

**HOW TECHNOLOGY BASED FORMATIVE ASSESSMENT IMPACTS STUDENT
ACHIEVEMENT IN AN ALTERNATIVE EDUCATION PROGRAM**

A Doctoral Capstone Project

Submitted to the School of Graduate Studies and Research

Department of Secondary Education and Administrative Leadership

In Partial Fulfillment of the
Requirements for the Degree of
Doctor of Education

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California University of Pennsylvania

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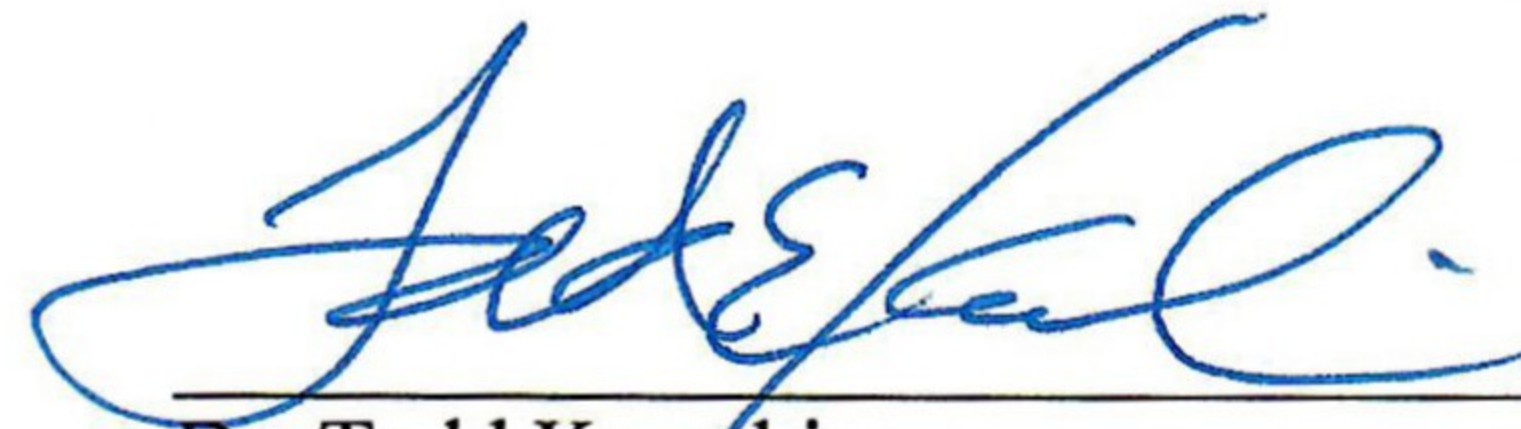
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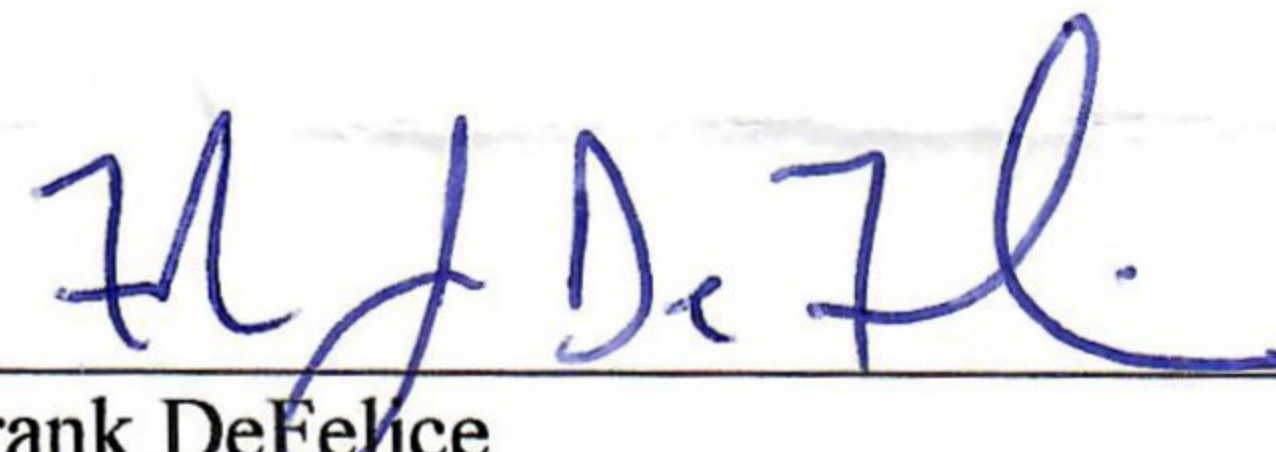
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Dedication

I dedicate this doctoral project to my family. For the last three years my family and I had to make a huge sacrifice by accommodating my work and graduate school schedule. There were many times when my time was consumed by work and class. Time is such a precious commodity, and I will make a commitment to be more present with my family moving forward.

First, I want to thank my wife, Missy, who has offered unwavering support and encouragement during these past few years. She is my biggest cheerleader. Her sacrificial care of me and our two children made it possible for me to complete this work. Thank you for your pushing me, being there for me, and your never-ending patience. You were always there to keep me focused and push me, while continually keeping our family running. I'm sure keeping me focused was very taxing. I am indebted to her, as a lot of additional responsibility was put on her plate throughout my doctoral journey. I will forever be thankful for the sacrifices she made throughout this process. She was always there to help in anyway she could.

Second, I want to thank my two children. I know at times it was difficult for to understand that I had work to do on nights and weekends and that I couldn't always provide them with attention that they needed at the moment. In no particular order (because everything is a competition with them), I'll start with Preston, my older son. I know that being enrolled in this Doctorate program has consumed a lot of my time. I hope that I did an effective job of balancing the amount of time I spent with you and doing school work. Thank you for always being there for me and our family. I appreciate the leadership role you take when needed. I also appreciate you helping out by cooking dinners for our family when we have to be in many different places at once and have limited time to cook. While you are only entering 10th grade at the moment, you just started your first college class. I wish you the best of luck as you begin your college education and know you will do great.

Next, I need to thank my younger, more spirited son, Parker. Thank you for always being there for me to make me laugh. Your quick wit, phrases, jokes, and continuous pursuit to push

the limits as much as possible is secretly entertaining to me. Actually, sometimes it's not in secret, as I will sometimes laugh, when I am trying to be serious. Your sense of humor and presence always provided me with a much-needed break and laugh. I remember doing school work one night and you asked what I was doing? When I replied that I was doing homework, you asked with all seriousness, "can't you just use a homework pass?" While I couldn't use a homework pass that night, perhaps this is something CalU wants to look into.

I can't forget Paxton, our Shih Tzu. Thank you for your unlimited amount of compassion and love. You are a true companion.

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I would like to acknowledge everyone who played a role in my academic accomplishments and have helped me along the way. First of all, my capstone committee chairperson, Dr. Todd Keruskin, your guidance, support, and encouragement throughout the doctoral process was invaluable. You always expressed a genuine willingness to help and started each of our conversations by asking how I was doing.

Secondly, I would like to thank my other committee member, Dr. Frank DeFelice. He is an invaluable resource as he served many years as a superintendent and assistant executive director. Dr. DeFelice always is there to listen and provide guidance to me. He has a wealth of knowledge that he is always willing to share. Despite what is going on, he has always made time for me, day or night.

Lastly, I would also like to thank the administrators, staff, and students of Colonial Academy for participating in the research study. Without your participation I wouldn't have been able to complete my research project. I hope the results of the capstone project provide you insight on what techniques can be used to increase student achievement.

Thank you to the teachers that volunteered to participate in this study. I know it wasn't easy for you and truly appreciate your willingness. I know you probably dreaded receiving emails from me asking for data throughout the last months of the school year. I truly appreciate your participation and hope that your experience, as well as your students' experiences, were meaningful.

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Abstract

This capstone project is focused on what impact the use of technology-based formative assessment has on student achievement in an alternative education school. This study analyzed student assessment scores prior to providing teachers with instruction on how to use technology to effectively give student formative assessments. After the teachers were provided with the knowledge to use a formative assessment application, the teachers were asked to implement the formative assessment process in their daily instruction. Surveys were also issued to teacher before training was provided to them, as well as after a period of time in which they were able to implement the instructional strategy in their classrooms. Classroom assessments were delivered at the end of the period in which teachers began using formative assessments. Afterward, student assessment scores were analyzed to identify whether the use of this instructional strategy had an effect on student achievement.

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CHAPTER I

Introduction

Schools are continually striving to assist students in reaching their fullest potential. There are a variety of instructional strategies that teachers can employ today to achieve this goal. One of those instructional strategies is formative assessment. When formative assessment is combined with technology, the teacher is provided with real time data on student comprehension. Children today have devices in their hands throughout the entire day, yet, many teachers lack the tools and knowledge necessary to provide instruction in today's digital world these kids are growing up in.

I have been an educator at Colonial Intermediate Unit 20 for 17 years of which I've held various technology related positions, currently serving as the Director of Technology and Operations. I have taken a unique approach to entering Education Administration as I have never been a teacher or building principal. While some might view this as a disadvantage, I view it as an advantage as it provides me with a unique viewpoint and allows me to truly think outside of the box as I haven't been jaded and exposed to "norms" and haven't been told to provide instruction a certain way or evaluate students in a classroom. My current role of Director is also advantageous also provides me an advantage because I sit on the cabinet and am able to work with my colleagues in a leadership capacity and gain many perspectives.

Colonial Intermediate Unit 20 operates an Alternative Education School, Colonial Academy. Students from the 13 different school districts around our regions choose to send students to this school when they have exhibit undesirable behaviors in their home district or have unique needs that the child's resident school is not equipped to handle. Colonial Academy consists of students from grades 6-12 and is currently serving roughly 300 students at the present time. Many of these students in attendance are at this school because of major and/or repetitive disciplinary issues. It is the goal of Colonial Academy to not only educate these students but to provide them with social and emotional skill sets that are needed to control their behaviors and ultimately return to their home district. A student's time at Colonial Academy is variable based

on the child's behavior and academic success, therefore, it's critical for teachers to use techniques to monitor their student's comprehension on a continual basis.

Over the years, Colonial Academy continues to get closer to a ratio of one device to one child. Each student having their own device would give the students the ability to retrieve and submit assignments and do research as assigned. These devices are already in some student's hands and could easily be used to complete formative assessments and provide teachers with real time data regarding student comprehension for the topic being taught at the moment. This data is invaluable as it instantly lets the teachers know which students are grasping the concepts and which students might need more follow up. The results also let the teacher know whether they generally can move onto the next topic or whether they need to review the current topic in further detail. Conducting formative assessments multiple times per day helps to make sure that students aren't left behind. It's fascinating to me that the use of technology-based assessment tools is not more wide spread. I can't imagine a situation in which a teacher wouldn't find this data valuable or see the potential return on investment.

Providing teachers with professional development on how to use technology based formative assessment tools and integrate it into lessons has the potential of impacting student achievement. Performing research in this alternative education setting is critical as there is limited research regarding the use of formative assessment with this specific type of student population. Teachers are often overwhelmed with training and professional development, especially in an alternative education setting. It is crucial to get buy-in prior to introducing formative assessment training, or any additional training. Getting buy-in ahead of time will result in the teachers being more engaged and make it more likely that they will take the newfound knowledge and successfully implement it in their classes.

Teachers are sometimes reluctant to explore new ways of teaching. When operating within an alternative education school, teachers are expected to take on many more tasks than that of a regular education teacher. This sometimes results in a reluctance to take on one more task.

Careful and direct communication must be used to explain how the implementation of technology based formative assessment could ultimately make their teaching job easier and positively impact student achievement simultaneously.

Students in this type of setting would benefit from their teachers using formative assessment tools. One reason is that some students are hesitant to speak up in the classroom for fear of how they might be perceived by their peers. By using technology based formative assessment tools, a student can answer a question without worrying about the whole class knowing whether they got the answer right or wrong, worrying that they may get bullied or called names because they got the answer wrong or got it right, or worrying they will be called “the class pet.” By using formative assessment, the teacher gets a feel for whether the whole class is understanding the topic and not just one or two students who raise their hand. A teacher can then move onto the next topic or can stay on the current topic and go further in depth with teaching the current topic. The use of technology based formative assessment tools allows students and teachers to be more engaged in learning and keeps children’s attention throughout the length of the entire class as they are actively engaged and participating all the time. Instant feedback is given which allows the students to know that they are learning or that they might need a little more help on a topic.

This research project will examine the impact of using technology based formative assessment and its impact on student achievement. The researcher will utilize teacher surveys to gain an understanding of how teachers use formative assessments in their classrooms. This researcher will also gather relevant data regarding academic performance, technology tools used in the classroom, as well as pre and post academic test scores.

This research study will be guided by the following three questions:

1. Does the use of technology based formative assessment lead to increased student achievement?
2. How does the frequency of using formative assessment affect student achievement?

3. Does the use of technology based formative assessment narrow the range of achievement when comparing high scores against low scores?

Anonymized initial assessment data will be collected. Teachers will then be provided professional development on a technology based formative assessment tools that they will utilize in their classroom for a period of time. Afterward, the teachers will be asked to utilize the new technique that they learned in their classrooms. Teacher surveys that will be completed prior to and after the implementation of technology based formative assessment will also be collected. Additional anonymized student assessments will be collected at the end of the research term as well. All of this data will be analyzed to look for patterns and ultimately determine whether the use of technology based formative assessment led to increased student achievement.

