide professional development opportunities that helped them to build their
capacity with regard to the use of different technology tools in the classroom setting. As
important, the teachers cited the importance of formal and informal collaborative structures
(PLC’s, informal collegial discussions) as providing ongoing support as they experimented with
different integration tactics in the classroom. This supports the literature that cites the
importance of a multi-layered and differentiated process that is tailored to address teacher needs
and concerns (Donovan, Hartley & Strudler, 2007; Holcombe, 2009).
The participants’ discussions about the content-based PD opportunities and discussions (*Apple Core*, content-based PLC’s) cited their importance in moving them beyond a basic understanding of the functionality of the technology and to the utilization of the technology tools to transform or redefine the educational activities in the classroom. This allowed the participants to identify and experiment with specific applications of the technology to their respective content areas. The presence of these types of supports, along with the trust of the teachers that experimentation (and possible failure) would not be penalized or be viewed pejoratively supports the literature that identifies the importance of making connections with teachers between the technology and the specific grade and content areas when such technology tools would be integrated (Ottenbreit-Leftwich, Glasewski, Newby, & Ertmer, 2010). Muir-Herzig (2004) goes further to say that when teachers are shown (through a variety of modalities) useful applications of technology in their subject areas (how to use it and how it benefits students), most teachers will take the time to learn it.

The literature is clear on the link between the level of sustained and differentiated professional development and the extent to which teachers pedagogically integrate 1:1 laptop integration in the classroom (Holcomb, 2009; Penuel, 2006). With the study participants, this link was reflected in their discussion of their respective journey to effective integration of 1:1 laptop technology in their practices. They unanimously made the connection between the access to reliable technology paired with a multi-level professional development plan that gave them the ability to learn, experiment, and incorporate technology into their practice at a high level (Modification and/or Redefinition).

Penuel (2006) discusses the findings of numerous studies that cite the fact that many teachers who have access to 1:1 laptop technology but employ teacher-centered strategies do not
incorporate or integrate such technology at a high level in the classroom. Thus, a number of studies note that the predominant teacher use of technology in the classroom is centered on the incorporation of productivity tools (word processing, Power Point, Internet searches) as opposed to the utilization of the technology as a thinking tool or a tool to demonstrate mastery (Christenson, 2002; Donovan, Hartley & Strudler, 2007; Fried, 2008; Maninger & Holden, 2009; Penuel, 2006). Kopcha (2012) found that a teacher’s willingness to integrate technology is heavily influenced by their own beliefs about technology, the amount of support they receive, and their skills in marrying the technology with their instruction (p. 1118). The study subjects were all clear in their support of technology as a teaching and thinking resource as opposed to a productivity tool meant to convey information to and from students. This difference between how the participants have integrated technology and the uneven implementation by teachers found in the literature is connected to the study subjects’ sustained access to quality professional development to build their capacity and confidence, their willingness to experiment and learn by “flying blind,” and their student-centered approach to teaching and learning. All of the participants expressed that they were provided with numerous positive experiences with regard to technology that lent to their willingness to incorporate laptop technology at a higher level. This is consistent with the literature that found that “…Teachers need to see positive outcomes and successful practice – they need to actually experience positive events” (Mueller et. al., 2008, p. 1535). The participants all had a number of positive exposures to content-specific integration tactics and experienced positive success, which, in turn, has influenced their continued pursuit of higher level applications.

