Integrating Math and Technology: Transforming Attitudes and Learning Outcomes

Nathalie Damaso

California State University, Sacramento
Abstract

Incorporating technology in the classroom allows students to use relevant forms of communication in the 21st century. With instructional shifts in the Common Core State Standards for math, the use of technology is an instrument that students can use to construct their conceptual math knowledge. Educators can use technology, such as iPads, to instruct students, check for understanding, and assess student work. Socrative is an educational app that allows educators to develop lesson instruction for their students. This action research investigated the effects of iPads and the educational app, Socrative, would transform student attitudes and overall math achievement. A 6th-grade classroom used Socrative to solve and answer real-world math problems. Prior to beginning the research the students took a Benchmark Practice 1 for Math and a Pre-Survey to measure their temperaments towards math. At the end of the research the students took Benchmark Practice 2 Math and a Post-Survey about their temperaments towards math. At the end of the research, it was found that their attitudes towards math increased. While the majority of the class increased in percentage on their benchmark, it was inconclusive that that was due to technology integration.

Keywords: technology, Common Core State Standards, technology integration, educational apps
Integrating Math and Technology: Transforming Attitudes and Learning Outcomes

**Introduction**

The transition from the current state standards to Common Core State Standards (CCSS) focuses on math conceptual development of their skills in the middle school grades. Having the foundational skills in grades K-5 is necessary for students to be successful in grades 6-8. CCSS for math focus on constructing math knowledge through rigorous content and are aligned with college and career expectations. Now that CCSS is becoming a nation-wide standards core that uses 21st century technology skills, the students’ attitudes towards and learning outcomes for math will need to improve.

Integrating technology and math is important to develop an integration methodology to make the student’s feel comfortable with the transition from state standards to the CCSS. Without appropriate interventions, students’ will not be performing at their grade level standards. By having data-driven implementation, students are able to focus on skills that they need to improve (Bolt & Yssekdyke, 2007). Using technology in the classroom will improve student’s shortages in foundational math skills and build conceptual skills. In turn, it will make their attitudes in math a more positive one that contains student engagement and achieve higher learning outcomes.

**Research Question and Anticipated Outcomes**

1. Will math and technology integration in the classroom, using Socrative, transform students’ attitudes toward math in a 6th-grade classroom?
a. Will English Language Learners’ attitudes toward math transform in a 6th-grade classroom?

2. Will math and technology integration produce higher learning outcomes through assessments in a 6th-grade classroom?

The researcher’s first research question focused on students’ attitudes towards math. An attitude pre-survey, the students have taken expresses their initial feelings toward math. Stemming from the first research question, the researcher focused on the English Language Learners. The researcher’s second research question focuses on student achievement and focuses on the development of students’ math skills using Socrative through CCSS for math. Through this, the anticipated outcome is an improvement in the students’ attitudes toward math and the students’ achievement of the standards.

Definitions

**Common Core State Standards for Math**- Newly adopted nation-wide standards that will be implemented in all math classrooms.

**Technology**- Mobile electronic device to facilitate learning, such as iPads.

**Socrative**- An education application that allows an educator to develop a skill set and lets the students answer in multiple choice and short-answer questions.

**Attitude Pre-Survey**- A survey that will be taken by the students in the beginning of the study. This will measure students’ attitudes and feelings towards math (Appendix A).

**Attitude Post Survey**- A survey that the student’s will take at the end of the study. (Appendix B).
Data Director- An online database that scores multiple choice answers and organizes them according to standards.

Benchmark Practice- A standardized math test that measures student knowledge.

Technology Integration- Using technology to increase learning, knowledge, and understanding.

**Review of Literature**

This literature review focuses on the impact of technology in the classroom in student attitudes and achievement. Incorporating technology in the classroom allows the students to use relevant forms of communication of the 21st century in their education. Technology has remodeled the way students gather information. Technology in the classroom opens multiple sources of information and connects learners to the world (Franklin & Peng, 2008). Educators and students are able to activate and build knowledge with technology. The learner controls the amount of information and modes of information that is being accessed. Learning in the classroom is rapidly changing with mobile technology, such as iPads. According to the ebook *Pockets of Potential*, mobile technology gives students access to anytime and anywhere access to information (Shuler, 2009). Shuler also states that mobile technology invites them to engage in their learning. Currently, the students and educators are shifting into Common Core State Standards (CCSS). CCSS were built to expand students’ knowledge to get them college and career ready. Educators can infuse 21st century skills into a well-developed math curriculum to prepare for the CCSS shifts in math. There are studies that focus on the influence of technology in math. *Mobile Math: Math Educators and Students Engage in Mobile Learning*, a study about the integration of mobile technology in math, focused on how mobile learning effected students attitudes (Franklin & Peng, 2008). While Schacter (2009) discussed how technology
acknowledges its effects on academic performance in *The Impact of Education Technology on Student Achievement*. Through this literature review it will address the effects of mobile technology on students’ attitudes and learning outcomes, or student achievement.

**Technology and Education**

Students who are digital natives have internet access and technology within their grasp. Technology can bridge learning at school to learning at home. It connects the student to the digital world. The digital world provides space where students can be social, individual, and inquisitive. Technology can transform educational experiences into innovative learning opportunities (Hew & Brush, 2007). According to the study *Integrating Technology into K-12 Teaching and Learning: Current Knowledge Gaps and Recommendations for Future Research*, technology serves “as a different means to the same instructional goal” (Hew & Brush, 2007, p. 227). By transforming pedagogy into a technology balanced classroom, the teacher can invite students to join in a learning journey. Technology encourages students to collaborate, construct their knowledge, and become active learners (Frankin & Peng, 2008).

Technology allows students to be stakeholders in their educations and learning processes. They become active learners who are motivated by their own volition. The technology shift in society is influencing a transformation of education (Quinn, 2011). Technology is being used on a daily basis out of the school atmosphere. It is being used to gather information for personal use and learners are using it to acquire specific information from accessible resources. Mobile technology is being used world-wide as a way to communicate with each other. It has become a tool to socialize. There are many types of applications that encourage socialization through technology, like social networks, texting, and online groups.
Technology is not just a tool for social media; the learner is using it as an educational tool. The integration and interactive math modules showed the students were gaining cognitively compared to traditional teaching strategies. Also, they revealed that students showed a higher amount of motivation and positive attitudes (Vogel et al, 2006).

With technology a learner becomes both, the student and the teacher. Students are able to gather materials from various sources to develop their ideas (Shuler, 2009). They can use websites, articles, studies, podcasts, interviews, photography, and videos to enrich their knowledge. Planning for technology integrated learning needs to include setting out learning outcomes and to have the tasks connect to real-world problems (Hernandez & Bredenfur, 2003). Educators “should develop teaching methods that go far beyond dispensing information, focus on challenging curriculum goals for all students, and meet the needs and interests of individual leaners” (Bottge et al, 2007, p. 48). With all the technology that is available, the students can collaborate and communicate with each other (Schuler, 2009). Discussions provide meaningful collaborative experiences where students can build upon each other’s experiences and knowledge. Technology’s classroom goal is to enhance “academic achievement by problem solving, reasoning, and communicating about real-world and work situations” (Hernandez & Bredenfur, 2003, p. 262).

Students who are digital natives have internet access and technology available within their grasp. Technology can bridge learning at school to learning at home. It connects the student to the digital world. The digital world provides space where students can be social, an individual, and inquisitive. By transforming pedagogy into a technology balanced classroom, the teacher can invite students to join in a learning journey. Teachers become guides and assist the students in reaching their learning goals through authentic experiences (Hernandez & Bredenfur,
Teachers are able to provide the students with support and structure to reinforce their eagerness to learn as an individual and a learning community.

**Integrating Technology**

The educator’s methodology can affect the implementation of the technology in the classroom. Educators must take advantage of the benefits of technology. Technology integration must be calculated and deliberate. It must be calculated and deliberate because it needs to be thought out on how it should be used with the direct intention to learn an outcome. When it comes to math, students need to develop an active role in their skills and a way that teachers can develop that is through technology. Technology-based programs influence the student’s problem-solving skills by elevating the student’s problem-solving strategies and techniques in approaching math problems (Anderson, Edwards, & Andersen, 2010). By letting the students actively participate in the problem-solving process, they are able to use those strategies by themselves. Planning math and technology-based projects allows the students to have purpose with their math skills and allows them to put them into practice (Carr, 2012).