CHAPTER II

Review of Literature

Introduction

Formative Assessment is an instructional technique that can be traced back to the 1960s. While it was first used back in the 1960s, it wasn't known as the definition we know it as today until the 1970s (Bloom et al., 1971). There is no widely agreed upon definition of formative assessment (Black & Wiliam, 2003; Wiliam, 2014; Baran-Łucarz, 2019). Hirsh (2020) states that formative assessment:

is characterized by clarification of the goals of instruction, the seeking of information on students' current level in relation to the goals, and provision of feedback that clarifies how the gap between the students' current levels and the goal can be closed. (p. 91)

(Nitko 1993, as cited in Ketabi & Ketabi, 2014) found various definitions of formative assessment: (1) formative assessment has two main purposes, to choose or modify the learning procedures and to decide on the best remedies to make the learning and teaching processes more effective and (2) formative assessment. (Gattulo 2000, as cited in Ketabi & Ketabi, 2014):

(a) is an ongoing multi-phase process that is carried out on a daily basis through teacher-pupil interaction, (b) it provides feedback for immediate action, and (c) it aims at modifying teaching activities in order to improve learning processes and results. (p. 437)

Furthermore, (Brown 2004, as cited in Baran-Łucarz, 2019), "pinpoints that most of the assessment taking place in the classroom is actually formative by nature since it allows learners to form their knowledge by analyzing and internalizing teachers' comments."

Definition of Formative Assessment

According to Wiliam (2014), The Assessment Reform Group defines formative assessment “as the process of seeking and interpreting evidence for learners and their teachers to decide where the learners are in their learning, where they need to go, and how best to get there.”

The Assessment Reform Group proposed seven characteristics of assessment that promotes learning:

- (1) it is embedded in a view of teaching and learning of which it is an essential part;
- (2) it involves sharing learning goals with pupils;
- (3) it aims to help pupils to know and to recognize the standards they are aiming for;
- (4) it involves pupils in self-assessment;
- (5) it provides feedback which leads to pupils recognizing their next steps and how to take them;
- (6) it is underpinned by confidence that every student can improve; and
- (7) it involves both teacher and pupils reviewing and reflecting on assessment data. (Wiliam, 2014, p.4)

Similarly, (Stiggins et al. 2005, as cited in Wiliam 2014) proposed that assessment for learning consists of seven strategies:

- (1) provide students with a clear and understandable vision of the learning target;
- (2) use examples and models of strong and weak work;
- (3) offer regular descriptive feedback;
- (4) teach students to self-assess and set goals;
- (5) design lessons to focus on one learning target or aspect of quality at a time;
- (6) teach students focused revision; and
- (7) engage students in self-reflection and let them keep track of and share their learning. (pp. 7-8)

Ng (2018) also based formative assessment on principles. They are:

- Principle 1 (P1): Aligning assessment to teaching and learning; Principle 2 (P2): Multidimensional assessment methods; Principle 3 (P3): Selecting assessments susceptible to learning; Principle 4 (P4): Drawing on join-efforts amongst colleagues; Principle 5 (P5): Assessing students continuously; Principle 6 (P6): Allowing students to take part in the assessment process; Principle 7 (P7): Using

assessment to uncover learning; Principle 8 (P8): Making marking criteria accessible; Principle 9 (P9): Providing feedback; and Principle 10 (P10): Analyzing and reporting students' results. (p. 2)

The common theme in the three definitions above is that there is frequent, interactive assessment of students' progress and understanding to identify learning needs and to adjust teaching accordingly (William, 2014).

Other key terms used in conjunction with formative assessment are assessment for learning and blended learning. Blended learning is the integration of conventional face-to-face learning with online content (Baig et al., 2020). Klenowski (2009) defines assessment for learning as "part of everyday practice by students, teachers and peers that seeks, reflects upon and responds to information from dialogue, demonstration and observation in ways that enhance ongoing learning."

Another form of assessment is called summative assessment, which is widely used in teaching today. It is mainly used because it is easy to administer and higher institutions require these standardized assessments for entrance into their facilities (Baran-Łucarz, 2019). Summative assessments are not based on instant feedback but verifies what the student knows and has mastered during a particular time. A student's success is measured by using scores, percentages, and/or points. There is no doubt that students need to be assessed in the classroom but what modality to do so is the question. According to Hirsh (2020), there are five assessment instruments that teachers considered to form the most important basis for assessing students' knowledge which were: continuous observations of what students do in the classroom (85% indicated this as an important basis for assessment), oral assignments and reports (83%), written assignments (67%), results of national tests (66%), and results of other tests (62%). Summative assessments force students to compare and rank themselves versus focusing on what they can improve on.

History of Formative Assessment

Formative assessment was initially used to reference educational programs rather than to evaluate the learning progress of students. Ten years later it shifted from programs to process, however it took till the 1980s to truly begin what is known today as formative assessment. In the 1970s and 1980s, the development of new tools was advanced by a series of research projects at Chelsea College (which merged with King's College in 1985) which explored ways assessments might support learning. The Concepts in Secondary Mathematics and Science (CSMS) project investigated mathematical and scientific reasoning in students through the use of tests that were intended to illuminate aspects of students' thinking, rather than just measure achievement:

This approach did not lead as directly to results applicable in normal teaching as did the more empirical approach of the mathematics team, which focused on the diagnosis of errors in the concepts formed by secondary school students, and looked for ways to address them. (Hart, 1981, as cited in Black & Wiliam, 2003, p. 624)

The recommendation of the Committee of Inquiry into the Teaching of Mathematics in Schools (1982) was for a system for "graded tests" to be developed for students in secondary schools to be certified, therefore, leaving the results of examinations to be developed. Black and Wiliam (2003) found that similar systems have been used to improve motivation and achievement in foreign language for many years. The group at Chelsea College chose to aim for a system for all pupils, and with support from both the Nuffield Foundation and the Inner London Education Authority (ILEA), their Graded Assessment in Mathematics (GAIM) Project was established in 1983. It was one of five graded assessment schemes supported by the ILEA. This development was more ambitious in attempting to establish a new system. In mathematics, English, and craft, design and technology, the schemes set out to integrate the summative function with the formative. They found three strains on this system:

First, in 1988, but then the new criteria for the General Certificate of Secondary Education (GCSE) specified that, in mathematics, the assessments must include a

written end-of-course examination which had to count for at least 50% of the available marks (Department of Education and Science & Welsh Office, 1985). The original developments in other subjects made more use of frequent formal tests, but were similarly constrained by the GCSE rules. Second, The National Curriculum Task Group on Assessment and Testing (TGAT) (1988a, 1988b) adopted the model of age-independent levels of achievement that had been used by the graded assessment schemes, but required a system of 10 levels to cover the age range 5–16, arranged so that the average student could be expected to achieve one level every two years. Third, assuring comparability of awards, both between schools and with other traditionally based awards, required costly administration. (Black & Wiliam, 2003, pp. 624-625)

By 1995 formative assessment went on hold and the government was not interested in going forth with researching formative assessment strategies. Ateh (2015) found that by the early 2000s, the focus shifted to that teachers' next instructional moves should not be based on what comes next in the lesson or unit plan but rather on what emerges from students' responses. He also found that the expectation for any classroom instruction is that teachers will use elicited evidence of student knowledge to address students' learning needs. Teachers must plan to elicit students' knowledge while reflecting on the three key processes that guide formative assessment: (a) What do students know? (b) What do students need to know? (c) How will students close the gap between what they know and what they need to know?

Variables

Grade Levels

“Much of the work has focused on breaking the domain of formative assessment into smaller, more management pieces (Leahy et al., 2005, as cited in Lyon et al., 2018) that could be used in any content area, at any grade level, and with any curriculum.” According to the literature

review there appears to be mixed data in regards to the subject area taught, grade level taught, and using formative assessment in those classrooms and how it affects student achievement.

Frey and Schmitt (2010) suggested that elementary teachers use tests that are already prepared for them less often than other grade levels and they might be more likely to design assessments for use in ways consistent with the goals of formative assessment. (Stiggins 2004, as cited in Frey & Schmitt, 2010) found that quality classroom assessment in middle grades schools have the potential to improve learning if teachers focus on the quality of their assessments, provide feedback to students, and involve students in the assessment process. The student involved approach to classroom assessment requires that the middle grade teachers have to make an effort to engage in a formative assessment approach (Frey & Schmitt, 2010). They conducted a study using a two-way analysis of variance with gender and grade level taught. They found that none of the analyses resulted in differences significant at less than the .05 level. However, two analyses identified differences significant at around the .06 level with small to moderate effect sizes. The frequency with which teachers give tests that do not affect student grades differed by subject taught and grade level taught. Follow-up analyses found frequency differences between elementary teachers and both math teachers and science teachers. Differences were also found between teachers of 3rd-5th grade and teachers of 9th-12th grade.

Subject Areas

A study conducted by Baran-Łucarz (2019) found that only 25% of students taking a foreign language in Poland high schools stated that they received any type of formative assessments.

There is not much research conducted about the practice of formative assessment in arts education (music, fine arts, dance, theatre). Much of arts education is based on teachers' reflective practice. This means that the researchers themselves either used formative assessment or they investigated other teachers who talked about doing so but didn't pay equal attention to other important aspects of teaching. A study conducted by Kazragytė and Kudinovienė (2019) found

that 49.3% of the arts education lessons for which formative assessment was used was effective. Of the above-mentioned lessons, 54% was provided for pupils of elementary education, 33% for pupils of lower secondary education, and only 13% for pupils of upper secondary education. Conversely, it was found that 50.7% of the arts education lessons in which formative assessment was used was found to be ineffective. Of them, 37% of the lessons were provided for pupils of elementary education, 61% was for pupils of lower secondary education, and only 8% for pupils of upper secondary education.

A study conducted by Lyon et al. (2018) found that teachers significantly increased their practice of formative assessment at the category level in both mathematics and science, specifically in the categories of providing feedback and asking questions. However, closer examination of implementation using responses to the Daily Log of Formative Assessment Practice (DLofP) indicates that mathematics and science teachers used different formative assessment approaches. These findings support the idea that teachers' content area can influence the way that a teacher chooses to use formative assessments.

(Ayala et al. 2008, as cited in Furtak et al., 2018) and (Bell et al. 1999, as cited in Furtak et al., 2018) reported that, "formative assessment is described as the instructional tasks teachers enact to surface student thinking as well as the whole-class discussions teachers orchestrate as opportunities to attend and respond to students' ideas" reported that designing and using formative assessment in science classrooms presents multiple challenges for teachers. That is teachers must be able to design their lessons that will allow students the opportunities to share their thinking and navigate their ideas on the fly. Studies of science classrooms today still indicate that teachers control the majority of classroom interactions leaving very little time or space for students to voice their ideas and expand on their thinking. Yet, research into classroom discourse has shown that teachers asking open-ended and authentic questions such as those that begin with "Why, How, or What do you think" provide room for students to share their ideas. Formative assessment classrooms provide a free exchange of ideas between teachers and students.

Formative assessments have been used longer in the English Language Arts classrooms than other classrooms. These types of classrooms use rubrics as a form of formative assessments to show the quality of work (Lyon et al., 2018). Rubrics are often used to improve complex skills such as writing, however, can be used and applied across other content areas (science) and other tasks such as writing lab reports, analysis, and oral presentations. (Ackermans et al., 2017; Panadero & Jonsson, 2013, as cited in Lyon et al., 2018).

Teacher Variables

Kazragytė and Kudinovienė (2019) believe that a teacher needs concurrent skills which can be used to identify not just “what the learner has (or has not) achieved, but what they might achieve, what they are ready to achieve.” They believe that there is a strong relationship between formative assessment and the teacher’s self-awareness abilities, needed to predict students’ achievements and plan them. They believe that:

a teacher should have good skills in feedback implementation and exactly the same skills of lesson leadership: to be able to have clear learning objectives and criteria, assignments, to make suggestions for learners, involving the suggestions of the learners themselves, etc. (Brookhart, 2008, as cited in Kazragytė and Kudinovienė, 2019, p. 219)

According to Swathi et al. (2020) they reported that when they studied an experienced teacher, she did not express feeling overwhelmed at asking questions or using student responses to guide her next steps. She felt more in control of using the framework in the classroom and of the cards given to her, she referred to them frequently and asked the questions as is evident from the classroom observations. (p. 113)

According to Robinson et al (2014)

Also of interest was the finding that a teacher’s years of experience was unrelated to any of the variables analyzed stating that experiences, indicating that

experience was not likely a factor in teachers' adoption or understanding of formative assessment practices. However, the negative and statistically significant negative correlations between teachers' ratings of the impact of other professional development activities on current (-.472) and planned use (-.426) and their understanding (-.475) do suggest other demands on their time limited how much they learned or could participate in using the AFL practices. This is hardly a surprise as time and competing demands are frequently noted as limiting factors in teacher participation in PD activities. (p. 156)

It was evident that teachers lacked the background and understandings of the fundamental principles of formative assessment to fully capitalize on the uses of its practice.

They also may lack the time and support needed to integrate these practices into their teaching over a sustained period, or have little opportunity for active and collaborative learning. Stewart and Houchens (2014) found that teachers who didn't fully understand how to implement formative assessments did not use formative assessments in their classrooms. Swathi et al. (2020) research shows that inexperienced teachers have lesser recall of classroom memories than experienced teachers and that they feel overwhelmed. Novices, in general, exhibit limited processing capacity that constraints learning and performance. A study conducted by Kazragytė and Kudinovienė (2019) revealed that teachers did not use formative assessment at the end of the lessons or did not conduct it properly. Without a deeper understanding of formative assessment teachers may fail to recognize that using formative assessment represents a major change in the teacher's role in student learning and a fundamental reorientation of the teacher-student learning relationship on the part of both teachers and students. It will take new ideas, professional development (PD), everyday practice, and change in student learning, all done over time that is the key to accomplishing the shift to formative assessment practices.