A last key aspect of the literature that was confirmed by the findings of this study connected to the importance of teacher attitudes and beliefs about learning and pedagogy. Such
beliefs are key to the type and level of laptop integration that occurs in the classroom (Baylor & Ritchie, 2002; Mueller et. al., 2008; Penuel, 2006). Penuel (2006) cites the essential nature of teachers connecting the use of technology tools to the curriculum within their respective subject areas. Further, it was found that teachers who espoused student-centered or constructivist beliefs and methodologies (e.g. PBL), and who had higher confidence in students’ ability to complete tasks individually and collaboratively were more likely to utilize laptops with students more often (Shapely et. al., 2010, Penuel, 2006; Trondeur et. al., 2008). The literature shows that the most significant influence on the type of laptop integration that occurs is connected to the impact of teachers’ beliefs about learning and pedagogy (Inan, 2010). The participants in the study underscored the above findings from the literature in their respective discussions about their beliefs and attitudes with regard to pedagogy and student learning. Every participant was clear in expressing their respective student-centered beliefs and how those beliefs play out with regard to their pedagogical tactics employed in the classroom. The literature found that teachers often will utilize instructional technology and laptops according in ways that fit into their pre-existing pedagogical beliefs (Bebel & Kay, 2010; Drayton et. al., 2010; Petko, 2012; Trondeur et. al., 2008). Mueller et. al. (2008) also found that teachers’ pedagogical beliefs can change as a result of positive experiences and outcomes with respect to computer integration. The study participants reflected these key findings in the literature, as they all espoused student-centered beliefs, while also discussing how they have shifted their practices as they have increasingly integrated laptop technology into their practices. This shift is reflected in the discussion of the teachers around how their respective mindsets have undergone a shift that has had them relinquishing more control in order to give students more open-ended and project-based inquiry opportunities.
The literature is inconclusive with regard to measurable gains in student learning and achievement. Much of the data utilized to measure student gains as a result of laptop integration have centered on student attendance, discipline, GPA, subject grades, and standardized assessments (state and national) and such data has been inconsistent from a causal-comparative standpoint (Baylor & Ritchie, 2002; Dunleavy, Dextert & Heinecke, 2007; Holcomb, 2009; Lei & Zhou, 2007; Muir-Herzig, 2004; Weston & Kay, 2010). Other measures of student gains connected to laptop integration have been connected to student reading and writing (Penuel, 2006). Lei and Zhou (2007) get closer to what is more realistic with regard to assessing the impact of laptop integration on student achievement by pointing out that the quality of student interaction with the technology in the context of the activities, the content area, and the teacher’s pedagogical beliefs is paramount to the determination of the overall impact on student achievement and engagement. This last point from the literature is key when examining the responses of the study participants with regard to their perceptions of the impact of effective integration of laptop technology on student learning and engagement. How they went about integrating student-centered activities that leveraged the functionality that laptop technology affords students with regard to access to information, interacting and collaborating and using different platforms to demonstrate their understanding, was key to informing the impact of such activities on student learning and engagement. For the study participants, the impact of effective technology integration has been to shift student mindsets away from a passive learning frame to one where students are pushed to gather, assess, and connect the material to their own assumptions and experiences. Within the approaches discussed above by the participants, their perception is that the impact on student learning is greater independence, creativity, and personalization of the learning experience where students take the subject matter and concepts
and apply them in new ways (independently and collaboratively) that were, heretofore, impossible before the advent of 1:1 laptop access. Thus, the gains discussed by the participants do not refute the inconsistent results in the literature, as they are connected to aspects of student learning that are difficult, if not impossible, to measure statistically. From their perspective, the participants were very clear in their perception that their integration of laptop technology has resulted in perceived gains in student creativity, independence, and their depth of understanding of the content.

**Significance of the Study**

With the explosion of 1:1 laptop and/or computing initiatives in school districts and states across the country, it is key to determine what the impact is of such initiatives on the teaching and learning practices that occur with such technology. As mentioned above, the literature has shown that how such initiatives are conceived and rolled out, how teachers are supported, and what teachers’ attitudes and beliefs are around technology and student learning and pedagogy are key variables that either contribute to or diminish the success of such initiatives. As mentioned above, the literature has shown that the implementation of laptop initiatives have had differing levels of success connected to how those initiatives are rolled out and supported. Further, the way that teachers choose to utilize new technology in the classroom is based on their confidence with the technology, their ability to connect utilization strategies to their specific subject/grade level, and their philosophical approach (teacher-centered vs. student-centered). While the research has indicated mixed results with regard to the success of laptop initiatives, the prospects that high-level integration of laptop technology in the classroom present for teachers and students are very alluring and demand further investigation. Indeed, Penuel (2006) stated that
such ubiquitous access, “...has the potential to transform learning environments and improve student outcomes” (p. 332).