Integrated technology allows the educators to implement a system that would enhance the student’s math experience by providing strategies that they would be able to use in the class. The combination of activities, in-person and technology-based, would support the educator’s instruction and motivate the students. Activating prior knowledge and building learners’ knowledge can help facilitate student learning.

**Scaffolding with Technology.** Scaffolding in the classroom involves having the students explain and justify their answers, checking for understanding, and have the scaffolding modified to fit the needs of students (Kiong & Yong, 2001). All learners, especially English language
learners, will benefit from the scaffolding and modeling because it begins at a place that they are familiar or fluent with and shows how a task should be completed. Educators must be aware of learners’ progress in their mathematical knowledge, so they can construct their learners’ knowledge. Constructivism is the ability for learners to build and apply their knowledge into relevant real-world math tasks (Kiong & Yong, 2001). Bottge et al (2007) found that the constructivist approach shifts student thinking, and that “students who have low math skills may not be able to solve more difficult types of math problems” (p. 31). Using technology to monitor student progress needs to be used to adequately address students’ needs in mathematical concepts.

**Use Technology to Monitor Student Progress.** In the article, “Effect of technology-enhanced continuous progress monitoring on math achievement,” progress monitoring of the students is important to determine the focus standards and skills (Ysseldyke & Bolt, 2007). The implementation of progress monitoring allows the educators and students to receive immediate feedback on mathematical standards. The feedback provided from can guide how a teacher plans future lessons (Hew & Brush, 2007). Students will have positive attitude towards math when introduced to technology driven intervention and instruction. Therefore, the students will have a positive impact on their problem solving skills. A positive attitude towards math is necessary because a student needs to have persistence and perseverance even when they cannot accomplish their learning goal. When they believe that they can accomplish a task and work diligently on it, they will strive to reach their goal.

Applying a technology-assisted program in the classroom significantly impacts proficiency in the standards. The use of technology in the classroom positively effects the student’s progression in math (Ysseldyke & Bolt, 2007). Technology allows the educators to
implement a tutoring system that would enhance the student’s math experience by providing strategies that they would be able to use in the class. Technology influences instruction in the classroom by providing educators with data about their students. Progress monitoring allows educators to have updated information about their student’s progression. This allows the educators to differentiate and enrich the student’s learning experience. By using the technology-assisted progress monitoring, the educators were able to closely monitor the students. The learners given assignments that built their fundamental skills in math. They will continue to build their skills according to the data collected (Ysseldyke & Bolt, 2007).

Without appropriate interventions, the students will not be performing at their grade level standards. By having data-driven implementation, the students are able to focus on skills that they need improvement on (Bolt & Yssekdyke, 2007). The implementation of progress monitoring allows the educators and students to receive immediate feedback on mathematical standards. By using the technology-assisted progress monitoring, the educators are able to closely monitor the students. Using technology in the classroom in line with the educators data-driven instruction, will improve student’s shortages in their math foundational skills and conceptual skills. In turn, it will make their attitudes in math a more positive one (Yssekdyke & Bolt, 2007). Using technology as a tool to monitor student progress will allow educators to gather formative data and develop prospective lessons according their students’ skill level.

Mobile Technology

“Schools at all levels are beginning to use […] mobile devices as a means of delivering coursework and content (Franking & Peng, 2008, p. 71). Mobile technology is a form of communication that is commonly used in everyday life. Mobile technology can take many forms
and performs various services. Mobile technology includes mobile phones, iPods, tablets, and laptops. It has the capability to be at any place and any time (Schuler, 2009). Information is at the tips of the users’ fingertips. Learners have the ability to research and access an endless amount of knowledge. Mobile technology is a prominent mode of communication with students, whether social or academic. Having access to endless amounts of information at any time is powerful. It meshes convenience with capability and potential in a mobile device. However, the shifts in Common Core State Standards for Math practices and assessments are uprooting the method in thought from the classroom. There is a focus on changing students’ thinking processes to get them to be college and career ready. It’s changing the way students think and solve problems. Technology can be the bridge that allows students to feel more comfortable and motivated as the shifts move forward. The students have the opportunity to develop an understanding of math through real-world learning experiences through technology.

With the use of mobile technology, 21st century learners that have technology at the tips of their fingers, they are able to effectively use technology to enhance their math education (Carr, 2012). The students are able to create their own understanding using task-oriented concepts and have the ability to provide reasons behind their solutions. Mobile technology helps learners make connections to their academics. They are able strengthen their thoughts and understanding of a concept. In math, mobile technology scaffolds the way a learner thinks. It provides countless opportunities to experience math in different approaches. Mobile technology presents real-world problems that require critical thinking and using appropriate math solving skills. Real-world problems offer learners opportunities to decipher word problems and determine which information is important.
Using mobile technology, like iPads, in the classroom engages student learning. With the move to Common Core State Standards, technology is a necessary teaching tool. Mobile learning intervention gives teachers tools to strengthen their teaching, and students’ tools to heighten their learning experiences. Mobile learning the classroom promotes productive learning interactions (Kiger, Herro, & Prunty, 2012). Mobile devices help learners construct their knowledge by giving them personalized information that empowers their learning. Students are able to have individualized moments of learning based on their interests and curiosity. iPads give the students the ability to personalize their learning. In the classroom, there are education apps that can specifically target a skill for students to strengthen.

**Education Apps.** Education apps are technology-based programs that are used in an educational setting. These applications are used on mobile devices to enhance a students’ education. Education apps activate students’ thinking, learning, and connections. According to Harry Walker (2011), educators have to maximize their instructional time with the students. A way to provide “meaningful reinforcement and extension activities” is through education apps (Walker, 2011). Education apps support the students in instructional skills by differentiating and concentrating “individualized instruction” for the students (Walker, 2011).

Socrative is an online application that engages students with mobile technology. Students use mobile devices, iPads, and Socrative to enhance their learning with the CCSS for math. Teachers develop the content that is given to the students. The students were given real-world tasks that focused on having the students develop various solutions and explanations. Socrative allowed the learners to expand their mathematical knowledge and fluency to apply them.
Socrative, an education app, allows the educators and students to receive immediate feedback on mathematical standards. By using the technology to monitor students’ progress, educators were able to closely monitor the students (Ysseldyke & Bolt, 2007). The teacher will be able to monitor student progress and guide student thinking by: posing different questions that will allow the students to think deeper into the concept, and guiding the student back to the main concept. Closely monitoring student progress and responses will allow educators to gauge students’ levels of thinking and develop technology strategies to support their math teaching (Kearney & Maher, 2013). Real-world tasks allow the learners to apply their mathematical fluency into tasks that could really happen (Hernandez, 2003). Students will become proactive learners because they have a real-world problem that needs fixing.

Effects of Integrated Technology

Technology integration in education has initiated a 21st century approach to learning. Rubin (1999) explained that technology integration in math education gave students access to “a set of tools widely available to students … [and] has the potential to significantly change the curriculum” (p. 6). When students are working with technology in the classrooms, they are involved in their learning experience. The students are able to interact with their lessons as active learners who are engaged and using critical thinking strategies.

Student Engagement. Learners need engaging tasks that promote intrinsic motivation. Intrinsic motivation allows students to be driven by internal rewards. The involvement and enthusiasm exudes from learners and transforms those feelings into personal engagement in their education. Educators must develop real-world math tasks focusing on relevant problems to engage their students (Alexander, et al., 2010). When students participate in the problem based
task, they are able to think critically about various solving methodologies. By building culturally relevant lessons, an educator can access his or her students’ knowledge and apply their math skills into life skills. Culturally relevant lessons occur when students are able to connect and associate their background, knowledge, and experiences with their education. These relevant lessons help motivate the learners in their own math achievement (Bottge, et al., 2004). In the article, Computer Games for the Math Achievement of Diverse Students, it discussed how technology “could help students to engage with math content by making class enjoyable” (Kim & Chang, 2010).

Technology integration offers a unique method to have all students experience the same background, knowledge, and experiences for real-world, culturally relevant problems. When students are using technology in the classroom they enjoy the classroom more and have positive attitudes. In turn, it causes learners to have positive beliefs about themselves and academics.

**Learning Attitude.** Efficacy plays an essential part in achievement within students (Zimmerman, 2000). Efficacy reflects a learner’s personal abilities, motivation and perseverance to achieve a goal. When learners are invested in their education, they influence how the students persist and the amount of effort that is given (Zimmerman, 2000). Having self-efficacy is stated as the “most important” factor when developing mathematics skills (Ozgen & Bindak, 2011, p. 1086).

