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HOW DIGITAL FORMATIVE ASSESSMENT
INCREASES STUDENT ACHIEVEMENT AND MOTIVATION

by

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A capstone submitted in partial fulfillment of the
requirements for the degree of Master of Arts in Education.

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CHAPTER ONE

Introduction

Overview

The capstone research question I investigated is as follows: *What is the impact of formative assessment using iPads on student achievement and motivation?* This chapter details my professional and personal experiences regarding technology in the classroom and formative assessment which led to the development of my capstone research question.

My Story

Oh, how times have changed... or have they? On my first day of teaching, I used an overhead projector. I carefully copied my lessons onto transparency sheets and organized them in three ring binders. I mastered the Xerox machine and painstakingly entered my grades into a paperbound gradebook with a #2 Dixon Ticonderoga pencil. My classroom housed a large calendar with upcoming due dates, extra copies of assignments, paperback books, dictionaries, and grammar workbooks. I often stayed late at work because I could not effectively plan out my lessons without access to the materials in my classroom and in the school building. Utter dismay struck me if I ever forgot to bring home my gradebook or prepare my transparencies before Monday morning.

Today, every student in my classroom has his/her own iPad. I can access my lessons anywhere, from any device, at any time. Many of my lessons are Google presentations which are adaptable and easily edited. Infinite Campus, a digital gradebook, stands in lieu of my worn, coffee-stained paper gradebook. I cannot even remember my

copier login code, and I no longer experience pangs of panic or fits of frustration when planning lessons from home since I can access what I need digitally. Schoology, an online digital learning platform, is now home to extra copies of assignments, classroom calendars, recordings of classroom lessons, and resources for my students.

How long have I taught to experience this kind of substantial change? Thirty-two years? Fifteen years? Ten years?

Six.

Embracing technology. My own personal journey in accepting and using technology in my classroom began as a high school teacher two years ago. Each teacher was given an iPad and the capability of AirPlay, which projects wirelessly the iPad screen onto the large projector screen. This small addition of having an iPad gave me more flexibility and creativity as I taught. For example, I began to use the app Notability quite often, which allows one to write, draw, or highlight directly onto a document. I liked it, and a small seed was planted. I also started Schoology pages for all of my classes. From time to time I would post assignments on Schoology, but I did not depend upon it as the sole platform for my courses. Because of these albeit small changes, I began to be more interested in integrating technology into my classroom. Then, I took a job in a different district in which every student has an iPad, and it is the expectation that the teachers utilize the Schoology platform to house everything for our courses. I took this job for many reasons, but perhaps the biggest reason I wanted to get into this district was because of their 1:1 initiative. I wanted to utilize technology more frequently and in a more meaningful way. I am still growing in this area, and have quite a bit of growth

ahead of me, but I cannot imagine going back to teaching without this level of access to technology. It is apparent on the days when Schoology or the Wi-Fi is unreliable just how dependent I now am on technology to teach. I now strongly believe in the benefits of technology in the classroom, and am an advocate for it. This is a drastic change from two years ago, when I would have said technology was a cool tool, but not absolutely necessary; today, I would contend that technology is an indispensable part of a twenty-first century education in America, and that when used well, it has the power to improve student learning in ways traditional teaching methods cannot.

Using formative assessment. Six years ago, formative assessment, the process of gathering student data about their learning and communicating that feedback to students, occurred almost daily in my classroom. For example, I frequently used a formative assessment method called “daily warm ups.” I posted a question or prompt on the board for students to answer; based on their responses, I gauged gaps in their learning and adjusted the class hour activities as necessary. Additionally, I posted learning targets in my classroom. In the last five minutes of class, students wrote down answers related to the learning targets and handed them into me on pieces of paper I called “exit slips.” I checked the exit slips for accuracy and followed up the next day with students who needed extra help.

Six years later, nothing has changed. I use the same formative assessment techniques. From time to time I try using digital formative assessment methods, but the technology is too cumbersome or distracting to make it worthwhile. While I know the methods I use are effective, I wish they could be faster and their results more easily

communicated to students. Scores of research exists on technology, and just as much, if not more, on formative assessment. Very little academic research exists on the benefits of, or even how to, use technology as a formative assessment tool. But why must they exist divorced from one another? If technology in the classroom is transformative, why has it not transformed the level to which students are active agents in their learning experience?

My six years as a teacher have convinced me that formative assessment is transformative. I began using it right away, even as a novice teacher. Creating a culture and a space in which I communicate with my students about where they are at in their learning has had the biggest impact on student achievement in my classroom. I have found that students are more motivated and interested in the task at hand when I communicate with them regarding their learning. Formative assessment detracts from students' tendency to just want an A and refocuses on the value of learning. I get far fewer questions about how many points something is, or when it is due, when I am consistently utilizing formative assessment techniques. Students are more interested in learning than grades in this kind of a classroom culture. They know where they are at, and what they need to do to close any gaps in their learning.

Students' experiences using technology. Last October, a number of my students started asking for paper copies of in class assignments, explaining that they focused better when it was not on their iPad. This self awareness and advocacy is especially impressive since I teach seventh graders. I now provide paper copies of assignments should students want them; it still surprises me how many, and what students, opt for the paper copy. Before this school year, I taught high school for five years. My high school students

absolutely preferred paper copies and refused to type on iPads to draft their essays. I dismissed this common complaint by categorizing them as “digital immigrants” (Prensky, 2001, p. 2) not yet reaching a comfort level in technology until I began teaching seventh grade and heard the same requests. I can confidently say my seventh graders are “digital natives,” (Prensky, 2001, p. 1) extremely adept in their use and understanding of all types of technology. Yet, both groups prefer paper copies in many instances. Furthermore, my observations lead me to informally observe that paper copies often do increase student focus, especially in struggling students.

On the other hand, technology radically improved my students’ writing experiences and the quality of their work. Consider a seventh grade student of mine who struggled to revise their writing. This student could not transfer all the edits from the paper copy back to the digital version; they simply missed several corrections. This student was not an anomaly but maybe the most vocal about their frustration. This gave me an idea to utilize an iPad app called Notability in a different way. This app uploads word documents or text and wields many of the same text editing capabilities of Microsoft Word but with a distinct advantage: it provides the capability to write directly onto the text as if using a pen. In short, it digitizes handwriting. I began using Notability as a revision tool. Students paste their text into it, and their peer editor “writes” directly on top of the text. This eliminated the problem of transferring revisions for my students. This approach improved their writing and strengthened their revision skills. Because the revision process was streamlined, my students focused more easily on the task of thinking

critically about writing. This experience enhanced my teaching and improved student learning.

The two previous examples illustrate my core belief about technology in the classroom. When used for meaningful and higher order thinking tasks, it is transformative. When used solely for convenience, I believe it can hinder student learning. Just because classroom materials are available for use on the iPad does not mean those activities are meaningful or engaging. However, there are some activities that are indeed more meaningful because of technology; I believe digital formative assessment techniques could wield great power in improving student learning. My question focuses on engagement and sharpening teaching methods by using digital formative assessment. Students are engaged not because it is a fancy tool, but because it allows instantaneous and accurate feedback about their learning. Teachers benefit because they can more quickly adapt instruction and have a record of student progress. It is convenient, yes, but for a specific purpose: it makes timely feedback a reality for teachers and students.

The connection between formative assessment and technology. I am focusing on merging formative assessment and technology because I believe that both can be beneficial, but when used together, it could take my students' learning and motivation to even higher levels. Technology made my teaching life more convenient and organized, but has not fundamentally improved my students' awareness of their own learning. This bothers me. Am I simply swapping out paper copies for PDFs and justifying its convenience as claiming it helps create prepared citizens of the digital age? What am I

doing with technology that carries enough weight to justify using it? If day-to-day classroom tasks have simply gone digital, then there is nothing all too dissimilar between classrooms now and fifty years ago. Technology in the classroom must not be used for convenience or novelty. When technology is used without careful consideration to the learning purpose and the complexity of the digital platform, it lowers student achievement (Chu, 2014; Lowerison, Sclater, Schmid, & Abrami, 2006; Peng & Chou, 2007). It is at this intersection I hope to discover effective and efficient formative assessment tools on the iPad so that technology is not just used for the sake of convenience.

Conclusion

My experiences with technology in my classroom, both positive and negative, laid the groundwork for my action research project. While there are certainly many aspects of technology in the classroom one could study, I chose formative assessment because of its impact on my teaching and on my students' learning; I am interested in moving beyond traditional formative assessment techniques and incorporating technology as a formative assessment tool. Technology cannot solely change the housekeeping tasks of a classroom; it should change the way teachers give feedback and the level of which students are aware of their learning progress. Realizing that not all classroom tasks carry more meaning just because they are digitized drives me to use technology more responsibly. As I look ahead, I am excited to discover ways to transform the learning experience by using formative assessment tools on the iPad. Thus, these beliefs are the foundation to my research question: *What is the impact of formative assessment using iPads on student*

achievement and motivation? In the coming chapter, I will detail the research I have found which supports the notion of combining technology and formative assessment.

CHAPTER TWO

Review of the Literature

Overview

Technology has changed the way I approach teaching. It has impacted nearly every dimension of my classroom: how I plan, what I teach, and how I teach it. The integration of technology is not immediately successful or effective solely because of its presence in the classroom; it requires a thoughtful and informed approach in order to improve student learning. This belief is the foundation of my research question: *What is the impact of formative assessment using iPads on student achievement and motivation?* Subtopics that will be addressed throughout this chapter are drawbacks to technology in education, the positive impact of technology in education, formative assessment, and student motivation.

The first section discusses formative assessment and the role it plays in guiding student learning. Next, the second section examines adolescent motivation and what factors may increase or decrease students' motivation levels. The third section presents a justification for the use of technology in the classroom as well as a close look at the ways students today interact with and use technology. Lastly, the fourth section presents concerns regarding the format and structure of digital learning tasks, environmental effects of technology, and technology's impact on critical thinking skills.

Formative Assessment

Definition of formative assessment. Formative assessment is the ongoing practice of using evidence of student learning to identify gaps in students' learning,

giving students specific and helpful feedback to remediate their learning, and modifying instruction in light of student performance (Black & Wiliam, 1998; Hudesman et al., 2013; McMillan & Cauley, 2010; Wang, Wang, Wang, & Huang, 2006). Formative assessment does not count against a student's grade, as its purpose is to identify gaps in a student's understanding and provide a way to close that gap. Ideally, formative assessment is used frequently enough so that the student is aware of any holes or gaps in their understanding of a given concept. The emphasis is placed on mastery of the material, and not on grades; formative assessment provides feedback to both the student and teacher regarding how well the student understands the content. Using this data, the teacher adjusts their teaching to best meet students' needs (Black, Harrison, Lee, Marshall, & Wiliam, 2004; Black & Wiliam, 1998; Hudesman et al., 2013; Macfarlane-Dick & Nicol, 2006; McMillan & Cauley, 2010). However, effective formative assessment does not merely use data about student learning to change the way a teacher teaches; its very nature is that it should give specific and detailed feedback to the student about their learning, and show them how to reach mastery of the material (Black et al., 2004; Black & Wiliam, 1998; Hudesman et al., 2013; Macfarlane-Dick & Nicol, 2006; McMillan & Cauley, 2010).

Definition of summative assessment. In contrast, summative assessment is when “evidence only records student achievement” (McMillan & Cauley, 2010, p. 1) of the final product or demonstration of what the student has learned. Traditionally, this would be a final test or essay, for example. Often times, summative assessments cannot be redone, and do count toward a student's grade in the course. Although policies might

vary from teacher to teacher, the idea is that a summative assessment is the final product of student learning and is graded using content standards. Formative assessment is therefore valuable because it indicates how well a student will perform on the summative assessment. However, the effectiveness of formative assessment is not that it merely will improve a student's scores on the summative assessment. That is a product of it, but not the primary goal. Its primary goal is to empower and enable students to become motivated and self aware when it comes to their learning (Black et al., 2004; Black & Wiliam, 1998; Hudesman et al., 2013; Macfarlane-Dick & Nicol, 2006; McMillan & Cauley, 2010). When this happens, higher levels of achievement will follow.