This study is important to the field of education given its focus on both the process by which high-level integrators of laptop technology got there, but also the impact on teaching and learning that such integration can have for teachers and students. This study allowed seven teachers who are integrating technology in highly impactful ways to shed light on their process and specific methods utilized to leverage ubiquitous technology access into highly engaging and empowering student learning activities. Such a perspective is important to add to the literature that surrounds 1:1 laptop initiatives. In the case of this study, the participants were able to provide a lens by which one could view the overall strategies utilized to increase teachers and student access to the technology, the differentiated supports (formal and informal) provided to/for teachers, as well as how these teachers adapted and shaped their practices around the new technology that was in the hands of every student. The lens of Constructivism informed the adaptive process for learning and meaning-making undertaken by both the participants and students as they had to make sense of what ubiquitous laptop access really means as a teaching and learning tool. The findings of the study provided a deeper understanding into how people learn and what opportunities are revealed by laptop access for every student.

Implications for Practice

The findings of this study suggest that, when in the hands of teachers who are student-centered and open to adapting their practice, 1:1 laptop access can have a tremendous impact on how teachers teach and how students learn. In discussing the many challenges and impacts of 1:1 laptop integration at a high level, one can see the possibilities that such access can have to meaningfully empower students to develop original thinking and to find relevance between the
subject matter and their perspectives. The ability to discuss the journey to integration, the impact of it on teaching and student learning and engagement has been truly inspiring, as new ways to teach and to have students demonstrate learning is energizing to behold. That said, the next steps are to develop a way to elevate the practice of many more teachers who have the same access as the participants, but who are not yet at the high level of integration of that technology into their respective practices. This requires more work with teachers, students, parents, and administrators to identify what constitutes effective practices and what the barriers are to all students being exposed to pedagogy that incorporates technology at a high level of efficacy. Naming those practices and developing subject-specific exemplars would be helpful to teachers and students as the implementation continues. The end goal is to use the ubiquitous access to technology that exists to challenge and push teachers to examine and re-examine their beliefs about teaching, learning, the role that technology can play, and the many new and never-before envisioned opportunities that such access can afford teachers and students.

Limitations of the Study

As stated above, this qualitative study was focused on a suburban combined middle-high school that had recently completed a new building that was designed for a wireless computer environment. Further, every grade 7-12 student and all teachers were issued school-owned Macbook Air laptops within a building that was designed to allow each device to access the Internet at the same time. This level of integrated infrastructure and ubiquitous access for students and teachers is not indicative of the infrastructure and access that many schools have, which limits the generalization of the findings. Many schools have much less access and infrastructure capabilities that are hard barriers to the effective integration of laptop technology. Another limitation of the study can be seen in the limited number of participants, as the study
focused on seven teachers who were identified by their subject supervisors and/or the Apple Core coordinator as being high-level integrators/implementers of laptop technology. While the participants were at the middle and high school level and connected to every major subject, the fact that there were seven and that they were high-level integrators makes it difficult to generalize beyond the setting of the study.

Future Studies

Given the limitations with the study discussed above, future studies could focus on examining the perceptions of a higher number of high-level integrators across different schools and subject areas to determine if the similarities that were found in this study with regard to the factors that brought them to implementation, their perceptions of the impact of laptop technology on their teaching and on student learning and engagement are evident across schools. This type of study could include high-level integrators/implementers from suburban and urban schools and would help researchers determine if a common set of themes exists with regard to the research questions across multiple contexts and multiple educators. Further study could also focus on teachers who are not yet at high-level integration to investigate further the link found in the literature between teacher attitudes about technology, pedagogy and student learning and the type and level of technology integration activities that result. Such a study across multiple contexts and involving multiple educators could illuminate common themes with regard to the centrality of the teacher to the implementation/integration process. More research could be conducted around where and how effective technology integration is or can occur within school environments with less ubiquitous access. One could also compare technology integration between schools with different per pupil expenditures to determine if high-level integration is causally dependent on the relative wealth of the district(s).
The purpose of such types of future study would be to identify across a greater demographic of school, student and teaching populations the common themes that could then inform with a greater degree of transferability the common elements that make up successful rollout and implementation of 1:1 laptop initiatives at the classroom level. These types of further study across greater contexts and with more educators could be beneficial to teachers, administrators, and policy makers.