Learners who do not show efficacy, effort and persistence, showed a lack of interest in math. This unambitious interest made the math tasks strenuous causing the learner to think it is laborious and feel indifferent to the tasks (Zimmerman, 2000). If learners are forced into learning, they will see their education as troublesome. Starting out with negative thoughts will
change a learner’s experience. Learners must have meaningful connections in their math experience, and have it should pique their interests (Bindak & Ozgen, 2011). A mixture of motivation, hard work, and dedication to reach a goal allows learners to change their mindset in a more positive direction.

There is a connection between learner attitudes and technology. Technology has been used in classrooms as a way to bridge achievement gaps and enrich learners. Technology provides an avenue to build knowledge in math. Learners are able to focus on the tasks and develop positive feelings towards technology instruction (Schacter, 1999). Technology instruction increases positive effects on math achievement (Schacter, 1999). Common Core State Standards for Math integrates explanations using academic language to clearly express their ideas. With this movement, students begin to feel anxious with the transition in math. Students have positive attitudes towards math when introduced to a computer assisted instruction and therefore will have a positive impact on their problem solving skills (Huang & Chang, 2012). Students will need to use their positive attitudes, effort, persistence, and problem solving strategies to think critically about the problem and its solution.

**Critical Thinking.** Having critical thinking skills is essential in everyday life. Technology integration builds upon a learner’s critical thinking skills and allows a learner to build connections between the real-world and lessons. When learners are focusing on mathematical content, they need to focus on the construction of their knowledge. Constructing their mathematical content includes its language and vocabulary, mathematical literacy. By analyzing various real-world problems with technology, learners develop thinking skills to be able to differentiate the beneficial information from the useless. They need to evaluate the information and actively think on how it can be applied to the problem.
Educators need to act as students’ guide and assist them in discovering dependable knowledge. Eventually the students will be able to formulate and think critically about that information. Then from that process, they would be able to construct their knowledge abundantly. Educators can use technology in the classroom to accomplish various tasks. When technology is being used in an academic setting, it needs to be used as a tool for success. The task must use technology purposefully and within context. As technology is being used in the classroom, educators have to model how technology can be used for academic growth. Students can have the opportunity to benefit of technology’s helpfulness and depth of knowledge.

CCSS is bringing a shift in thought into the classrooms. Common Core State Standards for math, CCSS math, is transforming how the students think, how the teachers teach, and what materials are taught. The teachers will need to give students the ability to construct their knowledge through various experiences, discussions, and explanations. Technology integration will engage the students and have a seamless transition from unilateral thinking from the current Content Standards to the multilateral thinking promoted by CCSS.

Common Core Shifts in Math

CCSS integrates technology into the curriculum and classroom. It is embedded into the CCSS for research and presentations. Students must effectively use technology to expand their knowledge. The students are able to use technology to create a better understanding or build background knowledge and develop connections (Bush & Hall, 2013). CCSS focuses on the students’ abilities of thinking critically in language arts and in math. They can build and design knowledge that will benefit their expertise in a concept. The students will differentiate between information, which provides a deeper insight into their lessons.
The shift in CCSS for math is changing the way learners think. The California Content Standards for Math focused more on the skill and methods to solve problems. Common Core State Standards for Math focus on the application and thought processes behind problem-solving (Common Core State Standards California, 2013). They must express their thoughts in multiple ways and be able to defend their responses with evidence. This shift in thought enforces the learner’s abilities to be thinkers and doers, and obtain dual roles as student and teacher.

There are three instructional shifts: focus, coherence, and rigor. In focus, the students have less to learn, but they must be able to understand and learn it. Learning is connected and linked across the grade levels in a cohesive way. Rigor has three parts to it: conceptual understanding, procedural skills, and application (real-world situations). Conceptual understanding means that a concept can be explained to others, shown in various ways, applied to solve problems, and explained in terms of its similarities and differences.

Standards for Mathematical Practice are eight practices that should be used in the classroom. They are not specifically taught instead they are embedded in the lesson (Common Core State Standards Initiative, 2012). CCSS require students to think critically and collaboratively with 21st century skills to build their knowledge constructively (Barnes & Herring, 2012). Technology allows the students to develop their own problems and methods to find solutions. It provides engaging opportunities to build confidence within mathematical practices by developing student-created problems and giving culturally-relevant problems to solve (Beal & Cohen, 2012).

Common Core State Standards in Math have included the Standards of Mathematical Practice that influence how the lessons are taught and translated to the students. Students will
construct their knowledge, balancing procedure and concept development, and be able to follow the eight Standards of Mathematical Practice (Common Core State Standards Initiative, 2012). In the Common Core State Standards for Math, there are instructional shifts that transform the methodology of teaching math. These shifts make math interactive and makes the learning constructive. Learning communities can be built with technology in the classroom. Educators and students work towards a common goal and understand that each person can help.

**Standards for Mathematical Practice.** In CCSS for math, there are eight Standards of Math Practice that are required in a math lesson. An important aspect to the Standards of Math Practice is the student’s ability to explain how they retrieved their answer and why they chose that method to solve it. The eight Standards of math practice are (a) solve problems efficaciously, (b) make sense of the relationships with quantities, (c) provide explanations and critique student work, (d) model math with everyday problems, (e) use the “appropriate tools strategically,” (f) communicate effectively on math reasoning, (g) observe patterns and structure, and (h) look for repeating reasoning (Common Core State Standards California, 2013, p. 6). With instructional shifts in the Common Core State Standards for math, the use of technology is an instrument that students can use to construct their conceptual math knowledge and develop their thought processes in math.

The interactive teaching qualities of technology contain learning, problem-solving, and logic that can increase students’ motivation (Carr, 2012). With the encouragement of technology use in the classroom, the focus on math achievement and student motivation increases. With technology integration in the classroom, educators are able to utilize educational applications to assist CCSS Math’s evolutionary approach to teaching and learning.
**English Language Learners.** English language learners are able to have authentic learning experiences and various opportunities to make connections and build their backgrounds. English language learners need to have multiple learning opportunities using technology to enhance the instruction. Using the appropriate tool allows an educator to develop lessons that will assist in constructing one’s knowledge. Technology can provide differentiation to students according to their abilities. Academic success is dependent on the understanding of academic language in math. Academic language is key to the success of English language learners. Conversing about how a solution was achieved, or the way they solved the problem gives an English language learner the opportunity to talk to another person using academic language. They are able to examine their thoughts to clearly discuss their thoughts and solutions (Ruben, 1999).

With the transition to the Common Core State Standards the emphasis on academic language is significant to develop the advancement in student learning. The internet and mobile technology has become a significant teaching tool for English language learners. It provides a plethora of information to construct knowledge and numerous ways to communicate and collaborate with a world-wide community. There has been a positive effect of integrating technology into instruction (O’Hara & Pritchard, 2013). High-quality instruction, enhance their background knowledge, and vocabulary development is essential in mastery in the math content area for an ELL (Short & Echevarria, 2004).

Using technology to enhance student learning has provided students with positive and effective learning environments (Kim & Chang, 2010). The popularity of the game based activities is significant to a student’s learning process. The more interested they are in the activity, the more effort they would put into it. ELLs are able to communicate with other
students about their tasks within technology and collaborate with others in the class (Kim & Chang, 2010). Technology integration creates opportunities for every student in the classroom to have discussions about their learnings.

**Mathematical Literacy.** All learners need to have exposure in mathematical literacy. Math literacy is the listening, speaking, writing, and reading of math (Bindak & Ozgen, 2011). The learners are able to focus on the content of the task when they have math literacy. They are able to deconstruct the real-world problems and determine each part of the task, using both reading comprehension skills and math comprehension skills (Bottge et al, 2004). The learners can develop a plan of action. The students are able to brainstorm solutions and how they plan to get to that solution. Math literacy and fluency, academic language, comprehension, and efficacy aid in constructing a learner’s math knowledge.

Both math fluency and conceptual understanding are critical for being successful in math (Baker & Epper, 2009). Building math fluency is significant in addressing conceptual math. CCSS Math focuses on students’ power to construct their knowledge. In order to construct, there must be foundational skills in place, math fluency. Then learners will be able to apply their math knowledge into conceptual math, which consists of culturally relevant real-world tasks. Incorporating the use of technology into the classroom connects the students to the world and motivates them to develop solutions in math (Ke & Grabowski, 2007). Students can explore and gather information from electronic sources to attain data on their tasks.