Misconception about formative assessment. When employed effectively, it does not merely provide pieces of data that reflect student learning; rather, it gives students the opportunity to become a self-guided learner (Black et al., 2004; Black & Wiliam, 1998; Hudesman et al., 2013; Macfarlane-Dick & Nicol, 2006; McMillan & Cauley, 2010). A misconception about formative assessment is that it is enough to tell students where they are right and wrong, and that this information alone will empower students to make the necessary changes in their work (Black et al., 2004; Macfarlane-Dick & Nicol, 2006). This is not valuable formative assessment, and as Black and Wiliam (2004) argued, it is actually not authentic formative assessment, since its defining characteristic is when “the evidence [of student learning] is actually used to adapt the teaching work to meet learning needs” (p. 10). For it to be worthwhile, formative assessment must change the way teachers teach; teachers must be flexible and willing to pace the curriculum as necessary, or reteach concepts in various ways, so

students truly learn it. Using formative assessment changes teachers' mindsets from being worried about what they are going to teach when, to whether or not their students truly understand the content (Black et al., 2004; Black & Wiliam, 1998). Formative assessment not only changes the way teachers approach teaching, but it also changes the way students learn.

Characteristics of effective use. For formative assessment to be useful for students, three conditions must be met: as explained by Macfarlane-Dick and Nicol (2006) "students must know... what good performance is... how current performance relates to good performance... [and] how to act to close the gap between current and good performance" (p. 204). It is not a score reflecting the student's performance, but rather is valuable feedback that enables the student to improve their performance. Rather than just being a snapshot, it actually facilitates learning. It shows the student what they need to do to improve; it goes far beyond just telling them that they need to improve (Black et al., 2004; Black & Wiliam, 1998; Wang et al, 2006). Simply put, it shows them how they can improve. This is significant because when the emphasis is placed on mastery and not on grades, students actually perform at much higher levels (Black et al., 2004; Black & Wiliam, 1998; Wang et al., 2006). High quality and frequent formative assessment fosters motivation and enables students to perform at high levels.

Additionally, if the classroom culture is such that emphasis is placed on effort, and not on ability, students will be motivated and will achieve at high levels (Dweck, 2006; McMillan & Cauley, 2010). In this classroom environment, students are not compared to one another, and learning is not treated as a competition; mistakes are

regarded as necessary to learning (McMillan & Cauley, 2010). This normalizes what students perceive as failure, and reshapes it to be a beneficial part of the learning process.

Relationship between formative assessment and motivation. Intrinsic motivation is increased using formative assessment (Black et al., 2004). Students who are intrinsically motivated hold a mastery-goal orientation, which as McMillan and Cauley (2010) note, “emphasizes learning, understanding, improving, mastering new skills, and taking on challenges” (p. 3). First, these students believe that they can learn. If students believe they can be successful, even if it might take them longer than others, they will put forth effort to learn (Black et al., 2004). They believe that they are not born with a fixed amount of intelligence, but can actually become smarter. They also attribute their successes not to their level of intelligence, but rather to their level of effort and dedication (Dweck, 2006; McMillan & Cauley, 2010). Second, intrinsically motivated students are aware of whether or not they are learning. Because they value the importance of understanding, they will be vocal in communicating that fact (Black et al., 2004). Third, intrinsically motivated students use deep learning strategies, defined by McClintic-Gilbert and Corpus (2013) as strategies that “represent active cognitive engagement on the part of the learner” (p. 2), which ultimately result in higher achievement levels and a higher level of one’s “perceived competence” (p. 2).

Motivation

Decline in motivation. Researchers have found a sharp decline in motivation during the middle school years (Anderman & Maehr, 1994; Kiefer, Ellerbrock, & Alley, 2014; Ryan & Patrick, 2001). Many students experience a change in their motivation

levels, or their willingness and eagerness to learn and achieve. While this is never a positive development, it is particularly concerning during the middle level years, which are a time of immense change and also crucial to developing one's sense of self (Anderman & Maehr, 1994; Ryan & Patrick, 2001). The middle school years are a tumultuous time for students, with drastic changes occurring socially and developmentally. Ryan and Patrick (2001) observed the phenomenon that adolescents "doubt their ability to succeed at their schoolwork" and put forth less effort as a result (p. 439). Socially, adolescents strongly desire to be accepted by their peers. They are preoccupied with finding their unique identity and fitting in with other peers. Although positive adult relationships have an immense impact on their lives, adolescents will prioritize their peer relationships because it is so vitally important to them.

Developmentally, adolescents are experiencing rapid change, in which their motivation levels are directly impacted. There is a drastic and substantial shift in early adolescents' view of attribution, or to what they give credit for their success (Anderman & Maehr, 1994; Ryan & Patrick, 2001). Instead of believing that they can become more intelligent, or that their academic success is largely due to effort and not to ability, early adolescents, as Anderman and Maehr explained (1994), have "a pervasive belief that abilities are fixed traits" (p. 290). Additionally, as cited in Anderman and Maehr (1994), the work of Dweck on motivation also supports this claim, noting that adolescents have a strong tendency to characterize ability as a "stable, internal trait and as less related to effort than they did earlier" (p. 290).

If an adolescent student experiences failure in a given subject area and does not have the motivation to persist in learning the concepts, even when it is hard, it is more likely s/he will view themselves as not intelligent and give up trying altogether (Anderman & Maehr, 1994; Ryan & Patrick, 2001). They may do this to save face, or even to preserve their sense of self, since it is less discouraging to not try and fail at a task than to put forth effort and still fail (Anderman & Maehr, 1994). The former is less risky, since they do not have to question whether or not they are capable since they did not even try (Anderman & Maehr, 1994). The latter can be intimidating to adolescents, since they are likely to perceive that if they fail at a task, even when they try, they are unintelligent (Anderman & Maehr, 1994). The tendency of adolescents to experience a decrease in motivation, coupled with their already fragile sense of self, may lead to lower academic achievement than they previously experienced (Kiefer et al., 2014). The implications for this decreased level of achievement means that the adolescent's future academic and career opportunities could very well be diminished.

While adolescents may not be aware of it, they are making choices that could dramatically impact their future. Anderman and Maehr (1994) observe that for the first time in their lives, adolescents in the middle grades are dealing with entering the process of becoming an adult since "school investment during the middle grades may have serious and enduring effects on shaping career patterns and life choices" (p. 289). This is a challenge unlike any they have faced previously, and the transition can be daunting. Adolescence is a time of immense change. During this time, students are investigating their interests, hobbies, and strengths; as such, they are experiencing a certain level of

pressure to figure out what they will do, and who they will be, as an adult. They are actively developing their sense of identity and determining what their strengths and weaknesses are. Their level of intrinsic motivation becomes vital, since prematurely shutting out certain fields of study in the middle grades due to a lack of motivation may negatively harm their career options later on in life (Anderman & Maehr, 1994, p. 289).

Intrinsic and extrinsic motivation. Intrinsic motivation may be viewed as the attitude or willingness to persist at a given task despite difficulties, and to view it not as a failure but as a learning opportunity (Anderman & Maehr, 1994; McClintic-Gilbert, Corpus, Wormington, & Haimovitz, 2013). Students with intrinsic motivation, as McClintic-Gilbert and colleagues (2013) noted, means they are “learning for the sake of learning” (p. 2). They are not shattered when they experience hardship while learning a new concept or skill, but rather are energized by the challenge it presents. They believe that their ability to succeed is not dependent upon their level of intelligence, but rather on their level of effort (Dweck, 2006). In fact, they do not even believe that they are given a set amount of intelligence; they believe they can become more intelligent if they are willing to put forth time and effort. Intrinsically motivated students are not driven to succeed by outside factors such as grades or praise (Anderman & Maehr, 1994; McClintic-Gilbert et al., 2013). In fact, achieving high grades is not their first priority, although it is very likely it will be a byproduct of their attitude and habits. Rather, they engage in tasks simply because they enjoy the challenge, and believe themselves to be capable of success.

Extrinsic motivation, on the other hand, is the tendency to view learning as “a means to an end” (McClintic-Gilbert et al., 2013, p. 2). Extrinsically motivated students do not value learning in and of itself; they are not driven to learn because they enjoy the challenge or are simply interested in something. They tend to use learning strategies that focus on rote memorization rather than truly understanding the material (Anderman & Maehr, 1994). Additionally, their actions and habits are directly linked to outside rewards given to them, be it praise or tangible items. Teachers unknowingly reinforce extrinsic motivation by offering praise to a student about accomplishing a task that was not that difficult (Hudesman et al., 2013). Additionally, setting up a token economy in the classroom, in which students are constantly rewarded for certain behaviors in an effort to modify their behavior or attitude, also fosters extrinsic motivation in students (Anderman & Maehr, 1994; Kohn, 1993). McClintic-Gilbert and colleagues (2013) investigated the relationship between intrinsic motivation and effective study habits and noted that intrinsically motivated students have more sophisticated approaches in studying and learning when compared to their extrinsically motivated peers, who are more likely to have poor study habits and use shallow learning strategies (pp. 2-3). Extrinsically motivated students tend to focus on task completion and not on genuinely engaging and understanding the material (McClintic-Gilbert et al., 2013).

Affecting change on student motivation. Although the changes adolescents experience concerning motivation is significant, it does not mean that their motivation levels cannot be impacted or changed. Educators can implement many approaches in their classroom to foster intrinsic motivation in their students. First, developing strong

and meaningful connections with students has a significant impact on their motivation (Kiefer et al., 2014; Ryan & Patrick, 2001; Wentzel & Wigfield, 1998). Second, teachers can work to promote a growth mindset in their classrooms through a variety of teaching methods. This contributes to higher levels of intrinsic motivation and achievement for students. Third, middle level educators can be mindful to create an environment that meets the unique cognitive needs of adolescents.

Positive connections with teachers. Fostering strong and positive relationships with students leads to increased student engagement and effort (Kiefer et al., 2014; Ryan & Patrick, 2001; Wentzel & Wigfield, 1998). Ryan and Patrick (2001) defined teacher support as “the extent to which students believe teachers value and establish personal relationships with them” (p. 440). An increase in student achievement motivation is a product of positive teacher support (Kiefer et al., 2014; Ryan & Patrick, 2001; Wentzel & Wigfield, 1998). Strong connections between teachers and students is perhaps the most critical aspect in increasing student motivation and achievement (Kiefer et al., 2014; Ryan & Patrick, 2001). Unless students know that their teacher cares about them on a personal level, and is interested in learning more about them, they are not invested in the learning taking place in the classroom. In other words, meaningful learning cannot occur unless students believe their teacher genuinely cares about them (Kiefer et al., 2014; Ryan & Patrick, 2001; Wentzel & Wigfield, 1998). In fact, this support has a bigger impact on middle level students’ motivation levels than it did during elementary school (Ryan & Patrick, 2001). These strong relationships enable teachers to set high expectations for the students; when high standards are communicated within the context

of a strong relationship, student academic motivation and achievement is dramatically impacted in a positive way (Kiefer et al., 2014). Therefore, in an effort to increase adolescent motivation, educators must be purposeful in establishing these connections with every student (Kiefer et al., 2014; Ryan & Patrick, 2001; Wentzel & Wigfield, 1998).

Pedagogical approaches to increase growth mindsets. Although teachers can only control their own classroom environment, this can still have substantial positive change on students' motivation levels, even if it is just in that particular classroom (Anderman & Maehr, 1994; Kiefer et al., 2014). Even though students enter the classroom with many different beliefs and attitudes, the type of mindset they adopt in a particular classroom is greatly determined by the classroom environment, and not by their prior experience (Anderman & Maehr, 1994; Kiefer et al., 2014). Therefore, establishing approaches that emphasize mastery of the material, and not achieving high grades, is not in vain. Teaching students deep learning strategies may be beneficial since there is a strong correlation between intrinsic motivation and deep learning strategies (McClintic-Gilbert et al., 2013). McClintic-Gilbert et al. (2013) defined deep learning strategies as “represent[ing] active cognitive engagement on the part of the learner and tend[ing] to involve techniques that help students assimilate and connect new material with prior knowledge” (p. 2). These strategies lead to authentic learning for the student. Intrinsically motivated students employ these techniques because they are genuinely interested in learning, not just rote memorization or academic performance. Additionally, employing frequent and low-stakes formative assessment strategies contribute to

increased intrinsic motivation. These strategies give students ample opportunities to engage with the material, to connect new concepts with what they already know, to engage in meaningful dialogue with their teacher and peers about these concepts, and to identify gaps in their learning. Utilizing both deep learning strategies and formative assessment helps to develop a growth mindset in students (McClintic-Gilbert et al., 2013). As Dweck (2006) noted, they believe that they can learn, and that their intelligence is not fixed; they are invested in the learning process because they have found meaning in it. The classroom learning environment is crucial in developing a student's motivational levels and outlook.