Conclusion

This study was driven by three research questions:

1. How do teachers identified as effectively integrating technology in their instruction perceive their journey to successful integration?

2. How do they perceive technology integration as impacting their teaching?

3. How do they perceive technology integration as impacting their students’ learning?

The responses of the participants during the interviews demonstrated just how many internal and external factors influence the translation of 1:1 laptop technology into meaningful student-centered learning activities. Bebell & Kay (2010) state that, “It is impossible to overstate the power of individual teachers in the success or failure of 1:1 computing” (p. 48). Further, much of the success of technology-based initiatives is dependent on the implementation strategies, pre-existing attitudes about technology integration, student learning, pedagogy, professional development, and ongoing support for teachers and students (Penuel, 2006; Holcomb, 2009). All of the participants stressed the importance of multi-faceted formal and informal supports to build capacity and encourage adaptive learning and practice. Further, it became clear that, with increasing comfort with the technology, the participants found that the wide array of technology tools and applications available was conducive to student-centered
pedagogical approaches that have shifted their role and that of their students. Last, the participants all agreed that the possibilities and applications available are highly motivating and engaging for them as teachers and for their students as they continue to develop more open-ended activities. Thus, the experiences of the teachers in this study underscore the above statements and the perspectives discussed in relation to the research questions are significant for policy makers, school administrators, department heads, and teachers as they investigate and undertake 1:1 laptop initiatives and seek models of what effective integration entails at the system, building, and individual teacher levels.

**Personal Reflection**

When I started to seriously consider undertaking a doctoral program, I was in a school system that was about to undertake a major building project that was creating a brand new, state-of-the-art combined middle-high school designed for the 21st Century. Having been a part of the visioning process and planning stages for this building from the beginning, I found the discussions and research we conducted around what education currently looks like and what we think it might look like in fifty years (the life span of the new building) to be particularly stimulating. Alongside the planning and discussions about the new building, we were also planning the leasing and distribution of laptops to every student to coincide with the new building coming on line.

Seeing what was coming for the high school for which I was principal, I was keen to learn more about how we could prepare teachers to do more with the technology access that was coming. Thus, I applied for the Northeastern doctoral program with the idea that, by the time I was ready to complete my dissertation, we would be at least two years into the new building and laptop program. I remember being very heartened by the fact that conducting action research
within my own school and context was not only supported, but encouraged. My biggest fear was a lack of engagement on my part, as I had heard horror stories about doctoral candidates who, in the end, hated their topics because they had no relation to their own experiences or environment. This couldn’t have been further from the case for me. The study I conducted was topical and allowed me to delve into an area that I found to be missing from the research, which was rich, lived experiences of highly effective integrators of laptop technology. This study also revealed to me the work ahead to move all of the teachers to see and embrace the possibilities as these talented study participants have. This is a difficult and sometimes daunting task but the pay-off is incredible with every success.

The discussions I had with the participants of this study were nothing short of amazing. These educators were, to me, the embodiment of everything that we hope for in a teacher. They were all passionate, creative, engaged, reflective, and centered on how they could better engage their students to and with the subject they were respectively teaching. I discussed above the common theme of “flying blind” discussed by the participants with regard to their experimentation with new technology tools or projects. Seeing that, I realize that, in many ways, we were all flying blind in making the decision to jump into full technology integration with a staff and student body that did not necessarily feel that they were ready for it. The same was true for the administrators charged with making all of this happen. None of us really knew how this would all turn out. In the end, this dissertation has expanded my understanding of what laptops can do in the right hands to elevate teaching and learning far beyond what was ever possible in an “analog” world. Being able to identify those “right hands” and describe some of the incredible work that those teachers were doing with laptops completely energized me. The process also served to validate the work so many of us had been doing for so many years behind
the scenes to help make a wireless 1:1 laptop environment possible and, thus, the great work I was privileged to discuss with the participants.