Students must develop conclusions and decide the significance of the information that is given in a word problem. A student must develop critical thinking skills to determine if information is relevant to finding the solution of a problem. Technology integration can assist in
developing and strengthening critical thinking by having access to numerous examples and communicating with collaborative learning.

For English language learners, technology is the bridge between academic language and academic proficiency. Educators must have the appropriate technology teaching tools and content matter that best suits the lesson. Being able to understand and use academic language will help the ELLs communicate with their peers and teacher effectively (Harper & de Jong, 2004). Educators will need to address the language demands in math to build ELLs math literacy (Harper & de Jong, 2004). By identifying the language requirements, the teacher can support the ELLs to develop their math language proficiency. With mobile technology, they are able to practice multiple mathematic skills and offer reasons to their methodology. ELLs will be able to build their mathematical reasoning and literacy with the technology support. Practicing the skills on a regular basis contributes to the students’ familiarity and comfort of applying math literacy and concepts.

In CCSS, teachers will focus on specific literacy needs for the ELLs: listening, speaking, reading, and writing. The CCSS Mathematical Practices include literacy tasks with the use of academic language, which are embedded in the standards. Technology can help ELLs develop their academic language in various subjects (O’Hara & Pritchard, 2013). Math academic language requires substantial practice. Students are likely to retain the information and build their knowledge when they are attentive. Being able to participate in the lesson engages and motivates students to work. Students are able to build upon personal attributes to gather and work collaboratively to gain information. Authentic and collaborative learning allows the students to analyze and examine the data to rationalize their own perspective (Brown 2007). ELLs are capable of internalizing mathematical concepts and vocabulary to exercise them daily.
Technology enables students to take their education outside of the classroom and implement their skills in real-world situations.

Conclusion

Through the review of the studies on technology integration, it has shown that technology integration affects classrooms positively. Bringing in mobile technology into the classroom develops a connection between school and home life of the students. Mobile technology allows students to use familiar devices, like iPads, to enrich their learning. Since technology integration is moving into the classrooms, it has shown its engaging effects on the students.

Technology integration with mobile learning can bond Common Core State Standards and the classroom methodology. There is a disconnection between how the students learn on a daily basis and how they learn in school. Print sources, like textbooks, must be supplemented with additional information; whether it is credible electronic sources, photos, videos, or online discussions, for the learners, to gain a deeper understanding of the text. Mobile technology provides the multimedia, videos, podcasts, and audio into educational content allows the learners to connect to learning experiences and information. Technology integration can build background for learners, so they can make connections to their lessons.

Technology in the classroom has the ability to connect and engage students in their learning. Students developed positive attitudes towards technology because it integrated videos, games, podcasts, and collaborative exercises into constructing their knowledge. Learning has become engaging, enriching, and interactive through technology. Students are inclined to use technology to investigate topics and gather additional information. Educational apps provide an avenue for students to actively engage and be supported in their education with mobile
Students became motivated with the various applications available (McKenna, 2012). Education apps provide many methods of utilization in the classroom.

In the meta-analysis on interactive learning by Vogel et al (2006) discovered that “interactive experiential activities that increase student motivation also show increased learning outcome” (p. 239). Technology and educational apps were able to significantly increase in math concepts. Practicing mathematic skills with education apps reinforced learners’ mathematic literacy and foundation. Using mobile technology in the classroom engages the students with multiple types of interactions. Mobile learning can differentiate and engage students in math, as well as, have them work at their own pace and level (Novak et al 2009). Students are able to have individualized programs that are unique to them; which makes the students invested in their education.

**Methods**

The students used iPads in the classroom as their mobile technology. They used an educational app called Socrative with the iPads. The students received teacher-developed math assignments on Socrative. The teacher-developed activities were data-driven and aligned with the CCSS for Math with a focus on the Standards of Practice. Students went into the educational app, Socrative, to develop solutions to the problems posed. The problems were real-world and work related questions where the students applied their math knowledge.

Technology integration in the classroom was innovative way for students to improve and the mastery of their math skills. The students addressed their areas of need so that their foundational skills became conceptual skills, which are necessary in the current world. The learner had to make sense of the problems and persevere in the problems. By using Socrative on
iPads, the students analyzed their answers and illustrated their understanding with models and explanations.

All students in this particular 6th-grade classroom took the pretest and posttest. The student participants received 30 minutes of technology time 2 days a week to address math needs as determined by the pretest. At the beginning of week 1, the group took a pre-test, Benchmark Practice 1 Math, to determine the students’ baseline data. At the end of week 6, the students took the posttest and to see if technology impacted their learning in math as well as their attitudes.

Setting

The study was conducted at a K-8 school, in a 6th-grade classroom. The school began as a charter school within the district, but was appointed as a priority school by the district’s superintendent. It was deemed as a Priority School because it was a low-performing, high-poverty school. The Priority School teachers have been trained on various teaching strategies that focus on standards-based instruction to accelerate student learning. During the last year of California State Test, CST, this K-8 school reached an Academic Performance Index (API) of 813. API measures a school’s academic growth and performance according to measures established by California Department of Education.

At this school, there was an increase in the student population. This school added a 6th-grade at the beginning of the school year, therefore transforming the elementary school into a K-8 school. Due to the closure of a nearby school, nearly one-third of the class’s students are from the previously closed school. The other two-thirds of the class are students who attended this school in prior grades. The 6th-grade classroom is self-contained with one teacher and an AmeriCorps team member. They are taught multiple subjects, which include English language
arts, writing, math, social studies, and science. There is a focus on academic achievement and building foundational skills necessary to be successful in college and careers.

The students have a positive learning atmosphere. They communicate with each other respectfully. They have high expectations from their teacher and themselves. They are encouraged to be thinkers in the classroom and to believe in themselves. The students are inspired to be efficacious within the Growth Mindset. Growth mindset refers to the students believing that they can be successful, in any circumstance, with effort and hard work.

Participants

There were 27 students who participated in the study with Socrative application installed on the iPads. Through the 6-week innovation, 4 students left the school. There were 23 students who completed the entire 6-week process. The study started with 10 male students and 17 female students. At the end of the study, there were 9 male participants and 14 female participants. Of the 23 students, there were 6 English Language Learners. The participants were 11- to 12-year old students ($M=10.7$ years, $SD=0.5$).

The families of the participants and the participants were recruited from the researcher’s self-contained 6th-grade classroom. The participants were the researcher’s students for the school year. Their family members were informed about the study through parent communication, notes sent home and phone calls. Each parent was spoken to and had the opportunity to ask questions regarding the study. The participants were given information through a class presentation and discussion. Contact with family members and participants was a vital part in the study. With an open line of communication, the researcher was able to connect to the participants and family members regarding any questions or concerns.
After talking to the participants and their families, the researcher sent home two consent forms. The front consent form informed the family members of the procedures and actions taken during the study. The second consent form was a student consent form that explained the procedures in kid-friendly language. The participants and family members had to sign both consent forms to participate in the study.

Measures

The data that was collected was mixed-method with both qualitative and quantitative data. The students took an Attitude Pre-Survey on their attitudes of math and then an Attitude Post-Survey on their attitudes towards math. The participants had a Post-Survey Questionnaire regarding their feelings towards the integration of math and technology (Appendix C).

A benchmark was given to the participants before and after the 6-week program. Benchmarks are standards-based tests that allow the students to show their knowledge. The benchmarks are assessment tools that are used within the school district. The assessment data was collected through Data Director. Data Director is an online program that monitors the student’s progress and standards development. Another assessment was designed according to CCSS Math. This assessment compares the previous assessment to the later assessment.

Temperament. The pre-survey was taken prior to beginning the study. The pre-survey contained 10 questions regarding attitudes towards 6th-grade math. The post-survey contained 11 questions and asked the students to rate their attitudes towards math at the end of the study. After analyzing student responses, the participants were interviewed with 10 open ended questions. The participant’s answers have been examined to determine a deeper understanding of their responses.
**Student Engagement.** The quality of the participants’ work in the beginning, middle, and end of the study formed the qualitative data. Classroom observations were collected throughout the process. Making observations on student engagement shows how motivated the student is. When students are motivated and engaged in their learning, they feel connected to the work (Appleton, Christenson, & Furlong, 2008). The classroom observations included the students’ abilities to navigate through and complete the Smarter Balance Assessment Consortium’s California Assessment of Student Performance and Progress (CAASPP). The participants have taken the CAASPP Practice Test. The CAASPP Practice Test required the students to use technology, apply their math skills, and explain their thinking.