Effective classroom learning environment. The unique changes adolescents face demands a learning environment to meet their needs. In addition to experiencing safe, supportive, and positive relationships with their teachers, the unique and rapid developmental changes adolescents experience require multiple opportunities for autonomy and creative thinking (Anderman & Maehr, 1994; Kiefer et al., 2014; Ryan & Patrick, 2001). Therefore, context is crucial to fostering adolescent motivation. Even the change from elementary school, where a student has one teacher for the entire day, to multiple teachers throughout the day, can be a contextual change which students find overwhelming. But establishing strict rules and punishments in response to adolescent behavior is ineffective; they need to feel liked, respected, valued, and held to high expectations. The learning environment will best facilitate adolescent intrinsic motivation when it is positive, but also when the learning tasks are interactive, challenging,

interesting, and require creative and critical thinking (Anderman & Maehr, 1994; Kiefer et al., 2014; Ryan & Patrick, 2001).

In sum, student motivation levels tend to decline in adolescence. Teachers can instill intrinsic motivation in students through positive relationships, pedagogical approaches, and creating a classroom environment that encourages growth mindset thinking. In the coming section, common concerns regarding technology use in the classroom will be discussed.

Concerns About Technology in Education

Technology in the classroom may well be compared to a sharp scalpel in the hand of a doctor. When used by a capable and talented surgeon, the scalpel can work nothing short of miracles. But when used by a poorly trained doctor, the scalpel means certain and irreversible harm. Just because a teacher and his students receive mobile learning devices, such as laptops or iPads, does not mean an increase in students' critical thinking skills, motivation levels, or learning will follow.

Although there are clear benefits to technology in education, several drawbacks must be considered. First, successful and meaningful technology use does not merely happen once devices are placed into teachers' and students' hands; in fact, without certain parameters, it is actually detrimental to student learning (Chu, 2014; Morgan & Olivares, 2012; Peng & Chou, 2007; Wang et al., 2006). Additionally, the concern of environmental sustainability is a valid one, as is perpetuating the Western belief that rapid development and consumption of technology goods is permissible (Elshof, 2009; Johnson, 2012; Palfrey & Gasser, 2008). Lastly, there is concern for the tendency of the

automation of technology to suppress critical thought in students (Diem, 2006; Lowerison et al., 2006).

Format and structure. The structure of digital learning activities determines the likelihood of a successful learning experience. If the digital platform is too complicated, requires students to consider too many ideas at once, or is confusing in structure or content, the likelihood of learning decreases (Chu, 2014; Peng & Chou, 2007). When students are using digital devices, they are being asked to interact with both the real and digital world simultaneously (Chu, 2014). The cognitive load of the digital task, or to what level performing a certain task strains the cognitive system, must not be overwhelming (Chu, 2014; Peng & Chou, 2007). The result of overly complex digital platforms ~~cause~~ is for student learning experiences to be unsuccessful since the task requires too much working memory (Chu, 2014; Peng & Chou, 2007). Instead of being able to focus on the content, a student is distracted and overwhelmed by the technology, having to devote most of their working memory to successfully complete the technological task.

When developing digital learning activities, the digital learning platform used must not be overly complicated (Chu, 2014; Peng & Chou, 2007; Wang et al., 2006) and it should require active and meaningful engagement of the learner (Morgan & Olivares, 2012; Peng & Chou, 2007). Baddeley and Hitch, as cited in Chu (2014), discussed how “human working memory can handle only a very limited number of novel interacting elements, possibly no more than two or three” (p. 333). The complexity of the digital platform must be appropriate in light of the academic task. When digital learning

activities place too a high cognitive load on students, learning decreases when compared to students learning the material from traditional modes of instruction (Chu, 2014).

Therefore, if not properly designed or executed, digital learning activities can actually significantly inhibit learning when they place too high a cognitive load on students (Chu, 2014, pp. 339-340). On the other hand, if executed well, digital learning activities lead to higher student achievement compared to traditional instructional models (Chu, 2014; Wang et al., 2006) and allow students to interact with the curriculum using higher-order thinking skills (Peng & Chou, 2007).

Environmental effects of technology. The rate at which Western cultures design, manufacture, and discard technologies is incredible. The rapid dissemination and short life span of technological devices is considered not only normal, but inevitable, in the name of technological advancement. Thus, wisdom regarding the invention, use, and discarding of technological devices must be instilled in students. As Elshof (2009) pointed out, although “young people are not responsible for designing or creating the technological systems within which they live, they are nonetheless active participants in its evolution... [they] have a vital future interest in the direction they take” (p. 138). It follows, then, that our educational system has a certain level of responsibility in regards to preparing our students to be wise, critical thinkers regarding technology (Elshof, 2009; Johnson, 2012; Palfrey & Gasser, 2008). Elshof (2008) notes that producing citizens who are capable of engaging in “technology critiquing” is a necessary component of a true “democratic education” (p. 139). It is necessary that we not only teach our students how

to use technology, but how to be wise stewards of it (Elshof, 2009; Johnson, 2012; Palfrey & Gasser, 2008).

It is important to engage students in conversations regarding “specific knowledge, critical thinking capacities or capabilities with respect to the environmental and broader sustainability dimensions of technical thinking, design and capability that ‘technologically literate’ young people will need in the upcoming decades” (Elshof, 2009, p. 135). Education must prepare students for their future reality: this rapid production of waste could be unsustainable and might be problematic in the coming years. As a curriculum topic in education, the idea is not to demonize technology, but rather to cultivate citizens who are able to critically think about technology and develop sustainable practices regarding its production and consumption (Elshof, 2009; Johnson, 2012; Palfrey & Gasser, 2008).

Critical thinking. If not organized thoughtfully, technology in education can lead to the suppression of critical thinking (Diem, 2006; Lowerison et al., 2006). The intent of the instructor largely determines whether or not technology is being utilized to foster critical thinking or to inhibit it (Diem, 2006). Additionally, Lowerison (2006) noted that “the mere presence or use of computer technology does not guarantee a benefit to learning” (p. 403). When technology is primarily used to obtain right and wrong answers and disseminate information, students are only required to be passive recipients rather than active, thoughtful participants. In this situation, Diem (2006) noted that technology is merely being utilized to “reinforce society’s norms” and not to cultivate creative thinking (p. 150).

Ideally, as Diem (2006) explained, the utilization of technology in classrooms contributes to “the development of the potential of the individual” (p. 152). In this paradigm, the primary purpose of education is to develop the individual as a thoughtful, critical thinker who realizes their place in the culture, and technology is viewed as a supplementary tool to help accomplish that. Indeed, technology is regarded as a necessary tool in this model, since we must prepare our students for the digital age in which they will live (Elshof, 2009; Johnson, 2012; Palfrey & Gasser, 2008). However, the presence of technology should not detract from the development of students’ inquiry, analytical, critical, and problem-solving skills; rather, it must enhance those skills. Whether the presence of technology undermines critical thought or encourages it rests largely with the pedagogical intents of the teacher (Diem, 2006). Thus, effective training of teachers in this regard will help ensure that technology is enhancing, rather than suppressing, critical thought.

Technology in the Classroom

Justification for technology use. The pervasiveness of technology on the American culture today means that educators must prepare students for how to use it and interact with it (Johnson, 2012; Elshof, 2009; Peng & Chou, 2007). Currently, over two billion people in the world have internet access, and that number is expected to reach five billion by 2020 (Pitler, Hubbell, & Kuhn, 2012). Technology has transformed society and its innovations continue to have implications for classroom instruction (Johnson, 2012; Morgan & Olivares, 2012; Peng & Chou, 2007; Pitler et al., 2012; Thompson & Bieger, 2006). Minnesota State Standards include Media Literacy standards that must be met

(Minnesota Department of Education, 2015). Teachers are required to teach students how to use technology to demonstrate what they have learned, as well as how to critically analyze various forms of media for bias and meaning. In the classroom, the emphasis should not solely be placed on what types of technology to use; as Thompson and Bieger (2006) point out, the more important consideration is for teachers to decide how technology is best utilized to meet various pedagogical goals (p. 125).

Furthermore, educators must not only learn to distinguish what types of technology are best for certain tasks, but it is critical they instill this ability in students (Peng & Chou, 2007; Pitler et al., 2012). The issue is no longer that there is only a few types of technology, but that the nature of technology now is characterized by an abundance of programs, types, devices, and virtually instant access to any type of information. Therefore, it is necessary that students are taught skills related to digital citizenship (Elshof, 2009; Johnson, 2012; Pitler et al., 2012). The reality of our students' future is that technology will be a fundamental part of it. In order to be an effective citizen, the educational system must ensure students leave with the ability to use technology, to distinguish between valid and weak information accessed via technology, to determine what types of technology meet various tasks, and to be able to adapt to the unknown future types of technology (Johnson, 2012; Pitler et al., 2012). The pervasiveness of technology is not the sole reason technology must be used. Technology in the classroom creates an effective and transformative learning environment.

Technology can powerfully transform the classroom. Student learning is improved by technology and increases students' ability to make connections to prior knowledge

(Morgan & Olivares, 2012; Pitler et al., 2012). When used technology is used effectively, and when clear instructional goals are communicated to students beforehand, student learning is improved (Pitler et al., 2012; Thompson & Bieger, 2006). Students are able to collaborate more effectively and meaningfully using technology tools, and student learning is placed at the heart of instruction (Johnson, 2012; Morgan & Olivares, 2012; Pitler et al., 2012). Technology can enable teachers to truly create a collaborative environment that is student centered. The structure of the classroom can more easily shift from a teacher-dominated model, in which knowledge is transferred to students, to a student-centered model, in which students are active participants in the learning process. The mobility of technology today means students can engage in learning outside of the classroom, such as in the flipped classroom model, or simply because they have continuous access to learning materials and can dialogue with their peers and instructors outside of class (Johnson, 2012; Morgan & Olivares, 2012; Pitler et al., 2012). Because of technology, students can interact with the world and knowledge in a way that is not nearly as feasible without it. Technology has long been able to assist in strengthening students' basic skills and knowledge, but the advent of new and innovative technologies allows students to do much more.

Technology tools enable students to engage in higher order thinking skills. Bloom's Taxonomy lists six steps of engagement with learning; from more basic skills to higher order thinking skills, they are to remember, understand, apply, analyze, evaluate, and create (Pitler et al., 2012). Technology has the ability to help students to remember and understand concepts and skills without the instructor. Learning software programs

have automated that process. But what is significant is that technology lets students evaluate and create; at these levels, technology is not just used as a substitution for what is traditionally done on paper, but as a way for students to use what they have learned to create an original product. This process requires higher order critical thinking skills. Activities and projects that require students to create something that demonstrates their learning facilitates student choice, independence, autonomy, freedom, and creativity.

Digital natives. Students today interact with technology in drastically different ways than their adult counterparts (Palfrey & Gasser, 2010). The presence of technology has been a constant in their lives; they are extremely adept in using it and constantly use it in different ways. The term “digital natives,” coined by Prensky (2001), refers to our students, since “our students today are all ‘native speakers’ of the digital language of computers, video games, and the Internet” (p. 1). Because of their vast experiences with technology, Prensky (2001) explained that “it is very likely that *our students’ brains have physically changed* – and are different from ours – as a result of how they grew up” (p. 1). To a digital native, life is lived both online and in the real world, and there is no distinction between the two (Palfrey & Gasser, 2010; Pitler et al., 2012). Their social interactions are concentrated digitally, and they share their lives with others using endless social media platforms (Palfrey & Gasser, 2010; Pitler et al., 2012). They are well connected to their peers and to the larger world. They are constantly interacting with their peers through texting, Facebook, Snapchat, Vine, or YouTube, just to name a few. They are well adept at picking up on new software or apps, and have a knack for creating or altering many different types of media, such as pictures, video, or sound (Palfrey &

Gasser, 2010; Pitler et al., 2012). To a digital immigrant, a term explained by Prensky (2001) as someone “not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of the new technology” (pp. 1-2) the digital native can at times be baffling. The two generational experiences are so substantially different that at times it feels like digital natives live in a different world altogether. In many ways, they do. This difference need not be negative, however, but it should be observed.