Professional Development

Teachers have been tasked with a lot of training and other forms of professional development including advancing skills in using formative assessment. Despite the efforts for changing traditional education practices with contemporary ones, it appears the changes have happened at a slow rate (Ahmedi, 2019). Stewart and Houchens (2014) study found that teachers who participated in professional development experienced a growth in their capacity to use and teach various formative assessment strategies. (Wei et al. 2009, as cited in Robinson et al., 2014) found that professional development is most effective when teachers actively engage in learning during the PD which focuses on improved instruction and student achievement while taking those theories back to the classroom. Stewart and Houchens (2014) found that whole group one-day professional development sessions are not as effective as the same learning in a collegial group over time. They also believe that central administrators should offer mandatory formative assessment PD to new teachers only and then voluntary sessions to others within their schools. The different opinions lead to one asking themselves, “what type of professional development is needed?”

“The question remains, how do teachers use learning progressions in long-term professional development to support their understanding of student ideas, their formative assessment task design, and their abilities to draw out and respond to student thinking” (Whitcomb, 2013). He reported that many prior studies have already established that it is important for teachers to engage in long term, discipline specific professional development to enhance their classroom practices. As such, Borko et al. (2008) created a professional development approach that incorporated elements of established models of effective, long-term professional development, including cycles of planning, teaching and reflecting, reflecting on evidence of teaching together, engaging in active learning strategies as well as explicit instruction to learn new instructional approaches, and guiding teacher learning through active facilitation.

Furtak et al. (2018) developed the Formative Assessment Design Cycle, which is a five-step approach for professional development to support teachers in the development of formative

assessment tasks with the support of a learning progression. In the first step, the facilitator guides the learner to explore student ideas as well as their own understandings about the concept being taught. In the second step, the learner designs tasks with their colleagues to evoke more information about students' ideas during instruction. In the third step, learners practice using the tasks they rehearsed and actually use formative assessment tasks. In the fourth step, the learners enact the tasks during their units and collect student work. In the fifth and final step, the learners reflect on enactment by exploring examples of student work, videotaped enactment of the formative assessment, and reflecting on what students learned, as well as how to improve the formative assessment tasks and their accompanying classroom practices in the future. Furtak et al. (2018) believed that by using the above steps the teachers would rehearse asking the types of questions that would evoke student thinking and be better prepared to respond with quality feedback during instruction in the classroom. The findings of their study have important implications for the design and implementation of professional development, and the possible linkages between professional development, teacher formative assessment abilities, and student learning. Finding the right professional development can raise teacher effectiveness in a variety of schools with varying socio-cultural, social, and economic backgrounds.

Lyon et al. (2018) researched the development of various professional development (PD) programs that focus on increasing teachers' use of formative assessment across domains including the Keeping Learning on Track Program, The Learning Set, the Classroom Assessment for Student Learning, Embedded Formative Assessment, and many others. These PD programs all use a common approach to engage teachers with formative assessment.

Robinson et al. (2014) reported that these early observations and feedback from the public-school personnel emphasized the importance of the following when it comes to PD:

- (1) offering training that fit into the perceived needs of the participating schools;
- (2) recognizing/respecting teachers' background knowledge; (3) avoiding being perceived as an add-on to teachers' already heavy workload; (4) focusing on

strategies teachers could use in their daily work with students; (5) providing opportunities for collaborative dialog among teachers; (6) providing a means of examining changes in teachers' actual use of formative assessment strategies; and (7) providing a timely means of examining the impact of these changes in their teaching practices on student learning. (p. 142)

(Heritage 2007, as cited in Lyon et al., 2018) argued that to be effective,

PD related to formative assessment must be rooted in content to ensure that teachers are able to operationalize the complete formative assessment cycle (i.e., collecting quality evidence of student understanding through well-designed questions, interpreting the evidence collected, and selecting appropriate next instructional steps). The knowledge needed to accomplish these tasks in a consistent, systematic, and effective way differs by content area and must be based upon what we know about how student learning progresses within a specific content area. (p. 145)

(Stiggins et al. 2006 as cited in Robinson et al., 2014) found that in order to enhance teachers' understanding, develop their basic assessment skills, and provide practical strategies for teachers to use related to the above, professional development must specifically focus on:

(1) a balanced approach to formative and summative assessment; (2) use of formative assessment ideas/strategies; (3) use of assessment to motivate; (4) use of effective feedback strategies; (5) unwrapping learning targets with students; (6) unwrapping reasoning-level learning targets with students; (7) choosing appropriate means of assessment; (8) effectively leading reasoning-level discussions; (9) use of goal setting with students; (10) use of data for instruction; (11) use of data to meet individual student needs; (12) use of assessment for students' self-monitoring; (13) appropriately developing selection-type items; (14) use of peer questioning/discourse; (15) conducting effective discussions;

(16) use of exemplars and rubrics; and (17) student participation in developing rubrics. (p. 150)

(Atkins et al. 2005, as cited in Furtak et al., 2018) found little research has been completed that explores how to support teachers through professional development in designing their own formative assessment activities. Furthermore, the field is only beginning to examine how learning progressions can support teachers' formative assessment abilities. Another drawback for professional development is that these programs are typically pre-arranged and packed with essential knowledge and skills for teachers to understand and apply, therefore, giving them little time to practice these new skills. Also, time constraints placed on lecturers limit their ability as well to present sessions to where teachers can reflect upon their own assessment practices. Marsh (2006) reports that if teachers are to gain confidence in using formative assessments they need to observe and consult with other teachers about effective teaching and learning practices.

Oftentimes, it's not just the teachers lack of understanding of formative assessment but their willingness to learn about new initiatives. According to Frey and Schmitt (2010) formative assessment is not very common. They found that about 12% of assessments given do not even affect student grades and three out of every four tests are given after instruction is completed. Schneider and Randel (2010) found that even with continuing evidence and research that supports the effectiveness of formative assessment they are slow to be integrated into the classrooms and into everyday classroom practices. (Ali and Elmahdi 2001, as cited in Elmahdi et al., 2018) study used a program called "Plickers" in their classrooms and pointed out that technology resources, support, and teacher's reluctance in adopting technology in teaching activities to be the main issue in using formative assessments.

Frequency and Timing

Another factor that affects formative assessment and student achievement is the frequency of how often assessments are given. According to (Horwitz 2017, as cited in Frey and

Schmitt, 2010) frequent formal summative assessment in this case can lead to inhibition and anxiety, therefore, creative constant feedback and interaction leads to greater success and less overall anxiety and learning. Frey and Schmitt (2010) found that only a small proportion of classroom tests are formative assessment. They found that 87.68% were assessments that affected grades and are given after instruction is over. Stiggins and DuFour (2009) believe that “formative classroom assessments must provide an answer about where a student is located in his or her learning, not once a year or every few weeks, but continuously while the learning is happening.” Kazragytė and Kudinovienė (2019) found that formative assessment is used before teaching for diagnostic purposes, during teaching and after teaching to decide if the students are ready for the next teaching. They believe it is essential to continually gather data relating to student comprehension during instruction.

Cauley and McMillan (2010) found that “although formative assessment can be performed after a test, effective teachers use formative assessment during instruction to identify specific student misunderstandings, provide feedback to students to help them correct their errors, and identify and implement instructional correctives.”

Baran-Łucarz (2019) study found that leaving assessment till the end of a course and limiting it to a score can be expected to debilitate progress, due to depriving students of information about their foreign language use. However, Kazragytė and Kudinovienė (2019) argues that teachers should include formative assessment episodes following their teaching.

Special and Alternative Education

Research has shown that formative assessment in special education classrooms are a great tool for mastery of learning for special needs students. Research by Robinson et al. (2014) found that Teacher A, whose class was composed of nine special needs students and 11 regular education students, had an overall increase of 35 percentage points in students’ mastery of the standard of learning (SOL) being assessed (students scored 11% below the district average on the non-targeted SOL and 24% above the district average on the targeted SOL) and a 28 percentage

point difference in mastery for the special education students in her inclusion class. Teacher B, who taught a class of 22 gifted and regular education students, had a 13-percentage point difference in mastery (students scored 14% above the district average on the non-targeted SOL and 27% above the district average on the targeted SOL). Also of note is the overall percentage of students mastering the targeted SOL, where 80% of the inclusion class/regular education class and 83% of the gifted/regular education class reached a mastery level on the SOL, suggesting the potential for formative assessment practices to help close the gap between lower and higher performing students. Cornelius (2013) found that the outcomes for students who struggle with learning, students with disabilities, and English language learners increase when formative assessment is implemented as a systematic and continual process. He also found that “formative assessment allows teachers to make instructional decisions based on student needs, thus enabling more personalized instruction for all students,” therefore, if a different pace or extra support is needed, a teacher can use their knowledge of students and their responses to implement strategies to help the student learn and drive their instructional practices. Teachers can use technology as a way to use formative assessments to assist these students.

Technology Based

Bahati et al. (2019) found that effective use of technology can improve and support formative assessment in the classroom. It allows students to monitor real time data whenever and wherever they want. It allows instant feedback and changes a student's misconception. Technology speeds up tracking, tracing, storing, processing and visualizing students' results as well as actions. They also found that students felt that their learning was improved as a result of taking part in online formative assessment instructional activities. Dalby and Swan (2019) also agree that rapid assessment, timely feedback, and tracking of student learning can usefully contribute to formative assessment. They designed their lessons to help identify additional functions of benefit, including the accessibility of summaries of student responses for teachers, from which they can quickly identify common misconceptions, and then give direct formative

feedback to students that could be provided by some interactive, adaptive software. Robertson et al. (2018) found notable value in using a technology tool as a vehicle to deliver the formative assessment in the online classroom. They believe it creates a way to make the content more interesting and makes it possible for students to get specific individualized feedback. It also creates immediate feedback and provides clear data analytics. Immediacy was one of the biggest instructors and student benefits of using the technology tool. Skordis-Worrall et al. (2015) study conducted a thematic analysis in the online learning environment, and one of the five major themes that arose was the immediacy of feedback.

As stated by Robertson et al. (2018), effective technology tools can boost the teacher's presence with little effort and minimal time commitment on the part of the teacher. Today, recent technology allows teachers to create formative assessments that can be used to give students and teachers immediate feedback on student performance. Applications can offer one or both feedback options: verification or elaborative. Verification feedback is a great tool for students to progress towards learning objectives, but it only provides half of the needed details. (Marsh et al. 2012, as cited in Robertson et al., 2018) "found that verification feedback delivered directly after each question improved assessment scores in comparison to when an answer-key is posted for students to self-verify afterward." Robertson et al., (2018) found that:

The benefits of elaborative feedback take this one step further back, allowing the student to see why an answer was right or wrong and how the student can master the approach moving forward. Traditionally, teachers had to add up and create their own charts and reports to summarize class achievement. With Web 2.0 tools, data analytics are built into the application to allow teachers and students a fast, graphic way to see where they are excelling or struggling, and it even gives tips and hints for improvement. Furthermore, elaborative feedback reports allow teachers to tailor lesson plans or guide the discussion toward the needs of the individual student. (para. 6)

They also reported that:

Furthermore, program scoring released instructor time to focus on providing interventions during the week for commonly missed questions. For example, in one course many students may miss question number three while in a different course they may miss question number five. While there was not a significant difference between the scores of students who took either assessment, this comes as no surprise for anyone who knows how formative assessment works. (para. 30)

They also stated that:

The Web 2.0 tool was not only able to increase the effectiveness of the delivery of the formative assessment, but it also allowed for the instructor to be more productive by saving the teacher anywhere from 5 to 10 minutes per student submission. The time saved allowed the teacher to focus more time and energy into other areas of instruction while still helping students achieve the same results. The data from the technology tool provides instructors with a chunk of valuable information that can be used to increase student performance and teacher practices. (para. 34)

(Dakka 2015, as cited in Robertson et al., 2018):

the element that supports teachers most when integrating technology based, one-on-one feedback is the immediacy of that feedback. Additionally, students can further develop their critical thinking skills while reviewing and reflecting on individual or class results and feedback. Thus, the researchers for this study determined that the technology tool used for formative assessment must provide both elaborative and verification feedback that is immediate. Both of these elements allow the student to adjust their thinking towards the objective before the summative assessment. (para. 7)

Roberston et al. (2018) found that, “data collection and analytics are helpful for teachers because they provide a fast, graphic way to see where students are excelling and struggling.” Furthermore, students can further develop their critical thinking skills while reviewing and reflecting on the class results and immediate feedback. (Bhagat and Spector 2017, as cited in Robertson et al., 2018) “further concluded that technology can support formative assessment by enhancing learning performance, attitude, and motivation across various disciplines.” Additionally, today’s students live in a digital world with technology in all facets of life so they already know how to use it. The integration of technology in classrooms becomes a necessity for effective teaching that improves learning, especially in the 21st century; where the road to motivate and encourage students to learn is paved with their passion for technology and digital tools. Elmahdi et al. (2018) found that with the advent of technology and its role in education, a wide body of research has developed in investigating the role of technological instructions in the educational process and their effect in improving the interactive education environment. Through their research Elmahdi et al. (2018) identified two major advantages to using technology for formative assessment in that they support individualized learning and they open up time in teaching courses for more interactive lessons.