**Assessment Scores.** The quantitative data that was collected from the students was in the form of assessments. As the initial assessment, I used the first benchmark as a pretest for all students. The initial benchmark served as baseline data. The benchmark contained 65 questions on 6th-grade math. It assessed the students on their math skills in Number Sense, Algebra and Functions, Measurement and Geometry, and Statistics, Data Analysis, and Probability. There was a collection of data, and determined the following week’s problems of practice. At the end of the session, the participants had another benchmark. The posttest was used to see how the students assessed with the intervention applying Socrative on iPads.

**Procedures**

The students participated in a 6-week program that focused on the use of technology and math in the classroom. The innovation of Socrative on iPads occurred in 30-minute time periods, twice a week. The students took Benchmark Practice 1 as their baseline data. Their baseline data was compiled and determined the types of questions they would work on. The questions were formulated to construct their thinking and utilize the Standards of Mathematical
Practice. The questions were posted on Socrative as an assignment. There were two assignments each week. Each student had his or her own iPad. The students went to Socrative’s website and logged on as a student. The students entered a room and were prompted to begin their assignments. They used a writing utensil and paper to find the answer to the problem, and then inputted their answers in Socrative. Using the iPad’s keyboard, they explained how they achieved their answers for each question. At the end of each session, the students logged off and returned the iPads. The students took the Benchmark Practice 2 at the end of the 6-week program. Following the benchmark, the students answered a post-survey and were interviewed about their experiences.

**Limitations and delimitations.** A limitation that could affect data control is student absences. When students are absent, the student misses an opportunity to be assessed or time with the technology piece. There is a limit in controlling the student’s lives outside of the school setting. If the students are unavailable physically and emotionally, they cannot participate in the study. Another limitation occurs when the school has events that interferes with the designated times of intervention. Student ability to maneuver online is different for all students. Each student has a varying degree of familiarity with technology. Students who have more experience may navigate efficiently, while others may not.

The delimitations that were created informed the family members about their student’s current intervention and to ensure that students came to school every day. The class has been self-contained 6th-grade classroom. Having the students for the entire year, allowed me to implement a whole-class experimental group. Prior to the study, the students participated in iPad training in class and were able to become familiar with the technology prior to using it.
Timeline. The study started in the third week of October and ended on the third week of December (Appendix D). In the first week, week of October 21, the students took the Benchmark Practice 1 for Math and the math pre-survey. From the week of October 28 through the week of December 9, the students participated in the study for two days a week. Each session was a 30-minute period. In the third week of December, students completed their Benchmark Practice 2 for Math, the Attitude Post-Survey, and the Post-Survey Questionnaire. The student work was analyzed after the data collection (Appendix E).

Validity and reliability. The methodology for the analysis will be of mixed methods. Through assessments, the researcher gathered quantitative data and measured the achievement percentages of each standard through Benchmark Practice assessments. The quantitative data are collected from the benchmarks percentages and the standards assessment percentages. It is crucial that the assessments are taken the same way to rule out variability. The researcher also collected qualitative data. When collecting qualitative data, the researcher observed the students to monitor their achievement and attitudes.

The students took the pretest as a whole group in the same setting. The pretest was collected from each student. The pretest was scanned into Data Director, an online scoring system. The results showed the researcher the students’ baseline data. At the end of the 6-week session, the students took a posttest benchmark to show how their achievement in their math percentages. Also, the students took an Attitude Post-Survey that described their feelings after the intervention. The quantitative data from the pretest and posttest determined the full growth of the students’ progress in temperament and standards achievement. The participants were observed for attitudes, progression, and engagement. The data collected, qualitatively and
quantitatively, was triangulated with literature and student responses to ensure that the data that was collected is valid and reliable.

**Results**

The data presented has been collected using both from quantitative and qualitative methods. The results will first approach the demographic data collected from the 23 participants. The participants’ Benchmark Practice 1 data was collected as baseline data in the beginning of the study. After the 6-week period, the participants took Benchmark Practice 2 to show the participants’ progression. The participants were given a pre-test to develop baseline data on their temperaments towards math. Afterwards, the data was acquired after the innovation in a post-survey to measure the participants’ temperaments. The researcher has collected qualitative data with observations on participant engagement and from analyzing short answer questions.

**Descriptive Data**

In the research, there were 23 participants who finished the innovation with technology and math. Of the 23 participants, 14 (61%) were female and 9 (39%) were male. There were 6 (26%) participants who are English Language Learners in enrolled in the class (figure 1).

![Figure 1. Participants](image-url)
Benchmark Practice Data

The participants took Benchmark Practice 1 Math in the beginning of the 6-week innovation. Benchmark Practice 1 Math focused on standards-based questions and gave baseline data. The baseline line data shows the participants’ math knowledge at the start of the innovation. The participants achieved a percentage score of 22% to 78% (Range= 56%). After the 6-week innovation, the participants took the Benchmark Practice 2 Math. Prior to the innovation, a male participant did not take Benchmark Practice 1 Math. The participants achieved a percentage score of 25% to 89% (Range= 64%). Of the participants, 14 (61%) of them improved from Benchmark Practice 1 Math in Benchmark Practice 2 Math (figure 2). Of the participants, 9 (39%) did not improve from their Benchmark Practice 1 Math to Benchmark Practice 2 Math.

![Figure 2. Benchmark Practice 1 & 2 Math Participant Results](image)

The 6 English Language Learners (ELLs) that took Benchmark Practice 1 Math and scored in the spectrum of 28% to 31% (Range= 3%). The average score for Benchmark Practice 1 Math was 29.1%. The scores for Benchmark Practice 2 Math were 34%- 39% (Range= 5%). The ELLs scored an average of 35% in Benchmark Practice 2 Math. Of the ELL participants,
67% (4) showed an improvement in Benchmark 2, and 33% (2) of the ELL participants showed lack of improvement in their Benchmark Practice 2 Math (figure 3).

![Figure 3. Benchmark Practice 1 & 2 ELL Results](image)

**Pre-Survey Data**

The participants took a pre-survey that addressed the temperaments towards math and technology. In the pre-survey the students were asked how they feel towards the statements provided. They answered in multiple choice form answers: strongly agree, agree, neutral, disagree, and strongly disagree. There were 21 participants who took the pre-survey on math and technology. The participants consisted of 14 female and 7 male participants. Within the 21 participants for the pre-survey, there were 6 ELLs.

The first statement in the pre-survey is “I feel comfortable in 6th-grade math.” The majority (11) of the participants noted that they were neutral towards this statement, and 7 participants selected that they agreed or strongly agreed with the statement. The ELLs identified that 3 participants agreed with the statement, 2 participants were neutral, and 1 participant disagreed with the statement (figure 4).
The second statement focused on the participants’ temperament (figure 5). The participants responded to “If I find the solution right away, I feel really at peace.” The responses collected from the participants showed that the students were indifferent and differed from the statement. The majority (5) of the ELLs were in agreement with the statement, while 1 ELL participant responded with “strongly disagree.” In response to the statement “I feel that I am creating something when I am solving a problem,” and it shows that the participants have a temperament that is, overall neutral in feeling (figure 6). In response to this statement, the ELLs responded that they were (2) neutral in feeling, (3) disagreement, and (1) strong disagreement.
Figure 6. “I feel that I am creating something when I am solving a problem.”

In figure 7, the participants were asked about their feelings towards giving up. The students were asked “When confronted with a problem, I want to give up right away.” According to their responses, it showed 6 students agreed, while 16 students responded with neutral, disagree, and strongly disagree. The ELLs showed they do not want to give up when confronted with a problem by responding in disagreement and “neutral” to the statement.

Figure 7. “When confronted with a problem, I want to give up right away.”
In figures 8 through 11, participants were asked about their negative feelings towards math and how it affects them as students. The students indicated that when they cannot accomplish finding a solution, they feel defeated. The participants indicated that they range between strongly agree to strongly disagree. There were 9 participants who were in agreement, 4 participants were neutral in feeling, and 10 participants who were in disagreement with the statement. There were 4 ELLs who disagreed with the statement as well (figure 8).

Figure 8. “If I can’t find solution, I feel defeated.”

Through the statements that were presented, it showed that the participants had a positive outlook on math in the initial pre-survey. As indicated in figure 9, the majority of the participants disagreed with the statement “Could you tell what math means to you? It does not mean anything, it means nonsense.” The statement responses show that the participants have indicated that they have neutral to strong disagreement with the statements on the reasons they work on math. The participants showed a range of responses to the statement in figure 9. The participants revealed that 9 were in agreement, 4 were neutral, and 10 were in disagreement of the statement. The majority (4) of the ELLs showed that they disagreed with the statement.
Figure 9. “Could you tell what doing mathematics means to you? It does not mean anything, it is nonsense.”