The difference between digital natives and digital immigrants has an important implication for teaching. Technology has permeated our culture, it has enhanced student learning, but most importantly, it has fundamentally shaped the lives of digital natives (Palfrey & Gasser, 2010; Pitler et al., 2012). As Prensky (2001) pointed out, to digital immigrants, technology is something still a little unfamiliar and new; it is not inherently second nature (p. 2). But to the digital native, delineating between the digital and real world might not even occur to them. As such, there are certain considerations for how to protect the digital native, and for how to channel the remarkable skill set they have attained concerning technology.

First, educators must teach digital natives a level of caution and responsibility when it comes to the digital world (Johnson, 2012; Palfrey & Gasser, 2010). It is natural to the digital native to share information about themselves digitally (Johnson, 2012; Palfrey & Gasser, 2010). This is, indeed, a significant way that they interact with the world around them. However, concerns about children’s safety is valid. Cyberbullying, online predators, and inappropriate content is a reality digital natives encounter. Engaging

students in conversations regarding these topics is essential to helping them interact with technology in a safe way. Indeed, schools have already begun to address such issues, as illustrated in the recent anti-bullying law Minnesota enacted. Palfrey and Gasser (2010) pointed out that “we can, as a society, handle them in the digital age, too, without the hysteria that has surrounded them” (p. 10). Rather, it is much more impactful to approach these topics with students in a calm, open, and honest manner. Thus, the education students receive must explicitly teach them about how to protect themselves online.

Next, harnessing the skill set of digital natives can be beneficial in creating a meaningful learning environment. For example, if teachers are anxious about their level of technology competence, peer grouping is an effective strategy that mitigates the pressure of the teacher to have all of the answers (Thompson & Bieger, 2006). In many cases, students have a higher level of competence and comfort level concerning technology than adults, and their skill set can be utilized in the classroom (Palfrey & Gasser, 2010; Pitler et al., 2012; Thompson & Bieger, 2006). This approach does not lessen the authority of the teacher, but rather invites students to participate in a collaborative environment. Additionally, students can be central to helping teachers meaningfully integrate technology into the classroom (Palfrey & Gasser, 2010; Pitler et al., 2012; Thompson & Bieger, 2006). Providing opportunities for students to give feedback about the effectiveness of technology integration, and letting them contribute ideas to how technology can be used to learn, is a powerful way to create a student centered classroom.

Conclusion

Technology, student motivation, and formative assessment are closely related and overlap in many areas. In this digital age, it is necessary and beneficial to integrate technology into the classroom. Doing so improves student learning and achievement, and also strengthens the digital skill set they will need to be successful. Technology cannot be divorced from today's classroom, and therefore, investigating effective ways to implement it in my classroom in regards to formative assessment drives my research question. Formative assessment is an extremely effective intervention that improves student learning and understanding. Traditional modes of formative assessment have not been digital, and a new body of research investigating the effectiveness of digital formative assessment has emerged. Adolescent motivation is increased through a meaningful learning environment and strong, positive relationships with teachers. Therefore, all three areas interact with one another and contribute to the same end goal: improving student learning. My research question, *what is the impact of formative assessment using iPads on student achievement and motivation?*, investigates how to effectively use both formative assessment and technology to increase student motivation, and as a result, student achievement. In chapter three, I detail the research methods used when I conducted my action research project.

CHAPTER THREE

Methods

Overview

Technology in education is here to stay. Examining effective ways of its implementation is important, since technology in and of itself does not improve student learning (Chu, 2014; Lowerison et al., 2006; Peng & Chou, 2007). When used effectively, technology can drastically improve student learning. Formative assessment is the process by which teachers collect data about student learning, communicate that data to students, and often suggestions and direction to students to close any gaps in their learning. Formative assessment improves student learning. For my research study, I investigated if there is a marked difference in using digital formative assessment techniques as compared to traditional formative assessment techniques. This chapter explains the methods I used to investigate my research question, which is: *What is the impact of formative assessment using iPads on student achievement and motivation?* First, I describe my research paradigm and research method. Next, I describe the participants in the study and the methods I used to collect data. Finally, I explain the tools I used to collect data.

Research Paradigm

I chose a mixed methods approach as my research paradigm. This means I collected both qualitative and quantitative data as a way to evaluate my research question. I hoped to discover if formative assessment is more beneficial when delivered digitally, and what types of formative assessments lend themselves best to a digital platform. I felt

using a mixed methods approach produced a clearer understanding about the effectiveness of digital formative assessment rather than solely relying on one data collection tool. I not only gathered quantitative data about student achievement scores, but also elicited student feedback about their experience using digital formative assessment. Mills (2007) explained the importance of triangulation, in which a researcher draws upon multiple sources of data to ensure accuracy and validity in the research (p. 56). Thus, I used the mixed methods to ensure I would not solely rely upon one source of data to interpret the research.

Quantitative Methods

The quantitative research method plan I used compared student pre- and post-scores to determine the effectiveness of digital formative assessment as compared to their pre- and post-scores from a unit that exclusively used traditional formative assessment. I also compared one class to another, and examined how effective traditional and digital formative assessment were within each of these class hours. Comparison of these units to one another, both by averaging the classes together and examining their performance separately, provided me with useful data regarding the impact that traditional and digital formative assessment had on their achievement levels.

Qualitative Methods

I used a reflective journal (see Appendix A) and student surveys (see Appendix B) as qualitative research methods. The journal provided insight into the impact of digital formative assessment on student motivation and interest. It also revealed how the process changed me as a teacher, and what challenges I faced in implementing digital formative

assessment. I wrote in the journal once a week, and each journal entry contained three sections. In the first section, I described the lesson's learning goals and activities. In the second section, I reflected upon the effectiveness of the lesson overall by describing my informal observations of the lesson's success, and also by including student comments and observations. I also wrote extensively about the effectiveness that either the traditional or digital formative assessment tools were having on student learning, and how it was shaping our experiences in the classroom. In the third section, I wrote about any improvements I could make to the formative assessment techniques, digital or traditional.

Secondly, the student surveys (see Appendix B) gave students opportunities to voice their own opinions and share their experiences concerning digital and traditional formative assessment. These surveys were anonymous and were administered before and after each unit of study, for a total of four times. I facilitated this student feedback by using Google forms, which was administered to students online, and ensured students' complete anonymity.

Research Method

My research method was based on constructivism. Constructivism is grounded on the belief that genuine learning occurs when students construct their own understanding by connecting concepts to their own experiences and ideas (Creswell, 2013, Chapter 1, para. 14). I chose this method because I believe that genuine learning occurs when students shape the learning themselves; in short, they investigate questions and connect their learning to prior knowledge. A constructivist classroom is one where students are

aware of their own learning (metacognition) and know what they need to do to become an expert. Better yet, they become an expert because they are simply interested in what they are learning about. Connected to my research, I wanted to determine if digital formative assessment is more meaningful in the aforementioned process than traditional formative assessment techniques.

Participants

Participants in the study were 56 seventh grade students, aged twelve to thirteen years old. The study was conducted at a middle school in suburban Minnesota. The students were in a regular seventh grade Language Arts classroom (not advanced or accelerated students). The class format was an 88 minute block every school day.

The particular makeup of each class is as follows: Block 1 contained 15 students in Special Education; 2 students who were English Language learners; 20 boys and 13 girls. Block 2 contained 1 student in Special Education; 12 boys and 11 girls.

Methods

I conducted my research over a period of six weeks, beginning on October 7, 2015 and concluding on November 24, 2015. To determine the effectiveness of digital formative assessment, I gathered qualitative and quantitative data over two units of study: the first unit utilized solely traditional formative assessment, while the second unit of study exclusively used digital formative assessment. Before and after both units, students were given a pre- and a posttest. The first unit's topic was literary elements, and the pre- and post- tests given (see Appendix C and D) were the same tests given to both class hours. The second unit's topic was sentence writing, and the same pre- and posttest (see

Appendix E) was given to each class hour. Additionally, the pre- and post- tests were given to each class hour on the same dates, using the same delivery methods. Tests were given on paper and students independently completed them. The qualitative method I used to gather student feedback were surveys given on Google forms (see Appendix B) before and after each unit of study. These surveys gave students a chance to voice their opinions regarding traditional and digital formative assessment.

In the first unit which utilized traditional formative assessment, students were given seven minutes at the end of the hour to independently a “check-in,” my term for their formative assessment task. Each day, I would pass out square slips of paper titled “check-in” and also had a spot for their name. I would project their check-in question or task up on the overhead screen and students would individually complete their check-in. Near the conclusion of the hour, students passed their check-ins in to the turn-in basket, and we would discuss the answers to the check-in question or task. Additionally, I gave students feedback regarding their check-ins and hand them back at the beginning of the next class hour, where we would also discuss the learning as a whole class.

The second unit’s routine, which focused solely on digital formative assessment, was roughly the same. To compensate for the need for students to become more familiar with using the particular technological tools, I would begin the check-in process around twelve minutes before the conclusion of class. I found these few minutes of extra time were beneficial during the first three weeks of using the digital formative assessment tool. An unplanned factor in my study was that I heavily used one digital formative assessment tool, called ClassKick (see Appendix F). I anticipated that I would be able to use a wide

variety of tools, but I found that students needed more time to become familiar with using a digital tool so they would not become rushed or overwhelmed while expressing what they had learned on the check-in itself. While I did additionally use Socrative and Schoology (see Appendix F) as another form of digital feedback, I did so only once. ClassKick required students to log in using a unique code every day that brought them to their check-in, and to also type in their name every time they did so. Once they were logged in, students could interact with the digital task. Each student's answer was individually recorded and populated into the app on my end, but also stays on the student's end. The app is best described as a "live" document, one where I can instantly see what they are doing on their screen, and vice versa. The app also offered the capability of using various fonts, colors, and freehand drawing. Toward the conclusion of class, once I could see that students had submitted their responses on the check-in, we would share answers together as a whole class. Later on, I would comment on students' Classkick check-ins, which they could instantly see. The next class hour opened with students viewing the feedback I gave them on Classkick, and a discussion of the learning, which drove the rest of the class period.

Conclusion

In chapter three I discussed how I gathered my research using a mixed methods approach. Constructivism is the framework I used to guide my action research project. I have discussed the student population, tools I used to collect data, as well as how I conducted the research. These research methods gave me insight into my action research

question: *What is the impact of formative assessment using iPads on student achievement and motivation?* In chapter four, I discuss the results of my action research project.

CHAPTER FOUR

Results

Overview

The goal of this study was to evaluate the effectiveness of digital versus traditional formative assessment in a 1:1 classroom environment as reflected in student summative assessment scores. It also examined the impact of digital formative assessment on teacher practice and whether or not digital formative assessment positively impacted student motivation and attitude towards learning. This chapter will overview student pre- and post-assessment data over two units of study, one of which exclusively used digital formative assessment, the other traditional; qualitative student feedback regarding both digital and formative assessment; teacher field notes; and lastly, will analyze these data tools to determine whether digital formative assessment increased student learning and motivation.

Review of Research Question

Chapter Three detailed the methods used to investigate the question: *What is the impact of formative assessment using iPads on student achievement and motivation?* This study employed a mixed methods approach to answer this research question. The study took place at a middle school (grades 6-8) in suburban Minnesota. The participants were 33 seventh graders aged 12-13 years old in my Block 1 class and 23 seventh graders aged 12-13 years old in my Block 2 class. Class periods were 88 minutes long in a block scheduling format and class was held every day. Block 1 contained 15 students in Special Education; 2 students who were English Language learners; 20 boys and 13 girls. Block 2

contained 1 student in Special Education; 12 boys and 11 girls. Every student had a school issued iPad via the 1:1 program. All students had equal access to the applications and programs used on the iPad during this study. This study began on October 7, 2015 and concluded on November 24, 2015. Two units of curriculum were taught during this time. The first unit used exclusively traditional paper and pencil formative assessment methods while the second unit of study used exclusively digital formative assessment on the iPad. At the beginning of each unit of study, students were given a pretest to assess their prior knowledge. They were also given a qualitative survey (see Appendix B) to collect data on their attitudes toward the formative assessment technique being used, their motivation level in the class, and their preference for traditional or digital formative assessment.