As a last note, I have moved on to a different high school that is over sixty years old with no technology vision. What is in the future is the start of a visioning process for what a new building will need in order to provide the students with a state-of-the-art education. I find that I have much to say on all of these topics. I find that I am completely invested in sharing what I have been able to see as the possibilities that laptop technology brings to students and teachers. I find that I am actively using the knowledge I have gained from my experiences and from the completion of the real-world study I conducted for my dissertation, which is the point of this entire endeavor.
References


Dear ________________.

I am writing to let you know that you were identified as a candidate for a research study about high-level implementation of 1:1 laptops in the classroom. With the permission of the Superintendent, I asked Subject Supervisors and the Apple Core coordinator for the names of teachers who fit the criteria and who may be willing to be interviewed. You were referred to me as a result of being recognized for the utilization of laptop technology in your classroom that is repeatedly at the modification and/or redefinition level on the SAMR scale.

I am conducting the study for my dissertation at Northeastern University, Boston. This study will explore the perceptions and lived experiences of full time teachers as they explore technology implementation and its impact on teacher pedagogy, and student learning and engagement. The data collection will consist of two interviews with participants of approximately 45-75 minutes in length each. The interviews will be conducted at a time and place of your convenience. Additionally, you will sign a consent form and can withdraw from the study at any time.

At all times, confidentiality will be maintained with regard to your name and information as well as that of the school. In the actual report, pseudonyms will be used. You will be also be able to review the transcripts of the interviews for accuracy prior to the end of the research study. Last, the information gathered in this study will have no bearing whatsoever on your current employment or evaluation status.

I will follow-up this letter with an email. If you determine you would rather not participate, please email me at stephens.an@husky.neu.edu. Agreement to be contacted or a request for more information does not obligate you to participate in any study. If you would like additional information about this study, please email me at the address listed above. Thank for your time in considering your participation in this study.

Regards,

Andrew Stephens
To: Superintendent of Schools, Southeastern MA  
Re: Perceptions of high-level integrators of laptop technology in the classroom  
Andrew Stephens, Researcher

Dear Superintendent,

I am writing to obtain permission to contact educators in your district to participate in a research study about high-level implementation of 1:1 laptops in the classroom. I am conducting the study for my dissertation at Northeastern University, Boston. This study will explore the perceptions and lived experiences of full time teachers as they explore technology implementation and its impact on teacher pedagogy, and student learning and engagement. I would like to contact the Subject Supervisors and Apple Core program coordinator at the Middle-High School for the names of potential participants.

The participants will be interviewed in two semi-structured interview of approximately 60 to 90 minutes after school hours and in a location of their choosing. Participants will sign a consent form and can withdraw from the study at any time. Participants will be able to review the transcripts of the interviews for accuracy prior to the end of the research study.

I can be reached at 617-694-4924 to discuss the study further.

Thank you for your time,

Andrew Stephens
APPENDIX C
SEMI-STRUCTURED INTERVIEW I

Time of Interview:
Date:
Place:
Interviewer:
Interviewee:
Position of Interviewee:

Pre-Interview Topics:
• Purpose of this interview and study is to explore the perceptions and lived experiences of full time teachers as they explore technology implementation and its impact on teacher pedagogy, and student learning and engagement.
• Participants are classroom teachers in grades 6-12 identified to be utilizing laptop technology at a high level on the SAMR model.
• Confidentiality
• Introduction of myself to the participant.
• Review the consent form.

Interview Questions:
1. Please describe your role in school.

2. What is your teaching philosophy?
   Prompt: How do you think students learn best?

3. Before integrating technology into your instruction, how did your teaching philosophy manifest itself in your classroom instruction and assessment?

4. What are your earliest experiences with educational technology as a student?
   Prompt: As a teacher?

5. How do you view the 1:1 laptop access that students and teachers have at this school?

6. How did you come to use and integrate laptop technology in the way you do today?

7. What factors or conditions made it possible for you to integrate laptop technology at a high level in your classroom?

8. How has 1:1 laptop access impacted your teaching philosophy and pedagogical approach to teaching students?

9. How has 1:1 laptop access impacted your teaching and assessment approaches?

10. How has technology integration and your pedagogical shifts enhanced student learning and engagement?
APPENDIX D
SEMI-STRUCTURED INTERVIEW II

Time of Interview:
Date:
Place:
Interviewer:
Interviewee:
Position of Interviewee:

Pre-Interview Topics:
• Purpose of this interview and study is to explore the perceptions and lived experiences of full time teachers as they explore technology implementation and its impact on teacher pedagogy, and student learning and engagement.
• Participants are classroom teachers in grades 6-12 identified to be utilizing laptop technology at a high level on the SAMR model.
• Confidentiality
• Participants were asked for this round of interview to share 2-3 exemplary lessons, projects, handouts, student work samples utilizing laptop technology.