Figure 10. “Could you tell what doing mathematics means to you? It is doing something that you are told to do and that you have to keep doing over and over, like a machine.”

Figure 11. “Could you tell what doing mathematics means to you? It is doing something which I think I just can’t do.”
In figure 12 and figure 13, the statements focused on the participant’s belief about themselves and math. These two statements indicated that the students can cross a barrier even when it is difficult. It showed the participants’ responses ranged from strongly agree to strongly disagree. The results in figure 12 show the participants responded with “neutral” to “strongly disagree” to the statement. The ELLs showed the majority showed they were neutral or in disagreement, however, there were 2 ELLs who responded in agreement. In figure 13, the participants declared 8 were in agreement, 10 were in disagreement, and 4 were indifferent, while the ELLs showed 3 were in agreement, 1 was neutral, and 2 were in disagreement.

Figure 12. “If I feel there is a something that keeps me from solving a math problem, it’s a barrier I can’t get across.”

Figure 13. “When I start math, I feel completely in the dark.”
Post-Survey Data

The Attitude Post-Survey consisted of 11 statements to which the participants related their personal beliefs. There were 23 participants in the post-survey, 14 females and 9 males. Within the 23 students, there were 6 ELLs. The statements that were given in the post-survey focused on the students’ beliefs on mathematics.

In figure 14, the statement is “Math challenges me and I enjoy it.” The participants showed that 5 strongly agree, 3 were in agreement and 8 have neutral feelings towards this statement. Four of the ELLs indicated that they had indifferent feelings towards this statement (figure 15).

The statement, “When confronted with a problem, I don’t want to give up right away,” focused on the students’ perseverance when doing math problems. Through the survey, it was found that the majority of the participants within all three subgroups indicated that they do not want to give up right away by selecting strongly agree and agree. In figure 14, the participants are given the statements like “I believe that I do well in math.” The data shows that 12 of the students chose “strongly disagree” and “neutral.” In the data collected from the participants, it showed that they also chose “strongly agree” and “agree” in response to this statement. In figure 15, the students were given the statement “I believe that math means discovering something new.” The ELLs (6) selected that they strongly agreed and agreed with the statement.
**Figure 14. Attitude Post-Survey Positive Statements for Student Participants**

**Figure 15. Attitude Post-Survey Positive Statements for ELLs**
The statements in figure 16 were designed to get students’ feelings on mathematics when solving or approaching it. According to figure 16, the majority of students in all three subgroups indicated they were neutral to the statement “When solving math problems, if I can’t find the solution, I feel defeated.” Then in figure 16, the students were given the statements, “When solving math problems, I feel there is something that keeps me from getting at the problem, a sort of barrier I can’t get across,” and, “When solving math problems, when I start, I feel completely lost.” The data showed that the participants thought there was a barrier when they could not solve a problem. In contrast, in the statement “Math class is boring,” the researcher received 10 “neutral”s and 9 “strongly disagree”s from the participants, and a split between “neutral” and “strongly disagree” with the ELLs.

Figure 16: Attitude Post-Survey Negative Statements for Student Participants
In Figure 18, the student data indicated that the participants (14) were looking forward to the Common Core State Standards online test. Of the participants, there were 8 who indicated they disinterested and 1 participant was not looking forward to the online test, while ELLs showed that their feelings ranged through strongly agree (1), agree (2), neutral (2), and strongly disagree (1).

Figure 17: Attitude Post-Survey Negative Statements for ELLs

In figure 18, the student data indicated that the participants (14) were looking forward to the Common Core State Standards online test. Of the participants, there were 8 who indicated they disinterested and 1 participant was not looking forward to the online test, while ELLs showed that their feelings ranged through strongly agree (1), agree (2), neutral (2), and strongly disagree (1).

Figure 18. “I am looking forward to online math testing.”
Short Answer Responses

The participants were given short answer questions to develop their thoughts towards math and technology. They were asked a series of short answer questions to provide more insight regarding their thoughts about math and technology in Socrative. There were 23 participants, 14 females and 9 males, who took the post-survey after the 6-week innovation.

To gain understanding of how the students’ feelings have changed, the researcher asked, “How have your feelings towards math and technology changed from the beginning of the year? Explain your answer.” The female participants stated that using technology and math was a new experience that was helpful in understanding how to do math problems and made them learn “more about math.” With mixed emotions, about technology being unfamiliar the participants discussed how technology enhanced their comprehension of the math standards instead of “reading it out of the math book” or “using paper and pen.” The male participants wrote that they “got used to doing math more” and that “you need to think ahead of time.” Another participant “felt great to explain the answers,” while 2 male participants wrote that there wasn’t a change due to being “use to it” and “learning a little bit about technology.”

Relating particularly to the 6-week innovation, this question was designed to see changes in temperament from the innovation. They responded to, “How was the last 6 weeks influenced your feelings towards math? Explain your answer.” In the 6-weeks of the innovation, the participants identified that math was challenging. It was challenging because some of the posed problems were difficult to understand and find solutions for. However, even with the barriers within the math and technology session, they provide positive answers like, “I’m getting better” and that they were “more determined to solve problems.” A male participant wrote that “math seems easier,” while another responded, “It made me want to learn new things
and it pushes me.” In addition, a student included that it let “[him] know more about different way or solutions to figure out problems.”

The design of this question is to evoke the students’ thoughts about what they learned. The students were asked to respond to, “**Explain what you have learned from our technology experience in math.**” This question showed that the participants identified with positive responses. The technology and math experience has shown that technology enhances students’ understanding of math by engaging and has them do it in “a different way.” Their responses indicated that explanations were necessary, along with perseverance, and “to never give up.” A majority of the male participants found that their experience with math and technology was the “same” or “different.” However, there was a male participant who wrote that math and technology helped him “learn how to do many steps to get closer to my answer.”

The question, “**How will you use the problem solving strategies, that you learned with technology, to solve math problems?**” was asked to see if the participants were transferring their experience to everyday math skills. They responded that they have to read the question multiple times, “take it slower,” and “found it easier to read out the text.” Another student responded with “you have to work it out all the time.” The three of the male participants showed that this experience would have been the “same” without technology. Another male participant wrote that he “will explain how” he solved problems. A different student mentioned “problem solving strategies can guide us through a problem to answer the question.” Another male student responded “it helped me with doing math problems by using the things we know with real-life problems.”
“After your experience with math and technology, how successful do you think you will be when you solve math problems?” was asked to determine students’ positive attitudes when solving math problems. The participants were prompted with this question. It focused on their temperament towards solving math problems. The participants identified that they would be “successful” and “a little better.” One participant response identified that it’s “probably not going to be good.” Other students responded that they felt “excited” and “like a math expert.” A female participant recorded that it “has really helped me with math and I will improve in my math.” Another participant recorded “I will check my answers.” Male participants identified that they will be “successful” due to “lots of practice at home and at school” and “learning new things.” A participant identified that math is “going to be hard.” Another mentioned that it makes him “concentrate a little better.”

“After your experience with math and technology, do you think that this would be helpful for other 6th-grade classes? Explain your answer.” All female participants recorded that this experience would be helpful to other 6th-grade classes. A student recorded “you can lean the problems that you didn’t know.” Another female participant indicated that it helped more with math “methods and strategies.” All male participants indicated that this innovation would be helpful to other 6th-grade classes. A participant wrote “a change is coming,” referring to doing math with a pencil and paper. A different male participant wrote, “they can practice different problems and solutions.”

In another question about temperament, the participants were asked, “Do you feel like the math and technology experience helped you become more comfortable with technology and math? Explain your answer.” The participants recorded that the majority of them felt more comfortable with technology and math. Yet, there was a student who felt that she needed
more experience with math and technology. A student responded, “I feel more confident about my answers and responses.” Another student responded that it “changed the way” she looked at math and technology. The majority of the male participants identified that the innovation has made them feel more comfortable. There were three male students who were unclear of how comfortable they were with math and technology.

In connection to the previous question, they were asked, “What was the most helpful part of the math and technology experience? Why?” to reveal the students’ attitudes. The majority of the participants said the experience was helpful when it came to “practicing,” getting familiar with the math problems, and that it provided “key works in the problem and pictures.” There were 2 female participants who indicated that they were unsure of the most helpful part of the math and technology experience. The most helpful part of the innovation for male students was it gave “more knowledge in math” and it was “challenging.” However, from their responses they recorded, “it’s still kind of the same” and “the most helpful part is after Ms. Damaso explains it.”