The goal of this study was to evaluate not only the effectiveness of digital formative assessment on student achievement, but also its impact on student and teacher motivation and attitudes. It also aimed to analyze which types of digital assessment platforms on the iPad were most effective and easy to navigate for both teacher and student. Effectiveness of a digital platform was not only determined as having a positive impact on their achievement scores, but also being a program that did not place too high a cognitive load on students' working memory.

Quantitative Data Collection Results

Both class periods of students were given the same pre- and posttests in the same format. The pre- and posttest for the literary elements unit differed in passage and questions, but not in the complexity of the text nor the number or complexity of the

questions. The questions focused on the same skills, and there were the same number of questions for each skill on both the pre- and posttest. In the writing unit, which measured digital formative assessment, the same pre- and posttest was used (see Appendix E).

Impact of Traditional Formative Assessment on Student Achievement

During the literary elements unit, or rather, the first unit during this research study, students were given only traditional forms of formative assessment. While we did use the iPad throughout the unit, the iPad was not used for formative assessment purposes. The formative assessments were called “check-ins” and were on a sheet of white paper handed out to the students. The tasks varied, but the routine did not. The formative assessment, or check-in, was always given at the end of the hour. On the projector, students were given a task related to the material we were studying. Students were not allowed to collaborate with one another or use their class notes, since the purposes was to see what learning they had retained. Depending on the task, students might be given the answer to their task immediately that day, or I would give them feedback and redistribute first thing the following day in class. I also used these check-ins to reteach students in various ways, such as personally touching base with them the next day, or working with a small group of students on a given skill or task. Additionally, I used the formative assessment data to adjust my overall teaching, since it allowed me to see where students were at in their understanding of the material.

The pre- and posttest for the traditional formative assessment unit was comprised of a grade-level reading passage followed by a variety of questions about the text. The questions drew upon the following concepts: inference, theme, point of view, conflict,

setting, plot development, symbolism, and types of characters. After giving the pre-test, the unit was focused on reinforcing these skills and concepts. Below is a table illustrating the pre- and posttest scores from this unit:

Table 1.

<i>Pre- and Posttest Scores in Traditional Formative Assessment Unit</i>			
	pre-	Post	% Improved
Block 1	51%	82%	31%
Block 2	68%	88%	20%

Block 1 students, which contained the higher number of special education and ELL students, made the higher improvement between the pre- and posttest with their scores increasing by 31%. Collectively, these students went from a class average score of 51% on the pre-test to 82% on the posttest. Block 2 students also improved between the pre- and posttest, scoring 20% higher on the posttest. Block 2 students increased their scores by 20% (See Table 1).

Impact of Digital Formative Assessment on Student Achievement

The second half of this research study focused on digital formative assessment and its impact on student achievement. The unit taught during this portion of the study was a writing unit which focused on sentence construction and variety. One digital platform, or app, called Classkick, was primarily used as a digital formative assessment tool (see Appendix F). The classroom routine followed was the same as the traditional formative assessment portion: students were given their digital formative assessment task at the end of the hour. Depending on the task, and additionally the digital platform used,

students either immediately received feedback or were distributed their feedback the next class period.

The skills addressed during this unit were knowledge of basic parts of speech, ability to write a variety of sentence structures, and ability to write fluently. Below is a table of the pre- and posttest scores from this unit:

Table 2.

<i>Pre- and Posttest Scores in Digital Formative Assessment Unit</i>			
	pre-:	Post:	% Improved:
Block 1	60%	87%	27%
Block 2	70%	91%	21%

Again, Block 1 had a higher increase of their scores between the pre- and the posttest. Block 2 also increased their scores, but not as much as Block 1. Block 1 raised their scores by 27%, while Block 2 scores increased by 21% (see Table 2).

According to the quantitative data, traditional formative assessment resulted in a slight increase of improvement for Block 1 students between the pre- and posttests compared to digital formative assessment, at 31% versus 27%. However, digital formative assessment resulted in a higher overall score on the posttest (87%) compared to the traditional formative assessment posttest scores (82%).

Unlike Block 1, Block 2 students experienced the highest percent improvement after the digital formative assessment unit (21% compared to 20%). Additionally, Block 2's overall posttest scores were higher after the digital formative assessment at 91% compared to their performance after using traditional formative assessment at 88%.

Qualitative Data Collection Results

At the end of each unit, students were given a survey about their attitudes toward iPads, the content of the class, whether they feel motivated to do their best in the class, and whether they preferred paper or digital formative assessment. The surveys were given anonymously on Google forms so students could feel more comfortable in answering honestly. Furthermore, there was an open-ended question on each survey which was simply stated: “anything else you’d like to add?” This allowed students to voice their opinions in a more explicit and direct manner.

Table 3.

<i>Student responses: I feel totally comfortable when it comes to using my iPad (Post Traditional Formative Assessment unit)</i>		
	Agree	Disagree
Block 1	94%	6%
Block 2	95%	5%

Table 4.

<i>Student responses: I feel totally comfortable when it comes to using my iPad: (Post Digital Formative Assessment Unit)</i>		
	Agree	Disagree
Block 1	97%	3%
Block 2	100%	0%

Students from both classes reported an increased sense of confidence in using their iPad from the first to the second unit (see Tables 3 and 4). The second unit, which focused on

digital formative assessment, may have served to increase their sense of confidence since iPads were used every day. Students had more exposure to iPads, but also were expressly taught certain skills pertaining to the use of their iPads so that they could successfully interact with the digital formative assessment platforms.

Table 5.

<i>Student responses: The paper/pencil check-ins helped me learn during this unit (Post Traditional Formative Assessment unit)</i>		
	Agree	Disagree
Block 1	63%	37%
Block 2	77%	23%

Table 6.

<i>Student responses: The iPad check-ins helped me learn during this unit (Post Digital Formative Assessment Unit)</i>		
	Agree	Disagree
Block 1	75%	25%
Block 2	78%	22%

As illustrated in Tables 5 and 6, Block 1 students reported that digital formative assessment helped them learn more than traditional (75% compared to 63%). Block 2 students reported a 1% higher increase that digital formative assessment helped them learn more compared to traditional formative assessment.

Table 7.

<i>Student responses: I like using paper/pencil for check-ins (Post Traditional Formative Assessment unit)</i>		
	Agree	Disagree
Block 1	48%	52%
Block 2	81%	19%

Table 8.

<i>Student responses: I like using iPads for check-in (Post Digital Formative Assessment Unit)</i>		
	Agree	Disagree
Block 1	85%	15%
Block 2	96%	4%

When expressing their opinion as to what style they liked better for check-ins, Block 1 students substantially preferred digital check-ins as opposed to traditional; 85% reported liking using the iPads for check-ins, while 48% reported liking using paper/pencil check-ins (see Tables 7 and 8). Block 2 students expressed the same attitude, and although the difference between their preference was not as great compared to Block 1, their overall preference was much stronger; 96% of Block 2 students liked using the iPads for check-in, while 81% reported liking using paper/pencil check-ins (see Tables 7 and 8).

Table 9.

<i>Student responses: The paper/pencil check-ins made this class more interesting (Post Traditional Formative Assessment unit)</i>		
	Agree	Disagree
Block 1	48%	52%
Block 2	32%	68%

Table 10.

<i>Student responses: If check-ins were on the iPad, I think it would make this class more interesting (Post Traditional Formative Assessment unit)</i>		
	Agree	Disagree
Block 1	51%	49%
Block 2	45%	55%

Table 11.

<i>Student responses: The check-ins on the iPad made this class more interesting (Post Digital Formative Assessment Unit)</i>		
	Agree	Disagree
Block 1	64%	36%
Block 2	61%	39%

When asked if the paper/pencil check-ins made the class more interesting, the majority of both classes disagreed (see Table 9). When asked on the same survey if they thought iPad check-ins would make the class more interesting, no overwhelming majority was clear:

51% of Block 1 students thought it would be more interesting, while 55% of Block 2 students believed it would not make the course more interesting (see Table 10). However, when polled after the digital formative assessment unit about whether the iPads made the class more interesting, 64% of Block 1 students agreed and 61% of Block 2 students agreed (see Table 11). Even though both classes did not think digital check-ins would make the learning more interesting, the majority agreed afterwards that it did. Furthermore, when polled about whether they liked using the iPads for check-ins more than paper/pencil check-ins, a large majority of students agreed, with 79% of Block 1 students and 87% of Block 2 students preferring digital over paper/pencil.

Table 12.

<i>Student responses: I liked using the iPads for check-in better than when we just used paper/pencil check-in (Post digital formative assessment unit)</i>		
	Agree	Disagree
Block 1	79%	21%
Block 2	87%	13%

Table 13.

<i>Student responses: I learned a lot of new things during this unit (Post traditional formative assessment unit)</i>		
	Agree	Disagree
Block 1	83%	17%
Block 2	95%	5%

Table 14.

<i>Student responses: I learned a lot of new things during this unit (Post digital formative assessment unit)</i>		
	Agree	Disagree
Block 1	97%	3%
Block 2	91%	9%

Although both classes agreed in the majority that they learned a lot of new things during both units, Block 1 reported learning more during the digital formative assessment unit; 97% of Block 1 students reported learning a lot of new things during the digital assessment unit (see Table 14), compared to 83% reporting this during the traditional formative assessment unit (see Table 13). Block 2 students reported a slight decrease, though not significant, between the two units; 95% agreed they learned a lot of new things during the traditional formative assessment unit (see Table 13), while 91% reported this during the digital formative assessment unit (see Table 14).

While Block 2 students were more pessimistic regarding their belief that iPad check-ins would make the class more interesting (see Table 12), their posttest scores were higher than Block 1, as was their percentage improved between their pre- and posttest scores after the digital formative assessment unit.

Table 15.

<i>Student responses: I feel motivated to do my best in this class (Post Traditional Formative Assessment unit)</i>		
	Agree	Disagree
Block 1	94%	6%
Block 2	86%	14%

Table 16.

<i>Student responses: I feel motivated to do my best in this class (Post Digital Formative Assessment Unit)</i>		
	Agree	Disagree
Block 1	100%	0%
Block 2	97%	3%

Both classes reported at a higher percentage that they felt motivated to do their best in the class after the digital formative assessment unit. Although a high majority agreed with this statement after the traditional formative assessment unit, with Block 1 agreeing at 94% and Block 2 agreeing at 86% (see Table 15), their agreement jumped even higher after the digital formative assessment unit, with 100% of Block 1 and 97% of Block 2 agreeing with this statement (see Table 16).

Impact on Pedagogy: Field Notes

Once a week, I wrote in my field notes journal to reflect and to note any interesting observations from that week. Throughout the week, I would jot down student comments that I overheard or were directly stated to me. The semblance of these journals

revealed a few trends: one, the practice of daily check-ins brought a calming and structured presence to our classroom; two, both styles of check-ins were beneficial to student learning; and three, digital formative assessment was far more work to implement and maintain from a pedagogical standpoint.

First, daily check-ins brought a sense of calm and routine to my classroom. Students benefitted from having time at the end of each block to allow new learning to be solidified and reinforced through the check-in tasks. I reflected that even if the check-ins were not used for formative assessment purposes, “they hold immense value to give students the chance to let new learning just sink into their brains at the end of a class. It focuses what we’re doing.” Additionally, the sense of routine benefitted student learning. In another entry, I observed that “both blocks are very focused during check-in time. Students take it very seriously; it is a calm way to end class... kids know it will happen every day, and they also have come to anticipate what to do during this time.” Because students were engrossed in the check-in tasks and were motivated to do so, it brought a sense of calm to an otherwise boisterous group of seventh graders. Also, I think the fact that students knew the routine and knew they were an integral part of that routine contributed to the overall sense of focus in the classroom.