Interview Questions:

Review of teacher provided samples/exemplar lessons, projects, handouts, student work samples.

1. What are specific ways that you have used technology and specifically laptops in your classroom instruction?

2. How did you come to develop these samples?

3. What factors made it possible for you to envision this approach to your teaching?

4. How do these examples reflect changes in your teaching and assessment approaches?

5. How have these activities impacted student learning and engagement?
APPENDIX E
SIGNED INFORMED CONSENT DOCUMENT – PARTICIPANT

Northeastern University, College of Professional Studies
Investigator Name: Andrew Stephens
Title of Project: Investigating perceptions of effective integrators of laptop technology in the classroom

Informed Consent to Participate in a Research Study
We are inviting you to take part in a research study. This form will tell you about the study, but the researcher will explain it to you as well. You may ask this person any questions that you have. When you are ready to make a decision, you may tell the researcher if you want to participate or not. You do not have to participate if you do not want to. If you decide to participate, the researcher will ask you to sign this statement and will give you a copy to keep.

Why am I being asked to take part in this research study?
You have been asked to participate in this study because you are a teacher at the middle-high schools selected for this study and have been identified by a Subject Supervisor and/or the Apple Core coordinator as an effective implementer of 1:1 laptop technology.

Why is this research study being done?
The purpose of this research is to examine the extent to which teachers seek out and use student feedback to improve their instruction.

What will I be asked to do?
If you decide to participate in this study, the researcher will ask for your participation in:

- Participate in two semi-structured interviews that focus on how you implemented laptop technology, and your perceptions on its impact on your pedagogy and student learning.
- Bring to the second interview and discuss samples/exemplar lessons, projects, handouts, and/or student work samples that reflect your implementation of 1:1 laptop technology in the classroom and/or its impact on your teaching and student learning.
- Participate in email or phone communication with the researcher to clarify any questions or concerns the researcher or you may have

Will there be any risk or discomfort to me?
There are no foreseeable risks involved in take part in this study. All responses will be kept confidential and the research will be destroyed after the project is completed. In no way will your participation reflect or be used in an evaluative capacity.

Will I benefit by being in this research?
There will be no direct benefit to you for taking part in the study. However, the information learned from this study may help schools as they implement 1:1 laptop programs in their schools.
Who will see the information about me?
Your part in the study will be held in a confidential manner. There will be no personal identifiers associated with any educator or students participating. Only the researcher of this study will see the information about you. No reports or publications will use information that can identify you in any way, including your school affiliation. All audiotapes, observation forms, and documents will be destroyed upon completion of the study. All email links will be broken and documentation obtained from those links will be destroyed.

If I do not want to take part in the study, what choices do I have?
You are not required to participate in this study. Stopping your participation will not affect your professional standing. At any time during the study, you may refuse to answer questions or end your participation. If you chose not to participate, ignore this form.

Who can I contact if I have questions or problems?
Andrew G. Stephens, Doctoral Student
Northeastern University
Cell # (617) 694-4924
Email stephens.an@husky.neu.edu

Chris Unger, Ed.D
Principal Investigator –Overseeing Study
Northeastern University, Boston
Cell # 857-272-8941
Email: c.unger@northeastern.edu

Who can I contact about my rights as a participant?
If you have any questions about your rights as a participant, you may contact Nan C. Regina, Director, Human Subject Research Protection, 960 Renaissance Park, Northeastern University Boston, MA 02115 tel. 617-373-7570, email: irb@neu.edu. You may call anonymously if you wish.

Will I be paid for my participation?
There is no compensation for participation in this study.

Will it cost me anything to participate?
There is no cost to participate in this study.

Participant Signature: _______________________________ Date: ___________