**Student Engagement**

Throughout the 6-week innovation the researcher observed the participants. The students were concentrated quietly on the CCSS Math questions in Socrative. The one to one ratio of iPads to students allowed them to have hands-on, individual time with the technology. The students’ attention was on the math problems, and they worked on them intently on to find solutions. All participants showed their work and inserted explanations to the posed problems. They were involved in the solving process. The students had the ability to ask questions to the researcher during the innovation. The questions that were asked were always regarding the CCSS Math questions and requesting assistance on direction to find solutions.
The gathered information from quantitative and qualitative data has shown that students’ attitudes have transformed toward math in a 6th-grade classroom. Originally, the students had a neutral temperament towards math and technology. At the end of the innovation, the students showed indifferent to marginal improvement of their temperaments towards technology integration. However, many students began the study with a positive temperament with math already. According to the researcher’s observations the students who started with a positive attitude, exited with a positive attitude. The ELLs, showed an indifferent to unfavorable temperament towards math. Yet, the students found math classes to be interesting and meaningful, but have a barrier blocking them from solving a math problem. The pre-survey and post-survey were useful tools in acquiring knowledge about the students’ temperaments. Highly focused statements would be needed to get an accurate read on the students’ temperaments towards math and technology integration. The post-survey questionnaire enhanced the researcher’s understanding of the students’ responses and delved more deeply into their thoughts.

Benchmark Practice 1 Math showed the students’ baseline data. The baseline data showed where the students’ started in the beginning of the innovation. The students in the class showed that 14 (61%) of them increased from Benchmark Practice 1 Math to Benchmark Practice 2 Math. On the other hand, 9 (39%) of the participants did not increase in percentage points. The ELL participants showed 2 (33%) did not show improvement from Benchmark Practice 1 to Benchmark Practice 2, however, 4 (67%) of the ELLs showed growth from Benchmark Practice 1 to Benchmark Practice 2 (figure 3). To show that there was a significant increase in the student population would need to triangulate additional assessment data.

**Discussion and Reflection**
The researcher collected the data results and applied them to the 3 research questions. In this research it focused on three questions: (a) Will math and technology integration in the classroom, using Socrative, transform students’ attitudes toward math in a 6th-grade classroom? (b) Will English Language Learners’ attitudes towards math transform in a 6th-grade classroom? (c) Will math and technology integration produce higher learning outcomes through assessments in a 6th-grade classroom? The data was triangulated to determine the outcomes of the research questions. It was discovered that students have a fair-minded attitude towards math, however, the pre-test and post-test showed that their attitudes did not improve. ELLs revealed that math application strategies learned with mobile devices aided them in understanding math. It was shown that they had a favorable affinity towards math. Of the 23 student participants in the study, 60% of the students increased from Benchmark Practice 1 to Benchmark Practice 2. There were thirty-nine percent of the students who did not increase their scores. This demonstrates that technology integration is a significant tool in the student’s math education. However, it did not strongly reveal that technology integration affected student achievement in math.

**Finding 1: Transformation of Attitudes**

In the first research question, the researcher asked about the transformation of student attitudes towards the integration of math and technology. The student participants displayed an attitude towards math and technology integration that was evenhanded. Socrative, an educational app, provided the platform of how technology was integrated into math. The real-world problems that the students were faced with coincided with CCSS Math and required them to use various strategies to solve them. According to the students’ Attitude Pre-Survey towards math, it showed 100% of the participants entered the 6-week innovation with neutral to positive
temperaments towards math. In the Post-Survey, out of the 23 participants, 82% of the students were still neutral to strongly enjoy math (figure 14 & figure 16). From the survey data, it shows that 2 students improved their attitudes towards math. Through observations, qualitative data, the researcher found that the students were engaged and positive during the innovation time. In the Post-Survey Questionnaire, a student wrote two reasons why technology influenced her. She wrote “one it is very exciting to do math with technology, and two it really makes your brain work. I love to be challenged.” While another student wrote technology integration “made [me] more determined to solve problems.” The students who revealed their affinity toward math and technology showed it through their effort, concentration, and engagement with the real-world problems posed on Socrative.

Technology integration allowed the students to be engaged in their learning by providing a unique way to show their understanding of math. Socrative was a significant app in their education because it gave the students a space to plan and develop a solution. In the CCSS Math shift, students must be able to think critically about solving real-world problems with precision, perseverance, and detail. Not only must the students find solutions, they must be able to explain their thought processes. The technology integration has created a bridge to the shifts in CCSS Math while focusing on rigor.

Even though the students showed that there were barriers for them in math, they still believe that they are capable of being successful in it. The efficacious attitudes of the students exhibit their perseverance in problem solving for math. The majority of the participants have shown the experience with technology integration made them feel “successful” and “more comfortable with math.” According to other student responses, technology and math integration
“feel excited and challenged.” However, there were also students who commented on how it made them feel like they were “lacking their math lessons.”

An implication that could be identified with their positive attitudes could be their initial liking towards math. This experience allowed the students to participate in a new way of thinking and understanding math. The experience enhanced their learning and allowed them to strengthen their attitude towards math. Therefore, the students who started with a positive attitude left with a stronger or same temperament.

Another implication would be the types of questions that were assigned. The mathematical questions that were given to the students were CCSS based. Students who may not have a strong mathematical foundation that the CCSS math questions require could have affected the way students found solutions. If a student is struggling with their mathematical foundational skills or mathematical literacy, it would be difficult for them to approach the questions.

**Finding 2: ELLs Struggled with CCSS Math**

Regarding the transformation of attitudes towards math with technology integration in ELLs have shown that they develop an indifferent temperament towards math. In the Attitude Pre-Survey (figure 4), it was indicated that 3 students agreed, 1 student was neutral, and 1 student disagreed with the statement “I feel comfortable with 6th-grade math.” Then in the Attitude Post-Survey, it was indicated that 1 student strongly agreed, 4 students were neutral, and 1 disagree. However in the Attitude Post-Survey it was demonstrated that the ELLs were efficacious towards the real-world math problems (figure 15). The ELLs were asked, “When confronted with a problem, I don’t want to give up right away.” The ELLs were in agreement of the statement which showed, they would not give up. An ELLs wrote, “It is a lot harder with big
questions…, but I’ll get used to it.” Another student wrote “[it] was challenging and even though it’s hard, it will make me successful [in] math.” Even though the ELLs showed a change in their feelings towards math, it also showed that they were willing to try harder and work more diligently towards finding a solution to the real-world problems. This insightful find demonstrated that even though the students struggled in understanding the math concepts, they were willing to put forth their best effort. Even with barriers, the combination of iPads and Socrative allowed them to work at their own pace. The researcher noticed that the ELLs took their time and engaged with the technology. However, the ELLs did not converse to their classmates about the problems on Socrative, which is crucial to mastering English.

CCSS for math utilizes real-world problems to which students would be able to find solutions. The eight CCSS Math instructional shifts were implemented with this technology integration. When the students used Socrative on the iPads, they were faced with word problems. The real-world problems were designed with mathematical academic language and scenarios. The word problems focused on CCSS for math. If the ELLs do not have mathematical literacy, it would be a barrier to understanding the math problems.

ELLs are working towards mastering English language arts. They have been identified as students who need additional support towards mastery. The language that was used in the problems may not be familiar to the ELLs. Specific academic language, like math expressions, could hinder their learning experience because they may not have that vocabulary background. Math literacy is significant in ELL’s learning experience. Without practice with academic language, format, and features of word problems, it will be difficult for them to build their mathematical literacy. The transformation that CCSS for math is bringing will change how ELLs think about math. Since CCSS for math focuses on language, students who are still
mastering the English language will have a disadvantage from the start if the educators do not provide ELLs the necessary language support (Short & Echevarria, 2005).

**Finding 3: Technology Integration Findings are Inconsistent**

The third research question focuses on the ability of technology integration and math to produce higher learning outcomes through assessments. While 61% of the students showed an increase in their Benchmark Practice 1 to Benchmark Practice 2, 39% did not show an increase from the Benchmark Practice for Math focuses on math standards compliant with California Content Standards (figure 2). During this experience the students focused on finding solutions compliant with CCSS Math. The Benchmark Practice for Math still assessed the students on their abilities on solving various mathematical problems.