There are a number of affordable newly introduced technologies and software that aid teachers to use formative assessment during the instructional process which enhance learning and assessment. One of these technologies are classroom response systems; mainly referred to as CRSs. These technologies include, but not limited to, Clickers, Socrative, Kahoot, Plickers and Recap. The common denominator among these technologies is their ability to collect real-time formative assessment data that helps teachers to provide instant feedback (Elmahdi et al., 2018). Research findings by Elmahdi et al. (2018) reported that CRSs enhanced questioning and feedback when technology is integrated with the method of teaching, maximized learner engagement, and had a positive effect on students’ attitudes and academic performance. Research has found that these systems activate students thinking, enhance immediate feedback, motivate

participation, and foster discussion. Ultimately, it transforms the classroom from teacher-centered to student-centered. In a study conducted by Elmahdi et al. (2018):

it is apparent from this table that in investigating students perception about the importance of implementing formative assessment in their classroom, their responses showed how highly they view the importance of formative assessment (Mean = 4.40, SD = 0.54) in identifying different concepts that students are struggling to understand (Mean = 4.46, SD = 0.89), in identifying skills students are having difficulty acquiring (Mean = 4.29, SD = 0.96), in providing information needed to adjust teaching and learning while it is happening (Mean = 4.38, SD = 0.80), and in guiding teachers and students in making decisions about how to move forward to reach their goals (Mean = 4.28, SD = 1.00). The results also showed that participants agree that formative assessment should be an integral part of classroom learning (Mean = 4.57, SD = 0.77).

They also found that in response to their first open-ended question

As a student, how effective is using Plickers in the classroom for the teaching and learning process? participants overwhelmingly agree that Plickers is an effective tool in aiding the learning process. As students, they argue that Plickers help them to be engaged in the lesson. One student wrote, "I think that it's very useful method to engage all students to participate even they are shy or quiet."

On the same line, another respondent stated, "I think this method attract the students and makes them interest[ed]." A third participants wrote "the students will be engaged and enjoy their learning." One participant argued, "It motivates all learners and engages them." Another aspect that the participants offered in response to the above question is about checking understanding, which can be quickly and easily obtained by using Plickers. For example, one respondent stated, "It measures the students understanding in a fun and different way".

Another respondent wrote, “I will use it to assess the students’ understanding”. A third student wrote, “Yes, because it’s a very interesting way to assess the students and check their understanding”. (p. 185)

It is apparent from the above results that the current generation of children like to use technology in their daily lives and feel that using it in the classroom has a positive effect on their learning as evidenced by many researchers. Elmahdi et al. (2018):

continued probing and asking questions asking if students if using technology based formative assessment in the classroom impacts their learning outcomes, the results showed that they do agree (Mean = 4.19, SD = 0.98). For the open-ended question “Do you plan to use Plickers in your classrooms when you become a teacher? If the answer is yes, would you please explain the reasons?” indicated that they will use Plickers in the future when they become teachers. They offered a number of reasons; one of which is the excitement and fun that technology brings to the classroom; as one participant put it this way “it is fun of all ages for primary school or college students will have fun.” Another participant wrote “it makes the lesson very easier and in a fun way”. A second aspect that the researchers identified in the participants’ responses to the above question is saving the learning time. “Yes, I plan to use Plickers [because] it saves the learning time,” mentioned one respondent. Another respondent stated, “Another thing, it saves time because it can be done in a very quick [way].” Many of the respondents maintain that Plickers is good to break the traditional classrooms’ routines, as mentioned by one of the respondents in writing “Plickers is a great way to change the routine and change the ordinary atmosphere of the class”. Moreover, the participants indicated that using Plickers gives equal opportunities to all students to participate. “Students will have an equal chance to participate in the class,” stated one respondent. Another participant wrote, “Yes [I will use it]

because by it all the students will be participating.” A third respondent stated, “It gives all students the chance to respond”. (pp. 185-186)

The positive benefits of using technology with formative assessments creates a fun and exciting way which helps aid the learning process. It gives all students in the classroom, even the shy ones, an equal opportunity to participate in one class session with immediate feedback and frees up teacher time to focus on more in-depth teaching to the classroom's strengths and weaknesses.

Although there is research evidence that suggests positive benefits from using technology, it is sometimes difficult to draw strong conclusions about classroom use. While some research provides evidence of learning gains (Higgins et al., 2012, as cited in Dalby & Swan, 2019) and supports claims that technology can promote deeper learning, (Vander Ark & Schneider, 2012, as cited in Dalby & Swan, 2019), other studies are less conclusive (Haßler et al., 2016 as cited in Dalby & Swan, 2019). According to (Higgins et al. 2012, as cited in Dalby & Swan, 2019) these differences can be due to the way that technology is used or the way that teachers teach. Roschelle and Pea (2002) believe it is the teacher that affects the educational function of the technology in the classroom. They question whether technological methods are just a supplement rather than a replacement for teachers. (DeBarger et al. 2010, as cited in Dalby & Swan, 2019) suggest that teachers need clear learning patterns or teaching routines to effectively engage students in collaborative learning using technology. Although their suggestions of teaching routines are specific to the context, they indicate how learning might be enriched through a formative process informed by technology. Dalby and Swan (2010) also found that technology use and formative assessment in a classroom is still not widespread and developed like it should be. They believe the greatest challenge in doing so is not the technology itself but the understanding of the process by which it can enhance student learning. Likewise, (Fullan and Donnelly 2013, as cited in Dalby & Swan, 2019) and (Mishra and Koehler 2006, as cited in Dalby & Swan, 2019) agree that the difficulty is that teachers need to implement

appropriate teaching approaches to use technology successfully in their learning processes but in order to do so they must focus on improving teachers' skills with digital technology.

Another reason why formative assessments and technology fail is that principals oftentimes apply a considerable amount of pressure onto teachers requesting them to concentrate upon obtaining high academic standards for their respective classes especially in the core subjects of language, mathematics and science. Here in the US, we even have the ("No Child Left Behind Act "2001, as cited on Marsh, 2006) which requires principals to ensure that minimum standards are achieved in the core subjects in their respective schools. Schools are penalized for not meeting those standards; therefore, high pressure is placed on assessments.

Another flaw and reason that many teachers don't give formative assessments is that many education systems offer awards and honors for students who do well academically. Ultimately, these awards are based on high proficiency of students in summative examinations. Most schools praise students who meet a "high" level of achievement.

A challenge raised by Robertson et al. (2018) was determining the effectiveness of formative assessments from how and when the formative assessments are given. (Bhagat and Spector 2017, as cited in Robertson et al., 2018) found that if feedback is delayed, it may not support student learning or engagement and that constructive feedback could be perceived the wrong way and have a negative impact on the learning process. They found that sometimes one on one feedback can be challenging to achieve in the online classroom setting.

With over 80,000 educational applications available for download in just Apple's App Store alone, even though they are categorized as "educational," there is no evaluation criteria or statistical proof that these technology tools are geared to or improve teaching and learning. These technology apps are left for the teachers to determine if they are fit for the classroom and actually educational. The teachers will have to trial and error these apps to see if they are a fit for their classroom or not, which oftentimes wastes, time, money, and resources (Robertson et al., 2018).

A study conducted by Elmahdi et al (2018) reported that technology issues with the internet was a factor:

In the open-ended questions, the participants' responses to the above statements are, overwhelmingly, about the difficulties and problems related to technical aspects. For example, one participant wrote, "the network might not work or it might be slow". Another respondent stated, "Sometimes there is no internet service in the classroom so it will be hard to for the teacher to move from one question to another," a third participant wrote, "The teacher may face technological problems. For example, access to the Internet." An additional aspect that emerged from the respondents' answers to the above question is that Plickers is only limited to objective questions. For example, one of the respondents wrote, "The teacher is limited to use the multiple-choice questions." On the other hand, some respondents questioned the security of the information, "You don't guarantee that there won't be no bugs in the application that may delete all the histories and answers you saved in the application". (p. 187)

With the positive results of formative assessment from the technology standpoint, one should look at how satisfied students and teachers are with formative assessments.

Satisfaction

"It is important to notice that, amid the progressive increase of using new technologies to support Formative Assessment (FA), the consideration of students' perceptions has a paramount importance. Students' acceptance and attitude towards these technologies seem to be part of the determining factors" (Bahati et al., 2019).

Baig et al. (2020) found that Blackboard (Bb) was not used efficiently by medical students and that they reported having technical difficulties while using it. When they asked students some open-ended questions on recommendations, they received that 52% of students wanted their professors to use it in all their courses and then 52% recommended its use for more

formative assessment. They reported that the medical students extensively used digital self-directed learning resources, including Bb and all students attempted formative assessment on Bb; and the medical students stated that e-learning resources were beneficial. The students did point out that they liked the web-based learning as an alternative to face to face teacher, however, the shift caused them to feel stressed and anxious. Therefore, the students would have preferred a blended learning method to allow a more gradual transition to all online learning. Hirsh (2020) found that students continuously receive grades and perceive these grades and feedback as a display of constant flawlessness.

Kazragytė and Kudinovienė (2019) noted that where formative assessment was found to be most effective, there was a good student to teacher relationship, motivated student learning, and other positive qualities. They found that as the formative assessment didn't motivate students, behavioral problems emerged:

In more than one third of the lessons ($n = 28$; 39%), relationships between the teacher and pupils were noticed to be poor due to the teachers' dominance, negative emotional expressions of the teachers', excessively light tasks, lack of knowledge regarding what the pupils should to achieve and what kind of work is. (p. 227)

Bahati et al. (2019) found that students were mostly satisfied with the quality of every feedback criterion across all the formative e-assessment strategies.

The students' scores ($M = 69.2$, $SD = 12.36$) were correlated with the learner satisfaction ratings on the quality of the student engagement and the quality of feedback within formative e-assessment learning activities. Firstly, the high positive correlation ($.59 \leq r \leq .54$) was found where the students who reported high satisfaction ratings in one assessment strategy were highly likely to report higher satisfaction ratings in another formative e-assessment strategy. This was observed between the learner satisfaction with the quality of feedback in online

knowledge survey and in online student-generated questions, in online student-generated questions and electronic reflective journals, and in online knowledge survey and electronic reflective journals. Secondly, the moderate positive correlation ($.43 \leq r \leq .30$) was also found where the students who reported high satisfaction ratings in one assessment strategy were moderately likely to report higher satisfaction ratings in another formative e-assessment strategy. This was observed for example between the learner satisfaction with quality of student engagement and the quality of feedback in electronic reflective journals, between learner satisfaction with the quality of student engagement in online knowledge survey and electronic reflective journals, in online student-generated questions and electronic reflective journals. Thirdly, there was a low positive correlation ($.26 \leq r \leq .19$) where the students who reported high satisfaction ratings in one assessment strategy were less likely to report higher satisfaction ratings in another formative e-assessment strategy. This low positive correlation was observed for instance between the learner satisfaction with the quality of student engagement in online student-generated questions and the learner satisfaction with the quality of feedback in electronic reflective journals. In addition, a low positive correlation was revealed between the learner satisfaction with the quality of feedback in online knowledge survey and the learner satisfaction with the quality of student engagement in online-student generated-questions. (pp. 72-73)

Ahmedi (2019) found that formative assessment may have an important effect on the students' attitudes and their achievements, however, it may be the teachers' attitude towards formative assessment that has an effect towards the students' achievement as well.

William (2014) found that many teachers invent techniques that they believe are important to themselves, but may be less important to other teachers and maybe even irrelevant to the teaching

of the other teachers and/or classrooms. Ahmedi (2019) found that there is a correlation between attitudes toward formative assessment and its implementation in practice by Kosovar teachers:

Results indicated that 63.5 % of the teachers have a completely positive attitude towards formative assessment, whereas 40 % of these teachers have a completely positive action; 25.1 % have a partially positive attitude, whereas 35.2 % have a partially positive action; 5.1 % have a neutral attitude, whereas 15.2 % have a neutral action; 4.6 % have a partially negative attitude, whereas 3.7 % have a partially negative action; 1.7 % have a completely negative attitude, whereas 5.9 % of the teachers have a completely negative action regarding formative assessment. (p. 170)

They also found that attitudes not only affect the way teachers teach but also the content they teach. He found that teachers' attitudes towards formative assessment are positive, however, that they do not always use formative assessments or do not use them the right way. Overall, the question remains, is using formative assessment in the classroom an effective tool?

Effectiveness

In the traditional classroom model, the teacher is viewed as having the knowledge and student ideas are only drawn out for the purpose of evaluating them (Reznitskaya, 2012; Mercer, 2010; & Alexander, 2008, as cited in Furtak et al., 2018). In formative assessment, however, teachers build on student ideas and provide helpful feedback to move students onward in their everyday learning (Shepard, 2000, as cited in Furtak et al., 2018). In doing so, this provides information about the quality of student performance, prompting students for particular types of responses, and asking follow-up questions that push students to improve the understanding and quality of their work. These types of feedback have been positively associated with student learning and are central to many definitions of quality formative assessment (Hattie & Timperley, 2007; Kluger & DeNisi, 1996; & Wiliam, 2007, as cited in Furtak, 2018).