Second, both traditional and formative assessment were beneficial to student learning. As previously discussed, both forms of formative assessment caused student achievement to improve at high rates. But my informal observations in my field notes corroborated this empirical data by explaining the metacognitive benefit formative assessment has: “the value of letting the new learning solidify for them is immense.” The

check-in time brought a sense of calm to the classroom only because students were learning during that time; they were demonstrating their learning and interacting with feedback regarding their learning. Either form, be it digital or traditional, has immense value for student learning.

Lastly, implementing digital formative assessment was more work for me than traditional formative assessment. This surprised me as I reviewed my field notes; it was a definite trend throughout my entries. I expressed that “the downside is that many times using the digital checkins have been more frustrating or inconvenient for me.” These frustrations were due to not being as easily able to sort through the check-in feedback, since student responses would populate into a new spot if the student did not enter their name in exactly as they had before. Also, digital platforms will inevitably experiences glitches at times, such as the “couple days that their answers disappear after a period of time... another downside to certain forms of digital formative assessment.” Overall, these frustrations could be mitigated by improvements in the digital platform itself, or simply by a mindset change in the teacher. Even though it may have been more inconvenient for me at times, I do not think these inconveniences justify not using digital formative assessment as the benefits clearly outweigh the drawbacks.

Conclusion

When implementing this research project, my objectives were to determine how digital formative assessment impacted student learning and student motivation, and also to reflect upon the impact technology has on my teaching. In this chapter, I have presented both the quantitative and qualitative results of my research study. In chapter

five, I will discuss major learnings, connect these learnings to the literature review, discuss limitations of this study, and posit possible routes of further research needed on this topic.

CHAPTER FIVE

Conclusion

Overview

The previous chapter presented the results of my research that sought to answer the question, *What is the impact of formative assessment using iPads on student achievement and motivation?* I presented the quantitative and qualitative data and drew conclusions regarding the effectiveness of digital formative assessment. In this chapter, I will reflect on the capstone process, connect my research to the literature review, discuss the conclusions drawn from my data, discuss possibilities for future research, and also consider the implications and limitations of my research.

Reflections on the Capstone Process

When I began thinking about what the topic of my capstone might be, one area I kept being drawn to was technology. Just in the span of my seven-year teaching career, technology has already drastically changed the way I teach and the way my students learn. Technology has pervaded my students' lives, and as a result, I have been confronted with the question of whether to ignore it, or to embrace it. I must admit, embracing it was a challenge for me. I kept thinking about a saying an undergraduate professor of mine often said: "You will teach the way you were taught, until you realize that it's not working anymore." My secondary education experience did not include immersion in technology; its extent reached watching movies periodically in the classroom, or occasionally going to the computer lab to type a paper or do research. While this is better than nothing, compared to the level of access my students have to

technology, it might as well be considered nothing. Then the question remained - if I have absolutely no pattern for teaching kids in a 1:1 classroom, how will I teach them?

At first, I did teach them the way I was taught, and over time I realized that there was much more I could do as a teacher to integrate technology meaningfully into my classroom. It just was not enough to swap out paper copies of a worksheet for a PDF of a worksheet and call it 21st century learning. My graduate experience carried the common theme of technology in almost all of its coursework; my students carry technology around with them daily - both literally and figuratively - and I knew my capstone topic had to focus on it. I do not mean to communicate that I begrudgingly embraced this topic because it was something that just would not go away; on the contrary, I opened my eyes and realized how important technology is to my students and to my classroom.

The capstone introduced me to a concept brand new to me: viewing myself as a researcher in my own classroom. The idea that I can continually approach teaching with a researcher lens has invigorated my practice; it gives intention and direction to my teaching. Even in the last few months, after the official data gathering portion of my capstone ended, I have found myself approaching things differently as a teacher. I am more willing to try new things, to collect data and compare it, and to involve my students in the process by soliciting their ideas and feedback. I never viewed myself as a researcher before engaging in this capstone process. Now, this capstone process has given my confidence in an area that was formerly completely foreign to me.

During the early stages of the capstone process, while I was working on the literature review, I remembered how much I love to learn. Somewhere along the line as a

teacher the priority of continually being a learner myself fell along the wayside. The first few years as a teacher are packed with learning new skills, working on classroom management and engagement techniques, balancing the large load of grading and planning with our personal lives, and navigating the complexities of working with colleagues. While these tasks will always be a part of my life as a teacher, the amount of time and energy they take up has decreased. When the dust settled and I was simultaneously working through my graduate coursework, I was reminded that I became an English teacher because I love to learn, and I love to write. I was also surprised at how comfortable I had become in my habits in just a few years' time.

I did not see it at the time I was writing in my weekly field notes journal, but even though I viewed technology as a beneficial and positive tool for my students, I also viewed it as an inconvenience to me. I had become so comfortable in my pedagogical habits of traditional formative assessment that changing them quickly turned into a source of stress. The efficiency of traditional formative assessment was invaluable to me, but it had also caused me to engage in a practice that didn't particularly motivate or inspire my students. During the data collection period, I never mentioned once that traditional formative assessment was a lot of work, but I mentioned every chance I could that digital formative assessment definitely was. As I read through my field notes after the conclusion of the study, I was surprised at how often I wrote about this inconvenience, and saw in myself much of the attitude I claimed I would never have as a teacher: *I have done it this way for so long, and it works for me, so I will not change*. I realized what was missing in that mindset was the question: *what works for my students?* The data I

collected proved that digital formative assessment increased my students' motivation, engagement, and achievement levels. Teacher efficiency should not be the determining factor in whether or not I include technology in my classroom; rather, it must solely be whether or not the practice is in students' best interest.

Revisiting the Literature Review

The literature review detailed the practice of formative assessment, student motivation, and drawbacks and benefits of technology in the classroom. While all parts were holistically helpful to me, after reviewing my data, particular portions of the literature review were most relevant to my study.

Connections to the literature review. The discussions on cognitive load proved to be important to my capstone because I saw its reality while using digital formative assessment. If the digital platform is too complex or confusing, it places too high a cognitive load on students and therefore impedes their ability to learn (Chu, 2014; Peng & Chou, 2007). I saw this reality while beginning to use digital formative assessment. Even within a 1:1 school with students who feel confident in their ability to use the iPad, the introduction of a digital formative assessment platform, such as Classkick (see Appendix F), was initially overwhelming to the students. When I began using Classkick in the classroom, it took a couple of weeks for my students' anxiety to decrease. I also had to spend a considerable amount of time explaining and modeling the app to students. Until my students became comfortable with the app itself, it was clear from my field notes journal that their cognitive load had increased significantly. The multi-step process of logging into the app, choosing the "student" option, typing in their name and the class

code, and then interacting with the many interactive tools offered by the app was initially a distraction to my students. I compensated for this increased cognitive load placed on my students by lengthening the amount of time spent on the end of class check-in; I quickly learned that unless they had more time to do the many steps, they were too distracted or anxious to do quality work on their check-in. Once my students mastered how to use the app, however, their stress level and the amount of time it took to get the app going significantly decreased because the high cognitive load had decreased.

What I thought was a small but interesting portion of my research turned into the element that easily had the biggest impact on the way I collected data during the digital formative assessment period. I almost exclusively used Classkick throughout the subsequent three weeks of data collection because I did not want to engage in the process of mastering another app so soon with my students. I tried to use a couple other apps with my students, but the stressful reaction of my students and the large amount of time it took away from class time did not seem worth it to me. The reality of a high burden placed on their cognitive load became clear: students need to be given ample time, instruction, and practice with digital tools. Surely some students will master certain digital tools more easily than others, but the possibility that any digital tool might initially place a high burden on their cognitive load must be considered.

The other most useful area of research to my capstone was the literature focused on formative assessment. As McMillan and Cauley (2010) explain, “formative assessment is a process through which assessment-elicited evidence of student learning is gathered and instruction is modified in response to feedback” (p. 1). Formative

assessment is not graded, gives students feedback about where they are at in their learning, and provides students with information about how to master the concepts (Black et al., 2004; McMillan & Cauley, 2010). In light of student responses on formative assessments, teachers change their instruction accordingly to benefit student learning (Black et al., 2004; Black & Wiliam, 1998; Hudesman et al., 2013; Macfarlane-Dick & Nicol, 2007; McMillan & Cauley, 2010). Furthermore, formative assessment does not just change the teacher's instruction, but also provides meaningful and specific feedback so the student knows how to master the learning concepts at hand (Black et al., 2004; Black & Wiliam, 1998; Hudesman et al., 2013; Macfarlane-Dick & Nicol, 2006; McMillan & Cauley, 2010).

In contrast to the cognitive load body of research, the research on formative assessment is decidedly more broad and verified by many sources of research, but proved to be pivotal to my capstone process. Both traditional and digital formative assessment had great positive impact on my students' achievement levels. Additionally, my informal observations highlight the benefit of giving students time to allow new learning to solidify and to reflect upon it. Being intentional about using formative assessment every day in my teaching reminded me just how powerful this practice is: it truly does transform the learning process. Both teacher and student benefit from it and are meaningfully engaged with the curriculum. It empowers the student to learn, but also empowers the teacher to tailor instruction for each and every student.

Major Findings

This section will discuss the major findings of my research and how those findings answer my research question: *What is the impact of formative assessment using iPads on student achievement and motivation?* In each section, connections to the literature review will be made, followed by a discussion of potential areas for future research.

Student achievement increased during digital formative assessment. First, student learning increased because of formative assessment. As discussed in Chapter Two, formative assessment is the ongoing practice of identifying gaps in student learning in a low stakes manner, and communicating specific and timely feedback as to specifically what the student needs to do or understand in order to master a given concept (Black & Wiliam, 1998; Black et al., 2004; Macfarlane-Dick & Nicol, 2006; Wang et al., 2006). Formative assessment empowers students to learn because its focus is on mastery of the content and not on scores or grades; when this environment is cultivated in the classroom, students perform at high levels (Black & Wiliam, 1998; Black et al., 2004; Wang et al., 2006). These conclusions are consistent with the results of my study: both traditional and digital formative assessment led to high levels of achievement. Additionally, after both units students expressed that they felt they learned a lot during each unit. The fact that daily, meaningful, and appropriately challenging formative assessment was integral to an increase in student achievement cannot be dismissed; the conclusion drawn should not be that it was solely technology that increased student

achievement. Rather, the inclusion of technology in the formative assessment techniques met students' needs in a different way than traditional formative assessment could.

The results of my study showed that student achievement levels were higher after the digital formative assessment unit with Block 1 students improving by 27% and Block 2 students improving by 21%, as compared to improvement levels of 31% and 20% respectively after the traditional formative assessment unit. Additionally, a higher number of students reported having learned new things in the digital formative assessment unit, with 97% of Block 1 students agreeing, and 91% of Block 2 students agreeing, as compared to their response after the traditional formative assessment unit, in which 83% and 95% of students agreed. In my research study, compared to traditional formative assessment tasks, the digital learning tasks offered were more interactive, challenging, interesting, and demanded a higher level of creative and critical thinking, traits which develop intrinsic motivation (Kiefer et al., 2014). Students had the opportunity to demonstrate their learning through a medium that was of high interest to them; the digital platforms used allowed students to draw, type, write, or manipulate objects on the screen. What students might view as "mistakes" could be easily erased, instantly creating a new and empty canvas. The app offered the capability for more personalized and private feedback for the student; for an adolescent that is acutely aware of their peers' attitude and perception of them, having even an ounce of more privatized teacher feedback is invaluable. It also created a manageable way for the student to organize and store feedback given to them since all feedback could be kept in the app. Therefore, because

students were more interested in the capabilities the app offered to them, and could show their learning in more ways, student achievement was higher.

Future researchers may want to explore different types of apps and determine which style of digital platform would work best for a given learning task. Developing a list of attributes for effective digital learning platforms would be beneficial to the teacher since these platforms change so rapidly. It would be valuable to know what other specific apps meet the unique needs of adolescents, as well as common traits these kinds of digital platforms share.

Increase in motivation during digital formative assessment. A second finding was that students reported higher levels of motivation after the digital formative assessment unit. Although it is hard to exactly pinpoint, around the onset of adolescence, or when the middle grades begin, many adolescents experience a decrease in motivation levels (Anderman & Maehr, 1994; Kiefer et al., 2014; Ryan & Patrick, 2001).