Throughout the study, the students received daily math instruction. Every day the students learned about a new math lesson. They became familiar with math skills, concepts, and academic vocabulary for math. The lessons concentrated on specific skills and procedural tasks. The students were able to explain how they received their solutions aloud or in writing. The students also experienced Board Math daily. Board Math is a verbal overview of all the standards strands in math. It serves as a review and a pre-teaching mechanism for the standards. The study continued as the students learned new math concepts. First, the students must construct their knowledge and develop an understanding of it.

The students used iPads and the educational app, Socrative, to develop their skills in math. The learning outcomes from the innovation showed that the students did not increase specifically to the technology integration with math. The lessons on Socractive were CCSS based and focused conceptual and constructivist approaches versus the procedural approach.
Even though this statement suggests “continuous progress monitoring and data-driven decision making enhances progress toward meeting standards and results in higher test scores” (Ysseldyke & Bolt 2007, p. 464.), the researcher found that this must be done in a smaller group setting to specifically target math skills that the students need.

The results were affected because the students may not have solidified their math concepts prior to the iPad integration. In addition, they could have been unfamiliar with the math concepts due to learning them briefly through Board Math. Additional instruction during the day may explain the increase in student achievement and improvement in learning outcomes. Technology integration was there to support the application of math in real-world problems in line with CCSS Math. There is not a pin point to say, through quantitative and qualitative data, that technology integration influenced the students who increased in their learning outcomes.

The data that was collected from the students was given through surveys, questionnaires, and Benchmark Practice assessments. The pre-survey statements that were given to the students need to address more of their temperaments towards math. Also, the statements required more organization between feelings towards math and being efficacious. The results were affected by the sample size during the pre-survey. There were 21 participants who took the Attitude Pre-Survey, but there were 23 students who completed the study and post-survey. As the Attitude Post-Survey was given, the researcher could have considered using the same statements as the pre-survey to ensure the students responded to them as in the beginning of the study. That way the students could have responded in comparison to how they felt at the end of the study. However, the statements did ask the students about their temperament and feelings in a similar method, which assured the validity of the responses. The questionnaire at the end of the Post-Survey served as a method to delve into the thoughts of the students. It gave them a chance to
answer the questions with personal short answers. Its purpose was to discover how the students felt and triangulate that data with the Post-Survey results. Using Socrative as the education app allowed the researcher to develop CCSS Math real-world problems and relate them to the students. Other educational apps should be used to help the students apply and construct their knowledge, but also to focus and recall it. An extension of this research would be to explore various apps determine its quality and effectiveness in the classroom.

For future research, questions that should be asked would be about the importance of technology integration in the classroom when there is a technology shift and which technology would be the most effective in a classroom setting. Another question would be which apps in education would be most useful for teachers of various technology levels. Mobile devices are becoming widely used in a classroom setting. Developing technology integration’s effectiveness for the students growing in a digital world is important in preparing them to be college and career ready.
References


Carr, J. M. (2012). Does math achievement h’APP’en when iPads and game-based learning are incorporated into fifth-grade mathematics instruction?. *Journal of Information Technology Education, 11*


Appendix A

Math Attitude Survey Pre Test

This survey will ask you about your feelings towards math during your 6th grade school year. Read and answer the questions carefully. Mark only 1 multiple choice answer for each question. When you finish your survey, submit it. You will receive a confirmation page when your survey has been submitted.

Thank you!

Math challenges me and I enjoy it.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

Learning math prepares you for your next math class, but that’s about it.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

When solving math problems, I feel that I am better understanding of math when I am solving a problem.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

I believe math does not mean anything, it is nonsense.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

When confronted with a problem, I don’t want to give up right away.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree
When solving math problems, if I can’t find the solution, I feel defeated.
○ Strongly Disagree
○ Disagree
○ Neutral
○ Agree
○ Strongly Agree

Math classes are boring.
○ Strongly Disagree
○ Disagree
○ Neutral
○ Agree
○ Strongly Agree

When solving math problems, I discover an approach, I feel positive about the method I chose.
○ Strongly Disagree
○ Disagree
○ Neutral
○ Agree
○ Strongly Agree

I believe that I do well in math.
○ Strongly Disagree
○ Disagree
○ Neutral
○ Agree
○ Strongly Agree

If I find the solution to a math problem right away, I feel really at peace.
○ Strongly Disagree
○ Disagree
○ Neutral
○ Agree
○ Strongly Agree

When solving math problems, when I start, I feel completely in the dark.
○ Strongly Disagree
○ Disagree
○ Neutral
○ Agree
○ Strongly Agree
I believe that math means doing something basic which is the key to everything else.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

It is possible to like math even if you are not good at it.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I believe math is doing something which I think I just can’t do.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

When solving math problems, I feel there is something that keeps me from getting at the problem, a sort of barrier I can’t get across.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I believe math means discovering something new.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I believe math is a way of training my mind.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree
It's more important to get a good grade in math class than to understand math.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

Math comes easy to me.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I become discouraged by a math problem when I am unsuccessful at solving the problems the first time.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

It's more important to get a good grade in math class than to understand math.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

Math comes easy to me.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I become discouraged by a math problem when I am unsuccessful at solving the problems the first time.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree
Math Attitude Survey Pre Test

Thank you for your response. Your responses have been recorded.
Appendix B

Math Attitude Survey Post Survey

This survey will ask you about your feelings towards 6th grade math after participating in the study. Read and answer the questions carefully. Mark only 1 multiple choice answer for each question. When you finish your survey, submit it. You will receive a confirmation page when your survey has been submitted.

Thank you!

Math challenges me and I enjoy it.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

When confronted with a problem, I don't want to give up right away.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

When solving math problems, if I can't find the solution, I feel defeated.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

Math classes are boring.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I believe that I do well in math.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree
When solving math problems, when I start, I feel completely in the dark.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

It is possible to like math even if you are not good at it.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

When solving math problems, I feel there is something that keeps me from getting at the problem, a sort of barrier I can’t get across.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I believe math means discovering something new.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I become discouraged by a math problem when I am unsuccessful at solving the problems the first time.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

I am looking forward to online math testing.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree
Appendix C

Questionnaire on Socrative

1. How has your feelings towards math and technology changed from the beginning of the year? Explain your answer.

2. How has the last 6-weeks influenced your feelings towards math. Explain.

3. What are some of your math successes?

4. What are some of your math struggles?

5. Tell me what you have learned from our technology experience in math.

6. How will you use the problem solving strategies, that you learned with technology, to solve math problems?

7. After your experience with math and technology, how successful do you think you will be in your math problem solving?

8. After your experience with math and technology, do you think that this would be helpful to for 6th grade classes? Explain your answer.

9. Do you feel like the math and technology experience helped you become more comfortable with technology and math? Explain your answer.

10. What was the most helpful part of the math and technology experience? Why?
# Appendix D

## Timeline

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Assignment</th>
<th>Which group?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>September 2013</td>
<td>Send permission forms home and secure iPads</td>
<td>Ms. Damaso’s 6th-Grade Class</td>
</tr>
<tr>
<td>B</td>
<td>October 21-25</td>
<td>Take Pretest, Benchmark Practice 1 Math Interpret and analyze data Train students on how to use technology</td>
<td>All participants</td>
</tr>
<tr>
<td>1</td>
<td>October 28- November 2</td>
<td>30 minute 2-day sessions on math standards specific to student</td>
<td>All participants</td>
</tr>
<tr>
<td>2</td>
<td>November 4-8</td>
<td>30 minute 2-day sessions on math standards specific to student</td>
<td>All participants</td>
</tr>
<tr>
<td>3</td>
<td>November 11-15</td>
<td>30 minute 2-day sessions on math standards specific to student</td>
<td>All participants</td>
</tr>
<tr>
<td>4</td>
<td>November 18-22</td>
<td>30 minute 2-day sessions on math standards specific to student</td>
<td>All participants</td>
</tr>
<tr>
<td>5</td>
<td>December 2-6</td>
<td>30 minute 2-day sessions on math standards specific to student</td>
<td>All participants</td>
</tr>
<tr>
<td>6</td>
<td>December 9-13</td>
<td>30 minute 2-day sessions on math standards specific to student</td>
<td>All participants</td>
</tr>
<tr>
<td></td>
<td>December 16-20</td>
<td>Take Post-Test Benchmark Practice 2 Math Analyze and Triangulate Data</td>
<td>All participants</td>
</tr>
</tbody>
</table>