Baig et al. (2020) conducted a study to show the impact of formative assessment on the final marks in the module exam. After finishing module activity, each year, all students were invited to fill a structured questionnaire and almost all students returned a completed questionnaire. Overall, the exam score was significantly higher in all three years relative to the formative assessment ($p < 0.001$). A positive correlation was found between students' performance in the online Blackboard (Bb) MCQ exam and their final MCQ exam ($p < 0.001$). They found that the final exam score in the endocrine module was higher as compared to the online quiz as formative assessment in the endocrine module. Their study reported that more engagement of students with online materials improves the students' test scores as well as reported a robust relationship between discussion board activity and final marks. Their findings are comprehensible because the online MCQ exam was held a few days before the summative exam, so the students improved their weaknesses and removed their misconceptions and thus obtained better results. Their study also found that the use of only one method makes the teaching monotonous, and students lose interest and concentration in a few minutes while the combination of different teaching and learning methods improves the engagement with the content, comprehension, and retention of knowledge. The majority of the students liked the blended learning method and accepted Bb's impact and effectiveness. The formative online assessment on Bb improved the students' performance in the final exam, and a positive correlation was noted between students' marks in online (Bb) exam with their final exam marks.

According to Baran-Łucarz et al. (2019) "formative assessment yielded greater learning gains than that of conventional teacher-dominant summative assessment practices". Teachers who bring forth and use students' thinking as the basis for instructional decisions can positively affect student learning. (Black and Wiliam 1998, as cited in Baran-Łucarz et al. 2019), who demonstrated that when teachers effectively utilize formative assessment strategies, student learning increases significantly. (Hodgen and Webb 2008, as cited in Ng, 2018) believe that the quality of feedback, questioning, dialogue, and sharing are essential for the implementation of

formative assessment, they believe the teachers have to set and clarify the outcomes, and the students have to understand and share the learning outcomes. On the other hand, Ng et al. (2018) found that that quick feedback is also important. They believe that the students can actually use such feedback to guide their future learning. At the same time, students' motivation to use the feedback to improve learning is considered particularly important for online assessments (Azevedo & Bernard, 1995; Mory, 2004, as cited in Ng, 2018). Ahmedi (2019) also believe that through feedback from teachers, students learn their strengths and weaknesses in certain subjects and will engage more or less in the relevant subjects. She believes that both teachers and students benefit from formative assessments. She believes that teachers may use it to keep the class in control, and students will use it to keep their personal results in control.

Marsh (2006) agrees with Ahmedi (2019) as well that formative assessment is valuable for both teachers and students. He believes that formative assessment provides information to teachers about how students are progressing and they can use this information to make the necessary instructional adjustments to their teaching. He believes that students can also gain from feedback obtained from the assessment because it can help them realize where there are gaps in their desired goals and in their current knowledge and skills. From an educational point of view, it is difficult to disagree with many of the claims made about formative assessment:

formative assessment helps with planning because it involves giving clear learning intentions to students; formative assessment ensures that pupils are focused on the purpose of the task and that they can become involved in their learning and can comment on it - that is, there is a sharing of learning intentions; formative assessment empowers the student to realize his/her own learning needs and to have control over future targets. Students are trained to evaluate their own achievements against the learning intentions in oral or written form; formative assessment tracks progress diagnostically and informs a student of his/her successes and weaknesses; and formative assessment ensures student motivation

and involvement in progress - it raises achievement, it keeps teachers informed of individual needs. (Marsh, 2006, p 2)

Ng (2018) agrees that there are dual benefits to formative assessments. She believes that they provide feedback to students so they can improve on their assignments prior to any formal assessments and they can provide information for teachers, helping them monitor students' learning progress and revise reaching content accordingly.

According to Lyon et al. (2018) a class response or clicker system for formative assessment is extremely important and allows for increased student participation. According to Bahati et al. (2019) many studies have confirmed that both quantity and quality of student interactions are highly correlated with student satisfaction in most learning environments. Student interaction plays an important role and constitutes one of the major factors that determine student satisfaction in online courses. Robinson et al. (2014) found that the:

current use of strategies was also related to perceptions of students' ownership of their learning ($r = .434$) and a change in students' orientation to learning ($r = .506$). Teachers' understanding was related to increased student participation ($r = .443$) and teachers' plan to use the strategies in the future was related to increased student participation ($r = .476$), ownership ($r = .437$), and orientation to learning ($r = .448$). All of these correlations were statistically significant at the .05 level. (pp. 154-156)

Given the results above the correlation suggests that formative assessment had a positive impact on student learning.

Additional reasons for doing formative assessment have been given by educators who contend that summative assessment, especially standardized exams, can adversely affect students and that more formative assessment should be used in its place (Black & Wiliam, 2003; Marsh, 2006).

Furthermore, as the literature highlights (Erickson, 2007, as cited in Robinson, 2014), adopting formative assessment practices involves individual and societal shifts in terms of how educators and students think about the nature of knowledge and knowledge gains. Formative assessment is unlikely to be readily adopted by teachers whose beliefs systems and orientations have developed over time. These largely unexamined belief systems serve as what (Erickson 2007, as cited in Robinson, 2014) described as a threat to formative assessments.

Summary

Widespread adoption of formative assessment conducted with technology tools is not present at Colonial Academy. The research suggests the implementation of this technique can improve student achievement and provide teachers with the data they need to become more effective teachers. It improves student engagement, but more importantly in an alternative education setting it can perceivably decrease undesirable student behaviors by keeping the kids actively engaged. Since there's constant feedback and communication between the teachers and students it allows the teachers to identify the individual students that might need more assistance with a topic and allows them to provide them said assistance, therefore, improving student-teacher relationships.

Its particularly important during this pandemic and our increased demand for remote learning that there is a decrease in face-to-face interactions that there is a need for teachers to make the most of the “virtual” time with these students to make sure they are comprehending the material that is being taught. It is important that the constant feedback is given to these students even more so than if they were in class because in class there might be more evidence of visual cues that could tell the teacher whether the student(s) is grasping the concepts being taught.

It's clear that teachers need ongoing professional development for not only formative assessment but for general improvement for instructional strategies. I don't want to say that its comical but I guess it's somewhat concerning that one of the things teacher's requests is less professional development hours. With the various state mandates on content that needs to be

reviewed with school employees more professional development is actual needed because the majority of the preallotted time is being consumed already, leaving no time for focus on new initiatives and teacher development.

CHAPTER III

Methodology

The review of literature suggests that the use of technology based formative assessment tools have the potential to increase student achievement. However, teachers need the necessary professional development, tools, and support, to effectively implement these instructional techniques. This research study examined whether using formative assessment tools increase student academic achievement. This study also examined how the frequency of using formative based assessments affected student's achievement. In addition to identifying the purpose of the study, this chapter will identify the setting and participants. Chapter III will also include the intervention and research plan along with the research design, methods, and data collection. Finally, this chapter will summarize the results of the study.

It should be noted that during this research study that the COVID-19 pandemic has significantly impacted schools' instructional models over the past year. Not only has it impacted learning, it has significantly impacted children socially and emotionally. Approximately one year ago, schools in our area abruptly shut down for a period of two weeks. School administrators quickly developed a plan to continue to provide instruction to students in a variety of ways which mainly consisted of students receiving some form of asynchronous virtual instruction. During the time period in which data collection occurred students were still being instructed in a blended learning environment. One year into the pandemic, educators are still trying to figure out how to best teach students when they are not in the same physical space. While everyone is valiant in their efforts, there is certainly opportunity for improvement. Teachers are faced with students being removed from in-class instruction for periods of weeks as per recommendations from the Pennsylvania Department of Health and the United States Center for Disease Control and Prevention.

This action research study utilized a quantitative approach, utilizing participant surveys and assessment scores. Participants in this study include alternative education teachers assigned to work in Colonial Academy.

Purpose

The purpose of this action research study was to identify whether the use of technology based formative assessment positively impacts student achievement in sixth through twelfth grade students in an alternative setting. This is especially important in an alternative educational setting, as the transient rate in such a school is far greater than that of a traditional school. In fact, it is the goal of the alternative educational school to address the behaviors of the students that cause them to be transferred to the school in the first place and ultimately return them back to their resident district. Given the abbreviated stay it is essential that teachers are aware of how well each student is comprehending the material that is being presented so they can adapt their instruction accordingly.

The students at Colonial Academy typically benefit from being continuously engaged during the instructional process. The frequent use of a technology based formative assessment tool does just that. It allows for simultaneous interaction by all students in the classroom rather than just one at a time. This instructional strategy also provides educators with real time data they can use to adapt their teaching. For instance, if the data shows that a majority of the students are incorrectly answering a question the teacher can immediately review the material that was just presented and perhaps present it in an alternative fashion. If the data shows that one student in particular continues to not grasp the concepts that are being taught a paraprofessional can be assigned to work with the individual student to help them grasp the material that is being presented. If the data shows that all students are comprehending what is being taught the teacher knows that they may progress onto the next topic or concept.

Research questions were developed to explore whether students were able to increase their academic performance using technology based formative assessments.

- 1.) Does the use of technology based formative assessment lead to increased student achievement?
- 2.) How does the frequency of using formative assessment affect student achievement?
- 3.) Does the use of technology based formative assessment narrow the range of achievement when comparing high scores against low scores?

Determining whether using technology based formative assessments do and do not work to grow students' academic achievement would pragmatically inform teachers on how to utilize different teaching methods in instruction to increase academic performance of all students.

Setting and Participants

Colonial Academy is operated by Colonial Intermediate Unit 20 and serves 13 school districts in Northampton, Monroe, and Pike Counties in Pennsylvania. Colonial Academy provides alternative educational/treatment placement for identified at-risk children grades six through twelve, serving Alternative Education, Emotional Support, Life Skills Support, Autism and Partial Hospitalization students. Additional Academic and Behavioral Health Support Programs offered at Colonial Academy include: Physical Education, Art Education, Drug and Alcohol Intervention/Prevention, Anger Management, Psychological Services, Student Assistance Program, Positive Behavior Support, Violence Prevention Groups, and Social Skills

There are approximately 300 students served at a time. All students enrolled in Colonial Academy have an Individualized Educational Plan (IEP). There is a 1:12 staff to student ratio, with most classrooms having ten students or less in the classroom.

While at Colonial Academy, students not only receive typical classroom instruction, they also receive vocational study, character development, individual, group, and family counseling, crisis intervention, and community experiences. The program is designed to successfully return students to their home schools, enter the employment world, graduate from high school, and have a positive impact on the community.

Colonial Academy is a unique educational facility in that it serves students of varying educational backgrounds from 13 different school districts in three different counties. Each child in each classroom can be at a different level of education meaning the teachers can have a hard time teaching a classroom of ten students all with varying levels of need. Teachers need to come up with varying teaching strategies and techniques to assist students in achieving academic success. A strategy that could be utilized is technology based formative assessment. Technology based formative assessment will allow a teacher to understand whether the students are grasping the concepts to be able to move on or not. It will allow students the opportunity to answer questions without being called on and afraid that they maybe embarrassed because they might not know the answer and get bullied by their classmates. It would also allow instant feedback benefiting both the teacher and student knowing where the strengths and weaknesses are in the lesson.

The participants of this study were all volunteers and could elect to discontinue participants in the study at any time. They were made aware that their refusal to participate did not negatively have an impact on their job performance or evaluation. For the purpose of reporting results in this study each participant was assigned a letter after their job category in order to identify their feedback through their questionnaires, interviews, and observations.

There were five alternative education teachers who participated in this study (Table 1). The participants were asked to participate in a pre-research survey. The survey consisted of nine questions utilizing Google Forms. They were then asked to participate by watching a YouTube video I created on a formative assessment tool, Mentimeter. Teachers were made aware that they would have to utilize the formative assessment tool in the YouTube video in the frequency of their choosing. The teachers would then complete a post research survey approximately six to eight weeks later. The post survey consisted of eight questions utilizing Google Forms. The principal and assistant principal aided in collecting of the assessment scores from the teacher's classes.

Table 1*Participants in the Study*

Participant Code	Primary Job Duty
Teacher A	Alternative Education Teacher
Teacher B	Alternative Education Teacher
Teacher C	Alternative Education Teacher
Teacher D	Alternative Education Teacher
Teacher E	Alternative Education Teacher
Administrator A	Principal
Administrator B	Assistant Principal

The Institutional Review Board (IRB) (Appendix A) did not require parent permission for students to participate in this study because the non-identifying data collected is being administered by teachers and being collected as part of the curriculum. The Research Study Consent Form was provided to the alternative education teachers and administrators to review, sign, and return. (Appendix B).

Intervention and Research Plan

The literature review identified that many variables contribute to the effects that technology-based formative assessment has on student achievement. One idea that was noted by Frey and Schmitt (2010) were that formative assessment might be used more frequently in elementary grades as the availability of preexisting assessment material is not as abundant as it is in secondary grades. Another study by (Stiggins 2002, as cited in Frey & Schmitt, 2010) suggested that students in middle grades benefit from being the recipient of formative assessment due to the assessments providing instant feedback to both the student and the teacher. They also

found that this instructional strategy also aided in keeping students engaged in the learning process.

Stewart and Houchens (2014) found that the quality and frequency of professional development that teachers receive greatly affect their ability to not only implement technology based formative tools effectively but any instructional proactive that is being taught during professional development. Stewart and Houchens (2014) found that whole one day professional development is not as effective as professional development received over time. This is interesting as it is contrary to the methodology used by most districts that are in my region. Traditionally these schools build professional development days into the school year calendar in which students are off of school and teachers participate in professional development sessions all day.

Stewart and Houchens (2014) also noted that teachers did not have the skills necessary to effectively implement formative assessment strategies in the classroom which contributes to the frequency of which it is utilized. This directly ties back to their previous finding pertaining to the method in which teachers receive professional development.