Adolescence is a time of immense change socially, physically, emotionally, and mentally; as such, adolescents may find themselves grappling with a newfound self-consciousness which can trigger a decline in motivation levels. At times, it might be easier for the adolescent to avoid embarrassment by not attempting to learn something, rather than attempt to learn it and be unsuccessful (Anderman & Maehr, 1994). It is therefore imperative to find successful ways to motivate the adolescent, an important and powerful way being a positive and meaningful relationship with their teacher (Kiefer et al., 2014; Ryan & Patrick, 2001; Wentzel & Wigfield, 1998).

The results of my study agree with these findings; in both units, students reported feeling that they were motivated to do their best in my class; after the traditional formative assessment unit, 94% of Block 1 students agreed and 86% of Block 2 students agreed, and after the digital formative assessment unit, 100% and 97% agreed. This shows that a powerful motivator to the adolescent is knowing that their teacher likes them, cares about them, has high expectations for them, and believes them to be capable of tackling difficult tasks. However, my students expressed liking using the iPads for formative assessment much more compared to traditional formative assessment, with 70% of Block 1 students agreeing and 87% of Block 2 students agreeing. Additionally, although rates were high after both units, students reported feeling more motivated to do their best in my class after the digital formative assessment unit concluded. When their preference for digital formative assessment is viewed in light of what would constitute an interesting and relevant task to these “digital natives” (Prensky, 2001), it makes sense that they would feel more motivated and invested to learn because of the presence of technology. Lastly, it could be that when a teacher who is using technology is comfortable and confident doing so, it gives the adolescent and the teacher another way of connecting, since so many students today are familiarized with technology.

Future researchers might want to investigate if certain digital tasks increase motivation over others. It would be interesting to know what types of digital tasks students find boring and would actually increase the amount of off-task behaviors. Additionally, it would be valuable to know if students experience an increase in motivation levels when technology is introduced in a classroom where they do not feel

connected to their teacher. Perhaps the best data collection tool to determine that might be student surveys and feedback, but it would still be worth pursuing.

Increase in student interest during digital formative assessment. A third result of my research was students reported having a greater interest in the class because of the digital formative assessment tools used. A decline in motivation levels during adolescence (Anderman & Maehr, 1994; Kiefer, Ellerbrock, & Alley, 2014; Ryan & Patrick, 2001) makes it all the more important to teach a curriculum they find interesting and worthwhile. Certain technological tasks, especially those that facilitate meaningful collaboration and put student at the center of the learning process, are of high interest to the digital native (Johnson, 2012; Morgan & Olivares, 2012; Pitler et al., 2012). Not only will they be more motivated to learn, but they will simply be more interested in the curriculum at hand. Meeting the needs of these digital natives cannot be ignored (Johnson, 2012); if they are allowed to work in their strengths and demonstrate what they have learned via a technological tool, not only will they be more motivated, but they will hopefully begin to nurture a lifelong interest in the topic being learned - or at the very least, will develop habits of a lifelong learner.

The results of my study agree with these findings; my students expressed much higher levels of interest in the class after the conclusion of the digital formative assessment unit, with 64% of Block 1 students agreeing and 61% of Block 2 students agreeing, as compared to their responses after the traditional formative assessment unit, with 48% and 32% agreeing. The digital formative assessment tool met the various needs of the learners in the classroom. Some students may have found it more interesting

simply because they like technology, while others may have been able to interact more meaningfully with the digital formative assessment tools, thereby increasing their interest level in the curriculum. Perhaps the increase of their motivation levels caused them to be more interested in the curriculum. Whatever the case may be, a clear connection to technology and their interest in the curriculum was found.

Future research might try to distinguish what exactly caused this higher level of interest. Setting up the research study in a different manner might help determine this; teaching one unit but having different classes use digital or formative assessment could distinguish whether or not it was solely the addition of technology that they found more interesting, or whether it was the content itself.

Format and structure of platform is crucial to success. The digital formative assessment tool used must not place too high a cognitive load on the student; doing so actually inhibits students from successfully demonstrating their learning (Chu, 2014; Peng & Chou, 2007). The results of my study reflected the importance of considering cognitive load. During the digital formative assessment unit, I frequently journaled about the anxiety students first experienced using the digital formative assessment tool and extending the formative assessment activity to ten or fifteen minutes every day instead of the usual five minutes. Looking back on these field notes, I realized afterward that students were initially experiencing a high cognitive load and I compensated by modeling, giving extra time, and repeating directions many times. The task initially took up much of their working memory until students became familiar with the digital formative assessment app. While this was not a negative thing, it certainly is an aspect of

teaching using technology that cannot be ignored. Teachers must be provide time and guided instruction for teaching how to use a given digital tool; students must be able to practice on the digital tool and become familiar with it before being asked to also demonstrate their learning on that given tool. Educators cannot assume students will immediately master new digital platforms just because those students are generalized as “digital natives” (Prensky, 2001); as with any other skill being introduced in the classroom, giving time to practice said skill is essential, and students always begin at differing levels of mastery.

Future research might look at effective ways of modeling instruction for new technological tools as well as determining the traits of effective digital platforms that will not place too high a burden on students’ working memory. Ideally, this research could be paired with developers of these apps to produce digital platforms that are simple in their accessibility, but provide its users with high levels of interaction and creativity.

Possible Implications

Based upon the conclusions drawn from my data collection, digital formative assessment should be used in classrooms today because it increases student achievement, motivation, and interest. Technology is part of everyday life for students; these digital natives, who have grown up immersed in technology, are so familiarized with technology that we as educators cannot ignore the large role it plays in how they learn best. In order to implement technology successfully in the classroom, teachers should critically consider the benefits and drawbacks of each particular digital platform in light of the student population they are teaching.

The implication that technology should be utilized in the classroom cannot be separated from the consideration of what constitutes meaningful technological integration; technology is best used in the classroom when students are using it to collaborate, reflect, or create (Johnson, 2012; Morgan & Olivares, 2012; Pitler et al., 2012). It should not be used to promote passive forms of learning, such as rote memorization, or tasks that do not require active engagement on the part of the learner (Diem, 2006; Lowerison et al., 2006). Teachers should consider how best to use technology in their classroom to meet their curriculum goals (Thompson & Bieger, 2006). Lastly, it must not be overlooked that simply the addition of technology to a classroom will guarantee that meaningful learning will occur; it must be used with intention and careful consideration (Lowerison et al., 2006).

Possible Limitations

There were a few limitations of this study, the first of which being that the majority of the digital formative assessment check-ins were done using one app, Classkick (see Appendix F). Using more and varied digital formative assessment platforms might yield different results. Additionally, the data collection was done during two distinctly different curriculum units, rather than collecting data during one curriculum unit in which each class hour used a different type of formative assessment. Setting up the study in a different manner might produce different data trends and additional insights into the benefits of digital formative assessment. Lastly, there is a relatively small body of research that explicitly pertains to digital formative assessment and its benefits and drawbacks. The literature review for this research project drew upon

what was available, but also had to synthesize the separate bodies of research of technology integration, student motivation, and formative assessment to draw its conclusions.

Next Steps

Sharing this research locally with educators in my district might bring valuable benefits and changes in our approach to technology integration. Although the school in which this study was conducted was a 1:1 school, the district is still in its beginning stages of technology integration. It could very well be that the students in my study, although familiar with basic iPad usage, have not had much exposure to using digital tools in more creative or higher level ways. A different 1:1 setting that is more advanced in its stages of technology integration might not observe the same challenges related to cognitive load seen in this study. The conclusions drawn from my study could change the way technology integration is handled in my district. Our students need more than just a basic level of interaction with technology; technology must be integrated in meaningful ways for it to yield its highest benefits. In addition to sharing my research locally, the conclusions drawn could benefit other school districts that are still in the beginning stages of 1:1 implementation.

Conclusion

Throughout this chapter, I reflected on the capstone process and considered its lasting impact it had on who I am as a teacher. I revisited the literature review and considered how my research is connected to it, as well as what areas of the literature review proved to be most helpful to me as I conducted my research. Additionally, I drew

conclusions from my data to answer my research question, *What is the impact of formative assessment using iPads on student achievement and motivation?* I also discussed possible topics of future research and the implications and limitations of my study. Although this project has come to a close for me, I know that it has left an indelible mark on who I am as a teacher. I view myself as a continual researcher in my own classroom and now have the tools to implement these transformative practices in my teaching.

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APPENDIX A

Journal Format

Part 1: Description of lesson's learning goals and activities

Part 2: Reflection on lesson's effectiveness and formative assessment techniques

Student Comments:

Student Motivation:

Formative Assessment Techniques:

APPENDIX B

Student Surveys

Rating scale used: Strongly agree; agree; disagree; strongly disagree

Survey questions given after traditional formative assessment unit:

1. I feel totally comfortable when it comes to using my iPad.
2. The paper/pencil check-ins helped me learn during this unit.
3. I like using paper/pencil for check-ins.
4. The paper/pencil check-ins made this class more interesting.
5. If check-ins were on the iPad, I think it would make this class more interesting.
6. I learned a lot of new things during this unit.
7. I feel motivated to do my best in this class.
8. Anything else you'd like to add?

Survey questions given after digital formative assessment unit:

1. I feel totally comfortable when it comes to using my iPad.
2. I like using iPads for check-in.
3. The check-ins on the iPad made this class more interesting.
4. I liked using the iPads for check-in better than when we just used paper/pencil check-in.
5. The iPad check-ins helped me learn during this unit.
6. I learned a lot of new things during this unit.
7. I feel motivated to do my best in this class.
8. Anything else you'd like to add?

APPENDIX C
Literary Elements Pre-test

Record your answers to the responses in the spaces provided.

- _____ 1. Which is NOT an example of setting?
- A. Five years ago on a deserted island
 - B. Erie, Illinois—present day
 - C. New York City—400 years in the future
 - D. a robot on fire—in the desert
- _____ 2. Which is NOT an example of a symbol (or symbolism)?
- A. An American flag representing freedom.
 - B. An acorn representing an acorn.
 - C. A dog representing racism.
 - D. A character representing justice.
- _____ 3. What is the theme of a story?
- A. The way the main character changes throughout a story.
 - B. The underlying message, or “big idea,” of a story.
 - C. The mood created by the author’s word choice.
 - D. The feeling the reader gets while reading the story.
- _____ 4. Which is NOT part of a plot?
- A. exposition
 - B. style
 - C. climax
 - D. resolution
- _____ 5. Which part of a story plot introduces the characters and setting?
- A. exposition
 - B. rising action
 - C. falling action
 - D. resolution
- _____ 6. When a story is told from _____ point-of-view the narrator is a character in the story.
- A. third-person omniscient
 - B. third-person limited
 - C. second-person
 - D. first-person

- _____ 7. An example of third-person limited point-of-view is...
- A. I thought it was fun, but I wondered if Kay felt the same way.
 - B. Lee thought it was fun and wondered what Kay thought of it.
 - C. Lee thought it was fun, but Kay thought it was pretty dumb.
 - D. You thought it was fun but Kay thought it was pretty dumb.

Reading Assessment - Literary Analysis Multiple Choice (Short passage)
Read the passage and answer the following questions.

(1) In the summer, Jenna went to the town pool with her brother Jake nearly every day. (2) Theoretically, the pool was open to all town residents. (3) Nevertheless, very few adults used it except when accompanying their children. (4) Mrs. Dillard was an exception. (5) A middle-aged woman, she came to the pool almost daily—always alone. (6) Jenna did not like Mrs. Dillard. (7) She complained when Jenna and her friends splashed too much as they dove off the diving board, and she complained when Jake and his younger friends made too much noise playing Marco Polo. (8) Jenna thought someone with so many complaints had no business hanging around a pool full of kids. (9) When the old woman swam by, Jenna stuck her tongue out behind her back, making all her friends laugh. (10) Then, one day as he sat by the pool, Jake let out a terrible scream. (11) Jenna ran over to see what was wrong and realized that a wasp had stung him. (12) Neither she nor the lifeguards knew what to do. (13) But Mrs. Dillard came over with a special salve that she put on the sting, and soon Jake was back to his old self. (14) After that, Jenna knew that she would never again make fun of Mrs. Dillard.