The frequency and timing of technology based formative assessments has an impact on its effectiveness. When delivered too frequently students can become anxious which can inhibit their learning according to Horwitz (2017). Conversely, it is important to use formative assessment to gather data prior to and during instruction as Kazragytė and Kudinovienė (2019) stated. They found that it helps the teacher determine whether additional instruction is needed on the current topic or whether the teacher can proceed to the next topic.

This research study was divided up into three different research phases. During the first phase existing summative assessment results were gathered from the school. The data was analyzed and provided baseline data regarding students existing achievement.

The second phase of the research study consisted of providing professional development on using Mentimeter. After teachers were provided professional development, they then began issue formative assessments to the students during instruction.

During the third phase of this research study, additional assessment data was collected that was completed after four to eight weeks after assessment was used in the classroom. The baseline data was then compared to the data during phase three of the research study to make assumptions regarding the effectiveness of the technology based formative assessments.

There are many implications that need to be considered when deciding to use technology based formative assessments in a school. Many schools have pacing guidelines in place. Schools need to be able to adjust those guidelines if the results of the formative assessments show that a majority of the students are not comprehending the material that is being presented. This could lead to individual classes falling behind those pacing guidelines in exchange for comprehension. The second thing that needs to be considered is the cost of the application that is used as well as the devices that are needed. In order to collect the largest amount of data simultaneously during class its essential that each student has their own device. There's a cost associated with that a school would need to take into consideration for this. Secondly, the cost structure of the application itself needs to be budgeted for. Thirdly, schools need to make sure they are delivering professional development to their teachers in a way that is meaningful and effective. Schools might need to consider whether they need to move away from the model and schedule that professional development that is delivered today and switch to a model that is more frequent basis throughout the year in smaller allotments of time. This will allow for greater comprehension by the teachers as a whole day of different topics is not given in a single day. Lastly, at least initially, teachers might need some additional planning time to effectively implement the technology based formative assessment tool in the classroom. Some teachers might want to create the assessments ahead of time, where others may want to create the assessments in real time during the class.

Research Design, Methods, and Data Collection

A quantitative study was chosen to examine the research questions from an overall perspective. According to Dobrovolny and Fuentes (2008), quantitative research is used to seek to validate whether a particular assumption is true, assume an objective reality that is relatively constant, separate and detach the observer from the observed, explore population characteristics or sampling that represent population characteristics, refer to the people who participate in the research as subjects, randomly select samples that are as large as possible, describe behaviors with numbers, examine behavior and other observable variables, explore human behavior in natural or experiment-like settings, analyze social reality according to predefined variables, use preconceived concepts and theories to determine what data will be collected, use statistical methods and inference to analyze data, generalize findings from a sample to a defined population, prepare impersonal, objective reports of research findings, and make sure that the final report typically contains charts, graphs, and tables that summarize the data.

The researcher pursued California University of Pennsylvania's Institutional Review Board (IRB) approval on September 2, 2020. The researcher received approval on September 19, 2020 to begin collecting data.

Three methods of data collection were used to obtain a complete analysis of the data. The first method used to collect data was student assessment scores. These scores were obtained from each teacher on an individualized basis to obtain baseline data for each student. This is done because unlike a district, Colonial Academy serves children of all academic levels and abilities.

By assessing the frequency and quality with which teachers engage in a range of evidence-based practices, resources dedicated to promoting teacher effectiveness can be targeted more closely to specific needs, can be used to provide formative feedback, and potentially can contribute to growth in student achievement.

(Lekwa et al., 2019, p. 272)

The second method of data collection was an online questionnaire administered through Google Forms. The use of Google Forms allowed the researcher to quickly capture closed-ended

questions for the participant group. The use of closed-ended questions allows the researcher to limit the participants to responding to specific questions by providing them with predetermined answers. The researcher used the four types of questions used in surveys known as demographic, knowledge, attitudinal, and behavioral. Demographic questions are those that allow respondents to indicate personal characteristics. Knowledge questions seek to determine how much an individual knows about a particular subject. Attitudinal questions are questions that ask individual respondents to indicate their attitudes or opinions about a topic. Behavioral questions are those that seek information about actual behaviors of individuals in the sample group. The researcher used a mix of Likert-type questions, Likert scale, and checklists. A Likert scale question begins with a statement and then asks participants to respond with an agree-disagree continuum. A Likert-type question is similar to a Likert scale; however, it measures something other than extent of agreement. It forces the participants to respond on a scaled that examines quality, frequency of occurrence, or degree of benefit (Mertler, 2019).

The use of questionnaires come with many advantages such as the researcher being able to collect large amounts of data from participants in a relatively short amount of time, allows for generalizability for large populations, and is versatile in what can be investigated and how data can be collected (Mertler, 2019). Along with advantages comes limitations. Some limitations include low response rates as well as monetary issues relating to the mode of collecting data. Another limitation is that the researcher is relying on the participants to self-report data, that is they are telling us what they believe is true or accurate.

The next method of data collection was a post survey questionnaire using Google Docs. Again, just like the initial questionnaire, closed-ended questions were used to gather data. Finally, the last method of collection data was the post assessment scores. The post assessment scores were collected after the teachers utilized Mentimeter for a period of four to six weeks. Each of the teachers used Mentimeter at varying frequencies throughout their instruction.

Prior to the start of the research study, the researcher established the research timeline that appears in Table 2 to ensure timeliness for the completion of the research project. Since the conclusion of this research study, the actual dates that the data was collected has been added to the research timeline.

Table 2

Data Collection Timeline

Research Question	Types Of Data To Collect (i.e. qualitative, quantitative)	Data Sources (detailed explanation of the types of data you will collect)	Timeline For Collecting Data	Actual Data Collection Date
Does the use of technology-based formative assessment lead to increased student achievement?	quantitative	Student assessment data prior to and after formative assessment techniques are used when providing instruction to students.	April 2021 - June 2021	April 2021 - June 2021
How does the frequency of using formative assessment affect student achievement?	quantitative	Formative assessment surveys completed by teachers and student assessment scores	April 2021 - June 2021	April 2021 - June 2021
Does the use of technology based formative assessment narrow the range of achievement when comparing high scores against low scores?	quantitative	Student assessment data prior to and after formative assessment techniques are used when providing instruction to students.	April 2021 - June 2021	April 2021 - June 2021

In April 2021, all alternative education teachers were given a Research Study Consent Form. All participants in the research study were willing volunteers and were told that they could stop participating at any point of the study and for any reason. All participants who began the research study were able to follow through to completion of the study. Prior to the start of this research project, in April 2021, the researcher met with the alternative education teachers to explain the nature of the research study, the proposed data collection, the work involved and that

their participation was completely voluntary and they could opt out if they chose to do so at any time.

It was explained that anonymity would be held in the collection of the data. The researcher explained to the alternative education teachers that no personally identifying information would be included in the research study. This was accomplished by not collecting names, emails, or identifying information of the participants completing the surveys as well as not collecting students' names. Participants were assigned a letter in random order to prevent other participants from identifying the name of the participant.

In April 2021, all alternative education teachers who agreed to participate in this study were asked to watch Tech Tip #78- Use Mentimeter for Formative Assessment. This tech tip consisted of a screencast recorded by the researcher that provided an asynchronous professional development on the effective use of Mentimeter. After the teachers watched the video, they were then given the first questionnaire, Pre-Research Survey through Google Forms, which recorded their responses. The alternative education teachers were asked to complete the questionnaire within a week of receipt and all responses were returned within that timeframe. Participants were assigned a persistent letter designation in order to identify their responses and keep anonymity.

After the initial survey was completed, the researcher received the initial assessment scores from the alternative education teachers for the students that the teachers chose who would be participating in the research study. The alternative education teachers were then asked to complete the technology based formative assessment at the frequency of their choice (daily, weekly, monthly) for four to eight weeks. At the conclusion of the eight weeks the teachers were then asked to complete a questionnaire, Post-Research Study through Google Forms, which recorded their responses. Also requested was the students post assessment scores after they were given technology based formative assessments for the four-to-eight-week time period.

Through the review of the pre-assessment scores, initial questionnaire, second questionnaire, and post assessment scores, the researcher began to develop a targeted professional

plan that was implemented with teachers. This professional development plan will be slated to start in the 2021- 2022 school year and will be discussed in more depth in the next chapter.

Validity

All types of quantitative research are subject to threats of validity. The researcher collecting several types of data from the research participants to answer the research questions. The multiple sources of data were used not only to collect accurate data for students of different cognitive levels but also helped to eliminate concerns over the validity of the data. First, given that all data was collected by one single researcher, the data collection methods were done in a consistent way to protect the reliability and validity of the study. Secondly, the researcher attempted to use multiple data collection methods using pre-surveys, post-surveys, pre-assessment scores, and post- assessment in an effort to compare whether technology based formative assessment increased student academic achievement. Lastly, data accuracy for this study was ensured through documentation. Special care was taken when analyzing the quantitative data that was collected to make sure that the individual reported scores in both pre and post assessments were attributed to the same student.

According to Mertler (2019) there are four types of inferences drawn from validity: content, concurrent, predictive, and construct. Content validity measures whether a test is representative of all things being measured. In this research study the pre-survey, post-surveys were designed alongside the research questions. The use of concurrent validity is the use of two different assessment to predict the outcome. For example, which was not used in this study, could be the use of administering a math test if that subject was not used for the technology based formative assessment. Predictive validity is how well you can predictive future results. The use of comparing current student assessment scores to post assessment scores would be an example of predictive validity because one would make inferences that students' scores will increase at a later time. Construct validity refers to whether a measurement tool really is representative of the thing we are interested in measuring. For example, in this research study, is the academic scores

of the student's representative of the students' improvement/lack of improvement from the technology based formative assessment or are they having a good day/bad day?

Summary

This quantitative design study is intended to improve students' academic achievement while creating an interactive tool that teachers and students can utilize while getting immediate feedback on their comprehension of the topic being taught. This study was designed to ensure that data collected was reliable and valid. Other researchers should be able to go into other educational settings and be able to replicate this research study, however, may need to tailor the needs to their district, as Colonial Academy, is an alternate education placement setting. The next chapter will detail the results of the study. It will detail the answers to the research questions and reflect on the design of this research paper.

CHAPTER IV

Data Analysis and Results

The students that attend Colonial Academy are there for a variety of reasons. In some cases, students attend Colonial Academy because they have been expelled from their home district for discipline related issues. In other instances, the home school districts elect to send their students to Colonial Academy because Colonial Academy has specialized programs to meet the needs of unique students. These unique needs include emotional support, autistic support, physical support, life skills, drug and alcohol education, and students that are deemed “disruptive” under Title 24 P.S. Education § 19-1901-C. A disruptive student is defined as

A student who poses a clear threat to the safety and welfare of other students or the school staff, who creates an unsafe school environment or whose behavior materially interferes with the learning of other students or disrupts the overall educational process. The disruptive student exhibits to a marked degree any or all of the following conditions:

- (i) Disregard for school authority, including persistent violation of school policy and rules.
- (ii) Display or use of controlled substances on school property or during school-affiliated activities.
- (iii) Violent or threatening behavior on school property or during school-affiliated activities.
- (iv) Possession of a weapon on school property, as defined under 18 Pa.C.S. § 912 (relating to possession of weapon on school property).
- (v) Commission of a criminal act on school property or during school-affiliated activities.
- (vi) Misconduct that would merit suspension or expulsion under school policy.

(FindLaw Staff, 2019)

Data collection in an alternative education school like Colonial Academy is difficult due to the fact that it is not a traditional school or houses traditional classrooms. In addition the absenteeism and transient rate at Colonial Academy is higher than a traditional school setting. The students' unique needs hinder their ability to participate and learn at a prescribed time during the day.

Results from this study provide valuable information that can influence how teachers can engage students to increase student achievement in an alternative educational setting. While generalizations can be made from these results could be beneficial to all school districts, it is important to keep in mind that these results will be interpreted within the context of the alternative education setting. Other school districts may find the results of this research may yield different results based on their student population, teachers, curriculum, and other circumstances.

Data Analysis

Data was collected over a period of six to eight weeks depending on the classroom. The researcher reached out to the principal and asked him to identify some teachers who would be interested in participating in the research study. Those teachers who were interested were then asked to complete a Research Consent Form. The researcher then sent the teachers a video to watch regarding the assessment tool being used so that they could learn how to use the tool called, Mentimeter for Formative Assessment. The teachers were then asked to complete a Pre-Research Survey. The teachers were then told to give pre-assessments and then post assessments after using Mentimeter for Formative Assessment.

Results

When analyzing the results there were two different sets of data collection, the pre-assessment data and post-assessment data. The initial data was collected in order to understand where the students comprehension/learning of the content being presented without the use of formative assessment techniques. After Mentimeter Formative Assessment techniques were

utilized in the classroom, the participants collected final post- assessment data in order to determine whether or not using technology based formative technology increases student academic achievement. In order to understand the results of the research study it is important to analyze both the initial and final sets of data.

Results from Pre-Research Survey

The teachers were given a 13-question survey in order for the research to gain an understanding of their familiarity with formative assessment (Table 3).

Table 3

Teachers Familiarity with Formative Assessment

How familiar teacher is with formative assessment?	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Not At All Familiar	0	0	0	0
Slightly Familiar	0	0	0	0
Somewhat Familiar	0	0	0	1
Moderately Familiar	1	2	1	0
Extremely Familiar	0	1	2	0

One teacher in grades 10 through 12 was somewhat familiar with formative assessment techniques. Four of the teachers in grades four through nine were moderately familiar with formative assessment techniques. Three of the teachers in grades six through nine said they were extremely familiar with formative assessment techniques. The majority of teachers in grades six through seven were moderately familiar with formative assessment techniques. The majority of teacher in grades 8-9 said they were extremely familiar with formative assessment techniques.