_____ 1. What is the central conflict of this passage?

- A. Jenna's struggle to take care of her brother
- B. Jenna's struggle with Mrs. Dillard
- C. Mrs. Dillard's struggle to learn to swim
- D. Mrs. Dillard's struggle to save Jake

_____ 2. Which part of the plot is sentence 2?

- A. the falling action
- B. the rising action
- C. the exposition
- D. the climax

_____ 3. Where does the climax of the story take place?

- A. sentences 1 through 4
- B. sentences 5 through 6
- C. sentences 7 through 9
- D. sentences 10 through 12

_____ 4. What change or insight does the resolution of the story contain?

- A. Mrs. Dillard realizes that she has been too grouchy.
- B. Jake learns to live with pain.
- C. Jenna changes her opinion of Mrs. Dillard.
- D. Jenna realizes that she needs to pay more attention to her brother.

_____ 5. What kind of conflict is presented in the passage?

- A. Character vs. Society
- B. Character vs. Circumstances/Fate
- C. Character vs. Himself/Herself
- D. Character vs. Character

_____ 6. Who is the protagonist of the story?

- A. Mrs. Dillard
- B. Jake
- C. Jenna

_____ 7. Which type of point of view is being used in the passage?

- A. third-person omniscient
- B. third-person limited
- C. second-person
- D. first-person

_____ 8. From whose point of view is the story being told?

- A. Jenna's
- B. Jake's
- C. Mrs. Dillard's
- D. narrator

APPENDIX D
Literary Elements Posttest

Record your answers to the responses in the spaces provided.

- _____ 1. Which is NOT an example of setting?
- A. Five years ago on a deserted island
 - B. Erie, Illinois—present day
 - C. New York City—400 years in the future
 - D. a robot on fire—in the desert
- _____ 2. Which is NOT an example of a symbol (or symbolism)?
- A. An American flag representing freedom.
 - B. An acorn representing an acorn.
 - C. A dog representing racism.
 - D. A character representing justice.
- _____ 3. What is the theme of a story?
- A. The way the main character changes throughout a story.
 - B. The underlying message, or “big idea,” of a story.
 - C. The mood created by the author’s word choice.
 - D. The feeling the reader gets while reading the story.
- _____ 4. Which is NOT part of a plot?
- A. exposition
 - B. style
 - C. climax
 - D. resolution
- _____ 5. Which part of a story plot introduces the characters and setting?
- A. exposition
 - B. rising action
 - C. falling action
 - D. resolution
- _____ 6. When a story is told from _____ point-of-view the narrator is a character in the story.
- A. third-person omniscient
 - B. third-person limited
 - C. second-person
 - D. first-person

- _____ 7. An example of third-person limited point-of-view is...
- A. I thought it was fun, but I wondered if Kay felt the same way.
 - B. Lee thought it was fun and wondered what Kay thought of it.
 - C. Lee thought it was fun, but Kay thought it was pretty dumb.
 - D. You thought it was fun but Kay thought it was pretty dumb.

When Three's a Crowd

(1) In the beginning, the skit project sounded great. Mr. Johnson explained that we would choose an issue we had studied in our American history class and develop a ten-minute skit around it. "You can work in groups of two or more. But let's get this straight right from the start: there will be no freeloading on this assignment!" warned Mr. Johnson. "I expect each member of the group to do an equal portion of the work."

(2) As Mr. Johnson spoke, I turned around and looked at Hank. He smiled and nodded his head, sealing the agreement that he and I would work together. A minute later, when Mr. Johnson gave us a chance to form our groups, Hank and I pushed our desks together and started planning.

(3) "So, Nathaniel, what issue should we do?" Hank asked. I already knew he'd leave the decision to me, because I'm a total history buff and he's not. But I was also confident that Hank would really sink his teeth into whatever topic I picked, and we'd come up with a fantastic skit.

(4) I didn't hesitate. "How about the way the Civil War tore some families apart? You know, one son joins the Union army, and the other joins the Confederate Army."

(5) "Yeah, that would definitely make an awesome skit, Nathaniel," said Hank. "And it would be perfect for the two of us. You would be one brother, and I'd be the other."

(6) As Hank spoke, I noticed that Brendan was headed our way, with a self-satisfied expression on his face. "Whoa, Hank and Nathaniel, the makings of one dynamic group. And the only missing ingredient is... ME!"

(7) With my back to Brendan, I rolled my eyes at Hank, but he didn't take the hint. I half expected he wouldn't. Hank and Brendan had gotten friendly since they both made varsity basketball. Hank had been my best friend since preschool, but he didn't include me when he hung out with Brendan – and that was fine with me. I considered Brendan a jock, and he obviously put me in the nerdy geek department. I had to give Hank credit, though; he did an impressive job of juggling friendships with two really different guys.

(8) But with the three of us working together, the juggling got trickier, because Brendan and I clashed immediately. When he heard what topic I'd selected, Brendan announced that he and Hank should play the brothers, and I would be the boys' father. As soon as Hank went along with the suggestion, I was outvoted – and felt completely betrayed. My resentment was fueled by the fact that their basketball schedule made it difficult to plan the after-school meetings we needed to write and rehearse the skit.

(9) When the meetings got underway, things went from bad to horrible. While I hadn't really expected Brendan to contribute much to writing the script, Hank's dismal effort was a huge disappointment. He never took the skit seriously. Instead he kept allowing Brendan to distract him with jokes, gossip, and horseplay.

(10) I finally reached my limit on the day before the performance. Hank, Brendan, and I had agreed to memorize our lines on our own and then meet at Hank's house for a rehearsal. And while I had my lines down cold, it became obvious to me as soon as we did our first run-through that Hank and Brendan had never practiced. With all the coolness I could muster, I zipped my script into my backpack and head for the door. "Since I can't memorize your lines for you, I'm going to take off," I announced. Walking home, I felt like an animal just freed from a cage.

(11) My abrupt departure must have lit a roaring fire under Hank and Brendan because our skit performance the next day was amazing. Each of us delivered our lines flawlessly, as if we had spent days rehearsing. As the audience applauded loudly, I glanced over at Hank, who was smiling at me with a mixture of satisfaction and embarrassment. I thought about smiling back, but instead I looked away.

(12) Later, in the cafeteria, I found Hank and sat down with him. I had made up my mind to congratulate him when Brendan spotted us and walked over. Looking straight at me, Brendan said, "Hey, Geek, our skit rocked! Everyone says Hank and I really know how to act." Turning to face Hank, he added, "I think maybe we deserve some kind of award!"

(13) It was one of those moments when you're desperate for the perfect comeback to put the guy in his place, but your mind's a total blank. Fortunately, Hank came through. "Yeah, like, if there's one for freeloading," he told Brendan, "we'd win hands down."

- _____ 1. What is the central conflict of this passage?
 - a. Brendan's struggle to become friends with Nathaniel
 - b. Nathaniel's struggle with Mr. Johnson's grading policies
 - c. Nathaniel's struggle to work in a group with Brendan and Hank, who do not do much work
 - d. Hank's struggle to balance

- _____ 2. Which part of the plot is paragraph 8?
 - a. Climax
 - b. Exposition
 - c. Rising Action
 - d. Resolution

- _____ 3. Where does the climax of the story take place?
 - a. Paragraph 7
 - b. Paragraph 10
 - c. Paragraph 12
 - d. Paragraph 13

- _____ 4. What change or insight does the resolution contain?
- a. Hank realizes how much they slacked off during the skit project, and realizes they took advantage of Nathaniel's hard work.
 - b. Brendan feels badly for not contributing equally to the skit project.
 - c. Nathaniel decides he needs to stick up for himself more often, and decides not to be Hank's friend anymore.
 - d. Nathaniel realizes he should have been nicer to Brendan, and feels badly about it.
- _____ 5. What kind of conflict is presented in the passage?
- a. Character vs. Society
 - b. Character vs. Circumstances/Fate
 - c. Character vs. Himself/Herself
 - d. Character vs. Character
- _____ 6. Who is the protagonist in the story?
- a. Mr. Johnson
 - b. Brendan
 - c. Nathaniel
 - d. Hank
- _____ 7. Which type of point of view is being used in the passage?
- a. third-person omniscient
 - b. third-person limited
 - c. second-person
 - d. first-person
- _____ 8. From whose point of view is the story being told?
- a. Mr. Johnson
 - b. Brendan
 - c. Nathaniel
 - d. Hank

APPENDIX E
Sentence Writing Pre- and Posttest

Read the information and fill in the blanks.

The sentence is a basic unit of communication.

1. A simple sentence has ____ (how many?) independent clause(s).
2. A compound sentence has ____ (how many?) or more independent clauses.

An independent clause always has two important parts.

3. The part that names the person, place, thing, quality, or idea that the sentence is about is called the _____.
4. The part that shows the action or state of being is called the _____.

A compound sentence contains more than one independent clause.

Example Sentence #1: Helen helped, but Mary refused.

The two independent clauses in Example Sentence #1 are:

- 5.
- 6.

Example Sentence #2: Lee teaches math, and his wife teaches history.

The two independent clauses in Example Sentence #2 are:

- 7.
- 8.

Independent clauses in compound sentences can be joined by a comma and a coordinating conjunction. The most common coordinating conjunctions are for, and, nor, but, or, yet, and so.

Put the best conjunction in each of the following sentences. (Use each conjunction one time.)

9. I like Bill, Sometimes he is too loud.
10. The cat and dog raced around the yard, they hated each other.
11. The food got cold, they heated it up.
12. Mrs. Planter went to the butcher shop, she bought a sirloin steak.
13. The milk was not on the counter, was it on the table.
14. Put that back, I will call the cops.
15. She seems like a nice person, she has no friends.

When two independent clauses in a compound sentence are joined by a coordinating conjunction, a comma is usually placed right before the conjunction.

Put a comma in the proper place in each of the following sentences:

16. The clerk rang up the sale and his helper packed the groceries.
17. The children played tag but they did not include Steven.
18. By mistake, the ice man turned down the freezer so all the ice melted.

19. I invited Kathy for she is my best friend.

Independent clauses may also be joined by a semicolon (;) when there is no coordinating conjunction.

Put a semicolon between the independent clauses in each of the following Sentences:

20. Dr. Lee teaches math his wife teaches history.

21. The salmon swam upstream they were headed for their home.

22. Potatoes and beans were served the taste was terrible.

23. The snow finally is melting it has been on the ground for two weeks.

An independent clause must be able to stand alone. Do not mistake a simple sentence with compound subjects and/or compound verbs for a compound Sentence.

Put a comma in the proper place in each sentence that has two independent clauses.

Do not add a comma to sentences that have only one independent clause.

24. The water rose and then receded.

25. The bird rose rapidly and headed west.

26. The tree fell and the lumberjack stripped the branches from its trunk.

27. Her dress was green and her gloves were white.

28. She wore a green dress and white gloves.

29. The Angels got creamed by the Devils for the Devils are a better team.

30. The Angels played the Devils and lost.

APPENDIX F
Description of Digital Formative Assessment Tools Used

Digital App	Description
Classkick (www.classkick.com)	This app allows teachers to create open ended questions that students can access via a unique class code. It offers the capability for students to type, draw, and insert media on their answer screen. Student responses automatically populate into the teacher's app, allowing the teacher to digitally give personalized feedback for each student.
Schoology (www.schoology.com)	Schoology is an learning management system; each of the students' classes has a particular course page. Within each course, teachers can upload class handouts and materials, post assignments which also function as a dropbox for student work, post discussions, create quizzes and tests, create polls, and post course updates. This app, which also offers a desktop version, also has a messenger feature, allowing for private communication. Other notable features include: groups which can be created for specific groups of students as an efficient way to disperse materials and communicate; resources, which allows teachers to digitally house all course materials and share said materials with other teachers; and calendar, which populates all upcoming student assignments into a mainstream calendar for students to see their upcoming work and assessments.
Socrative (www.socrative.com)	Like Classkick, this app also allows teachers to creative formative assessment questions, but unlike Classkick, has the capability to automatically grade student responses. Teachers can create multiple choice questions, true/false questions, polls, quizzes, and exit tickets to check for student understanding. The app automatically grades these tasks and populates them into one area for the teacher, allowing the teacher to see individual student data as well as whole class trends.