The teachers were asked how often they used formative assessment to gather real time data using clickers. A clicker is a physical device that allows respondents to specify a response to

a question by pressing a button on the physical device. Table 4 shows how often the teachers utilized clickers.

Table 4

Formative Assessment Using Clickers

How often teacher uses formative assessment to gather real time data using clickers?	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	2	2	1
Quarterly	0	0	0	0
Monthly	0	0	0	0
Once or Twice a Week	1	1	1	0
Daily	0	0	0	0

Five teachers in grades six through 12 did not use clickers in the classroom. Three of the teachers in grades four through nine used clickers once or twice a week in the classroom.

The teachers were then asked about how they used formative assessment to gather data in the classroom. Table 5 shows how often the teachers used formative assessment in their classroom prior to the research study.

Table 5

How Often a Teacher Uses Formative Assessment in the Classroom

How often does the teacher use formative assessment to gather real time data using an application?	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	1	1	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	0

How often does the teacher use formative assessment to gather real time data using an application?	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Once or Twice a Week	0	2	2	1
Daily	0	0	1	0

Two of the teachers in grades four through seven did not use formative assessment applications in their classrooms prior to the research study. Five teachers in grades six through twelve used formative assessment applications in their classrooms once or twice a week. One teacher in grades eight through nine used formative assessment applications on a daily basis in their classroom prior to the research study.

The teachers were asked prior to the research study how often they utilized formative assessment to adjust sequence and pacing. Table 6 shows how often the teachers utilized formative assessment with pacing.

Table 6

Teachers Using Formative Assessment to Adjust Pacing

How often teacher uses formative assessment to adjust sequence and pacing	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	0	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	0
Once or Twice a Week	0	1	1	1
Daily	1	2	2	0

Three of the teachers in grades six through 12 utilize the data obtained from formative assessments to adjust pacing and sequence at least once or twice a week. Five teachers in grades

four through nine reported that they utilized formative assessment on a daily basis to adjust sequence and pacing. The teachers in grades six through nine adjusted their sequence and pacing more frequently than teachers in other grades as a result of data gathered from formative assessments.

The teachers were asked about their use of formative assessment to target learning gaps.

Table 7 shows how often participants utilized formative assessment to target learning gaps.

Table 7

Learning Gaps & Misconceptions

How often teacher uses formative assessment to target learning gaps and misconceptions	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	0	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	0
Once or Twice a Week	0	1	2	1
Daily	1	2	1	0

Four of the teachers used formative assessment at least once or twice a week to target learning gaps and misconceptions. Four teachers utilized formative assessment on a daily basis prior to the research study to target learning gaps and misconceptions.

Teachers were asked if they used formative assessment to provide descriptive feedback.

Table 8 shows how often the teachers utilized formative assessment prior to the research study.

Table 8

Teachers Using Formative Assessment to Provide Feedback

How often teacher uses formative assessment to provide descriptive feedback	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	0	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	1
Once or Twice a Week	0	2	2	0
Daily	1	1	1	0

One teacher in grades ten through twelve reported using formative assessment once a week to provide descriptive feedback. Four of the teachers in grades six through nine reported utilizing formative assessment to provide descriptive feedback. Three teachers in grades four through nine reported using formative assessment to provide descriptive feedback.

Teachers were asked their perception of how effective they believed that utilizing formative assessment will be. Table 9 shows the teachers perception of how effective they believe the use of formative assessment will have on the student's academic achievement.

Table 9

Effectiveness of Formative Assessment

The teacher's perception of how effective technology based formative assessment is that it will:	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
No Impact	0	0	0	0
Minimal Impact	0	0	0	0
Moderate Impact	1	3	2	1
Substantial Impact	0	0	1	0

Enormous Impact	0	0	0	0
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Seven of the teachers in grades four through twelve said that they believe using technology based formative assessment will have a moderate impact on students’ academic achievement. One teacher in grades eight through nine believes that there will be a substantial impact on students’ academic achievement. The sixth grade teachers unanimously felt that technology-based formative assessment would have a moderate impact on student achievement.

Results from Post-Research Survey

Teachers were then given a post survey questionnaire to help the researcher get an understanding of the teachers' familiarity with the use of technology based formative assessment and student academic achievement in an alternative educational setting. Table 10 shows the teachers understanding of formative assessment after utilizing it for the six to eight weeks in the classroom setting.

Table 10

Teachers Familiarity with Formative Assessment

How familiar teacher is with formative assessment	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Not At All Familiar	0	0	0	0
Slightly Familiar	0	0	0	0
Somewhat Familiar	0	0	0	0
Moderately Familiar	1	1	0	1
Extremely Familiar	0	2	3	0

Two teachers in grades four through seven and one teacher in grades 10 through 12 reported that they were moderately familiar with formative assessment at the conclusion of the research period.

Five teachers in grades six through nine stated that they were extremely familiar with formative assessment after the research period. This data generally represents a slight increase in familiarity with formative assessments when compared to the survey data from the beginning of the research period.

The teachers were then asked how often they used formative assessment to gather real time data using Clickers. Table 11 shows how often the teachers utilized Clickers.

Table 11

Formative Assessment Using Clickers

How often teacher uses formative assessment gather real time data using clickers	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	1	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	0
Once or Twice a Week	0	1	0	1
Daily	1	1	3	0

One teacher in grades four through five did not use clickers in the classroom at the conclusion of the research period. One teacher in grades six through seven and one teacher in grades 10 through 12 utilized clickers once or twice a week in the classroom by the end of the research period. Five teachers in grades four through nine chose to use clickers on a daily basis in their classroom by the end of the research period.

Teachers were then asked how they used formative assessment to gather real time data using an application (Table 12).

Table 12

How Often a Teacher Uses Formative Assessment in the Classroom

How often teacher uses formative assessment to gather real time data using an application	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	1	1	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	0
Once or Twice a Week	0	2	2	1
Daily	0	0	1	0

Two teachers in grades four through seven did not use formative assessment to gather real time data using an application at the end of the research period. Five teachers in grades six through 12 used formative assessment to gather real time data using an application at least once or twice a week at the conclusion of the study. One teacher in grades eight through nine reported that they utilized formative assessment to gather real time data using an application on a daily basis at the time the research study concluded.

Teachers were then asked how often they utilized formative assessment to adjust pacing. Table 13 shows how often the teachers utilized formative assessment to adjust sequence and pacing in their classroom for teaching at the conclusion of the research study.

Table 13

Teachers Using Formative Assessment to Adjust Pacing

How often teacher uses formative assessment to adjust sequence and pacing	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	0	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	0

Once or Twice a Week	0	1	1	1
Daily	1	2	2	0

Three teachers in grades six through 12 reported that they used formative assessment to adjust their pacing and sequencing in the classroom at least once or twice a week. Five teachers in grades four through nine reported that they used formative assessment on a daily basis in their classroom to adjust sequencing and pacing. There were no increases or decreases in frequency of sequence or pacing adjustments when compared to the data at the start of the research period.

Teachers were then asked how often they employed formative assessment in the classroom to target learning gaps and misconceptions (Table 14).

Table 14

Learning Gaps and Misconceptions

How often teacher uses formative assessment to target learning gaps and misconceptions	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	0	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	0
Once or Twice a Week	0	1	2	1
Daily	1	2	1	0

Four teachers in grades six through 12 reported that they utilized formative assessment to target learning gaps and misconceptions at least once or twice a week towards the end of the research period. Four teachers in grades four through nine reported that they used formative assessment on

a daily basis to target learning gaps and misconceptions at the conclusion of the research period.

This data was consistent with the data collected in the pre-research study questionnaire.

The teachers were asked about using formative assessment to provide feedback. Table 15 shows how often teachers used formative assessment to provide descriptive feedback in the classroom.

Table 15

Teachers Using Formative Assessment to Provide Feedback

How often teacher uses formative assessment to provide descriptive feedback	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
Do Not Use	0	0	0	0
Quarterly	0	0	0	0
Monthly	0	0	0	1
Once or Twice a Week	0	2	2	0
Daily	1	1	1	0

One teacher in grades 10 through 12 utilized formative assessment to provide descriptive feedback on a monthly basis at the end of the research period. Four teachers in grades six through nine reported that they used formative assessment to provide descriptive feedback at least once or twice a week at the conclusion of the research period. Three teachers in grades four through nine reported that they employed formative assessment on a daily basis to provide descriptive feedback once the research project was ending. There was no change in the frequency of feedback provided as a result of formative assessment when comparing the data collected in the pre-research study questionnaire against the data in the post-research study questionnaire.

The teachers were then asked how they feel regarding the effective of technology based formative assessment on student academic achievement. Table 16 shows the results of how the teachers feel regarding using technology based formative assessment in the classroom.

Table 16

Effectiveness of Formative Assessment

My perception of how effective technology based formative assessment is that it will:	Grades 4-5 n=1	Grades 6-7 n=3	Grades 8-9 n=3	Grades 10-12 n=1
No Impact	0	0	0	0
Minimal Impact	0	0	0	0
Moderate Impact	1	3	2	1
Substantial Impact	0	0	1	0
Enormous Impact	0	0	0	0

Seven teachers in grades four through 12 felt that there was a moderate impact on student academic achievement when utilizing technology based formative assessment in the classroom at the conclusion of the research study. One teacher in grades eight through nine felt there was a substantial impact on student academic achievement when using technology based formative assessment in the classroom. It will be shown later in this research study that the teacher’s perception on the effectiveness of technology-based formative assessment will be true.

Comparison of Questionnaire Results

Ultimately the pre and post research questionnaire was designed to help gauge the understanding of teacher’s use of formative assessment in the classroom as well as the frequency of use in the classroom. Table 17 shows the pre and post survey data regarding how familiar the teachers are with formative assessment.

Table 17

Comparison of Teachers Familiarity with Formative Assessment

How familiar teacher is with formative assessment	Grades 4-5 n=1		Grades 6-7 n=3		Grades 8-9 n=3		Grades 10-12 n=1	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Not At All Familiar	0	0	0	0	0	0	0	0
Slightly Familiar	0	0	0	0	0	0	0	0
Somewhat Familiar	0	0	0	0	0	0	1	0
Moderately Familiar	1	1	2	1	1	0	0	1
Extremely Familiar	0	0	1	2	2	3	0	0

The teacher in grades fourth through fifth did not change their understanding of formative assessment between the pre and post survey. The teachers in grades sixth through seven reported a slight increase in the familiarity with formative assessment at the end of the research period. One of the teachers in these grades changed from moderately familiar to extremely familiar at the conclusion of the research study. The data shows that the teachers in eight and ninth grade experienced a similar increase in familiarity. In general, a majority of teachers increased their familiarity with formative assessment.

Table 18 shows the comparison of how often the teachers used formative assessment to gather real time data using the program Clickers.

Table 18

Comparison of Formative Assessment Using Clickers

How often teacher uses formative assessment Gather Real Time Data Using Clickers	Grades 4-5 n=1		Grades 6-7 n=3		Grades 8-9 n=3		Grades 10-12 n=1	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Do Not Use	0	0	2	1	2	0	1	0
Quarterly	0	0	0	0	0	0	0	0
Monthly	0	0	0	0	0	0	0	0
Once or Twice a Week	1	0	1	1	1	0	0	1
Daily	0	1	0	1	0	3	0	0

The teacher in fourth through fifth grade increased the frequency in which they used clickers to gather real time data from their students from one or twice a week to daily. In grades six through seven, there were two teachers that reported they did not use clickers to gather real-time data from students, as well as one teacher that reported they used clickers once or twice week. When the research study concluded, there was only one teacher that did not use clickers. In grades eight through nine, the data shows that at the beginning of the research period there were two teachers that did not use clickers and 1 teacher that used clickers once or twice a week. All teachers in this grade range reported that they used clickers daily at the conclusion of the research period. In grades 10 through 12, the teacher went from not using clickers at the beginning of the research study to using them once or twice a week at the conclusion of the study. In general, there was an overall increase in the frequency in which teachers used clickers to gather real-time data from students.

Teachers were asked on both the pre and post research questionnaire how often they employed formative assessment in the classroom to gather real time data using a computer application (Table 19).

Table 19

Comparison of How Often a Teacher Uses Formative Assessment in the Classroom

How often teacher uses formative assessment Gather Real Time Data Using an Application	Grades 4-5 n=1		Grades 6-7 n=3		Grades 8-9 n=3		Grades 10-12 n=1	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Do Not Use	1	0	1	0	0	0	0	0
Quarterly	0	0	0	0	0	0	0	0
Monthly	0	0	0	0	0	0	0	0
Once or Twice a Week	0	1	2	3	2	2	1	1
Daily	0	0	0	0	1	1	0	0

The teacher in fourth through fifth grade reported that they did not use formative assessment applications to gather real time data using an application prior to the research study. By the conclusion of the study, the frequency of use increased to at least once or twice a week. One teacher in grades six through seven reported not using formative assessment applications to gather data using an application prior to the research study. Two teachers reported using formative assessment applications to gather data at least once or twice a week prior to the research study. By the end of the research study, two teachers reported utilizing formative assessment to gather data using an application at least once or twice a week and one teacher used it on a daily basis. The teachers in eight through ninth grade reported no change in the frequency of use of a formative assessment application to gather real time data. The teacher in tenth through twelfth grade reported also reported no change in frequency of use of a formative assessment application when comparing their pre and post research study questionnaire. Overall, there was a slight increase in the frequency in which teachers used formative assessment applications over the period of the research study.

Table 20 shows the comparison of how often teachers used formative assessment to adjust sequence and pacing in their classroom to teach lessons.

Table 20

Comparison of Teachers Using Formative Assessment to Adjust Pacing

How often teacher uses formative assessment to adjust sequence and pacing	Grades 4-5 n=1		Grades 6-7 n=3		Grades 8-9 n=3		Grades 10-12 n=1	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Do Not Use	0	0	0	0	0	0	0	0
Quarterly	0	0	0	0	0	0	0	0
Monthly	0	0	0	0	0	0	0	0
Once or Twice a Week	0	0	1	0	1	0	1	1
Daily	1	1	2	3	2	3	0	0

The teacher in grades four through five reported both prior and at the conclusion of the research study that they used formative assessment to adjust sequence and pacing in the classroom on a daily basis. One teacher in grades six through seven reported using formative assessment at least once or twice a week prior to the research study, and two teachers reported using it on a daily basis. By the conclusion of the research study, all teachers in the grade range reported using formative assessment to adjust pacing on a daily basis. One teacher in grades eight through nine reported using formative assessment at least once or twice a week prior to the research study, and two teachers reported using it on a daily basis. By the conclusion of the research study, all teachers in the grade range reported using formative assessment to adjust pacing on a daily basis. The teacher in grades 10 through 12 reported no change in the frequency of using formative assessment to adjust sequence and pacing in the classroom. They found themselves adjusting sequence and pacing once or twice a week consistently. Overall, Table 20 shows that a majority

of teachers increased the frequency in which they used formative assessment data to adjust sequence and pacing during the research study.

Teachers were asked how often they utilized formative assessment to target learning gaps and misconceptions (Table 21).

Table 21
Comparison of Learning Gaps and Misconceptions

How often teacher uses formative assessment to target learning gaps and misconceptions	Grades 4-5 n=1		Grades 6-7 n=3		Grades 8-9 n=3		Grades 10-12 n=1	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Do Not Use	0	0	0	0	0	0	0	0
Quarterly	0	0	0	0	0	0	0	0
Monthly	0	0	0	0	0	0	0	1
Once or Twice a Week	0	0	1	1	2	1	1	0
Daily	1	1	2	2	1	2	0	0

The teachers in grades four through five and six through seven reported no change in the frequency in which they used formative assessment to target learning gaps and misconceptions. All teachers in this grade range reported that they consistently used this practice from once or twice a week to daily. Teachers in grades eight through nine showed an increase in frequency in which they targeted learning gaps and misconceptions. When comparing the pre and post research study questionnaire, a majority of teachers went from using the formative assessment data to targeting learning gaps and misconceptions once or twice a week to doing so on a daily basis. The teacher in grades 10 through twelve reported a decrease in the frequency in which they used the data gathered from formative assessments to target learning gaps and misconceptions. Overall, since one grade range had an increase, and one grade range had a decrease, there was no

change in the frequency in which teachers used formative assessment data to target learning gaps and misconceptions when comparing pre and post questionnaire surveys.

Table 22 shows how often teachers used formative assessment to provide descriptive feedback during instruction.

Table 22

Comparison of Teachers Using Formative Assessment to Provide Feedback

How often teacher uses formative assessment to provide descriptive feedback	Grades 4-5 n=1		Grades 6-7 n=3		Grades 8-9 n=3		Grades 10-12 n=1	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Do Not Use	0	0	0	0	0	0	0	0
Quarterly	0	0	0	0	0	0	0	0
Monthly	0	0	0	0	0	0	1	0
Once or Twice a Week	0	1	2	2	2	1	0	1
Daily	1	0	1	1	1	2	0	0

The teacher in grades four through five initially reported providing feedback to students based on formative assessment data on a daily basis prior to the research study. Once the research study concluded, the same teacher reported providing feedback once or twice a week. The teachers in grades six through seven reported no change in frequency of providing students feedback based on formative assessment data when comparing the pre and post research study questionnaire. The data shows that teachers in grades eight through nine and 10 through 12 issued feedback based on formative assessment data more frequently by the conclusion of the research study. By the conclusion of the research study, all teachers were providing feedback at least once or twice a week.

The teachers were asked how effective they thought technology based formative assessment would be during their pre research questionnaire and then after the research study.

Table 23 shows their perceptions of how effective technology based formative assessment is in their opinions.

Table 23

Comparison of Effectiveness of Formative Assessment

My perception of how effective technology based formative assessment is that it will:	Grades 4-5 n=1		Grades 6-7 n=3		Grades 8-9 n=3		Grades 10-12 n=1	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	No Impact	0	0	0	0	0	0	0
Minimal Impact	0	0	0	0	0	0	0	0
Moderate Impact	1	1	3	3	2	2	1	0
Substantial Impact	0	0	0	0	1	1	0	1
Enormous Impact	0	0	0	0	0	0	0	0

All teachers in grades four through five, six through seven, and grades eight through nine were consistent in their response in that they thought that the use of technology-based formative assessment would have a moderate impact on student achievement. The teacher in grades 10 through 12 initially thought that the use of technology-based formative assessment would have a moderate impact on student achievement. Once the research study concluded, the same teacher felt that there was a substantial impact on student achievement. With the exception on one teacher, most teachers impression of how much of an impact technology-based formative assessment would have on student achievement did not change by the conclusion of the research period.

Pre and Post Score Results

The assessment scores of students in the participating teacher's classes were examined. Assessment scores were collected prior to the implementation of technology based formative assessment in the classroom, as well as at the conclusion of the research study. During the research study, teachers used Mentimeter at varying frequencies (once a week, twice a week, monthly, daily) throughout the four-to-six-week timeline. Table 24 shows the average of the pre and post assessment scores of all students that took the assessment tests.

Table 24*Average of Pre and Post Scores*

<i>Student #</i>	<i>Average of Pre-Formative Assessment Scores</i>	<i>Average of Post-Formative Assessment Scores</i>
1	37.50%	75.00%
2	87.50%	56.25%
3	62.50%	37.50%
4	43.75%	87.50%
5	31.25%	87.50%
6	43.75%	68.75%
7	43.75%	43.75%
8	43.75%	50.00%
9	75.00%	56.25%
10	29.50%	26.00%
11	47.67%	64.50%
12	53.33%	90.00%
13	25.67%	56.50%
14	29.00%	37.00%

<i>Student #</i>	Average of Pre-Formative Assessment Scores	Average of Post-Formative Assessment Scores
15	32.33%	47.00%
16	66.67%	52.67%
17	54.33%	-
18	40.00%	56.67%
19	46.67%	56.67%
20	53.33%	63.33%
21	53.33%	83.33%
22	53.33%	70.00%
23	100.00%	100.00%
24	100.00%	100.00%
25	100.00%	100.00%
26	-	-
27	100.00%	100.00%
28	100.00%	100.00%
29	-	-
30	100.00%	-
31	100.00%	100.00%
32	-	-
33	21.43%	42.86%
34	78.57%	100.00%
35	92.86%	85.71%

<i>Student #</i>	Average of Pre-Formative Assessment Scores	Average of Post-Formative Assessment Scores
36	50.00%	92.86%
37	100.00%	100.00%
38	35.71%	21.43%
39	42.86%	-
40	7.14%	92.86%
41	71.43%	-
42	21.43%	-
43	57.14%	92.86%
44	50.00%	-
Average	56.67%	72.21%

Note. - is a result of some students missing some assessment scores due to absenteeism for various reasons.

There was a total of forty-four students that completed assessments during the research study. Nine students' average scores could not be computed because they were absent for various reasons, including the COVID-19 pandemic. Their average scores were invalid and the researcher could not determine whether there was an increase in academic achievement for these specific students. Nineteen students in total showed an increase in their average assessment scores when comparing their pre-formative assessment scores to their post-formative assessment scores. Seven students showed a decrease in their overall pre and post assessment scores. Eight students did not show an increase or a decrease in their scores between their pre and post assessment scores. The average pre-formative assessment test scores of all 44 students was 56.67%. The average post-

formative assessment score of all 44 students was 72.21%. Overall, the data suggests that there is an increase in student academic achievement when comparing pre technology-based formative assessment scores to post technology-based formative assessment scores regardless of the frequency.

The same dataset was also analyzed to determine whether the frequency in which the teachers used technology-based formative assessment had an impact on student achievement. Table 25 shows the students and whether they received daily assessments or their assessments once or twice a week.

Table 25

Frequency of Pre and Post Test Assessments

Student #	Frequency technology-based formative assessment was used	Average Pre-Formative Assessment Score	Average Post-Formative Assessment Score
33	Daily	21.43%	42.86%
34	Daily	78.57%	100.00%
35	Daily	92.86%	85.71%
36	Daily	50.00%	92.86%
37	Daily	100.00%	100.00%
38	Daily	35.71%	21.43%
39	Daily	42.86%	-
40	Daily	7.14%	92.86%
41	Daily	71.43%	-
42	Daily	21.43%	-
43	Daily	57.14%	92.86%
44	Daily	50.00%	-

Student #	Frequency technology-based formative assessment was used	Average Pre-Formative Assessment Score	Average Post-Formative Assessment Score
	Daily Average	52.38%	78.57%
1	Once or twice a week	37.50%	75.00%
2	Once or twice a week	87.50%	56.25%
3	Once or twice a week	62.50%	37.50%
4	Once or twice a week	43.75%	87.50%
5	Once or twice a week	31.25%	87.50%
6	Once or twice a week	43.75%	68.75%
7	Once or twice a week	43.75%	43.75%
8	Once or twice a week	43.75%	50.00%
9	Once or twice a week	75.00%	56.25%
10	Once or twice a week	29.50%	26.00%
11	Once or twice a week	47.67%	64.50%
12	Once or twice a week	53.33%	90.00%
13	Once or twice a week	25.67%	56.50%
14	Once or twice a week	29.00%	37.00%
15	Once or twice a week	32.33%	47.00%
16	Once or twice a week	66.67%	52.67%
17	Once or twice a week	54.33%	-
18	Once or twice a week	40.00%	56.67%
19	Once or twice a week	46.67%	56.67%
20	Once or twice a week	53.33%	63.33%

Student #	Frequency technology-based formative assessment was used	Average Pre-Formative Assessment Score	Average Post-Formative Assessment Score
21	Once or twice a week	53.33%	83.33%
22	Once or twice a week	53.33%	70.00%
23	Once or twice a week	100.00%	100.00%
24	Once or twice a week	100.00%	100.00%
25	Once or twice a week	100.00%	100.00%
26	Once or twice a week	-	-
27	Once or twice a week	100.00%	100.00%
28	Once or twice a week	100.00%	100.00%
29	Once or twice a week	-	-
30	Once or twice a week	100.00%	-
31	Once or twice a week	100.00%	100.00%
32	Once or twice a week	-	-
Once or twice a week Average		57.54%	71.28%

Note. - is a result of some students missing some assessment scores due to absenteeism for various reasons.

Out of the forty-four students who participated in the study, twelve students were exposed to technology-based formative assessments on a daily basis. Of those twelve students, four students' assessment score averages were invalid because they were absent for one or more of the assessment days, therefore, providing an invalid calculation. Five students showed an increase in academic achievement when comparing their average pre and post assessment scores. Two

students showed a decrease between their pre and post assessment scores. One student did not show a decrease or an increase between the pre and post test scores. The average test score of students that ended up receiving daily technology-based formative assessments prior to the actual implementation of technology-based formative assessment was 52.38%. The average test scores of the same group of students after they received technology-based formative assessment on a daily basis was 78.57%. The data suggests that average assessment score increased by 26.19% for students that received technology-based formative assessment on a daily basis.

Out of the forty-four students who participated in the study, thirty-two students were given technology-based formative assessments once or twice a week. Of the thirty-two students, five students assessments were invalid because they were absent for one of the assessment days, therefore, providing an invalid calculation. Fifteen students from this group showed an increase in academic achievement when comparing their assessment scores prior to the implementation of technology-based formative assessment to their assessment scores after technology-based formative assessments were implemented. Five students showed a decrease between their pre technology-based formative assessment scores and their post technology-based formative assessment scores. Seven students did not show a decrease or an increase when comparing their scores. The average test score of this group of students prior to the implementation of technology-based formative assessment was 57.54%. The average test scores for the same group of students after the implementation of technology-based formative assessment scores once or twice a week was 71.28%. The data suggests that average assessment score increased by 13.74% for students that received technology-based formative assessment on a daily basis.

The difference between the pre and post assessment scores for students that received technology based formative assessments on a daily basis was 26.19% and the difference between the pre and post assessment scores for the group of students that received technology-based formative assessments once or twice a week was 13.74%. The data suggests that students who received technology-based formative assessments on a daily basis achieved a score that was

12.4% higher on their test scores compared to the students that received technology-based formative assessment once or twice a week. The data suggests that the frequency in which technology based formative assessment is used in the classroom has a direct correlation to student achievement.

The researcher also wanted to answer what impact the implementation of technology-based formative assessment would have on the range of assessment scores achieved by students (Table 26).

Table 26

Range of Pre and Post Score Assessment

<i>Assessment #</i>	Minimum Pre-Formative Assessment Score	Maximum Pre-Formative Assessment Score	Range
1	31.25%	87.50%	56.25%
2	20.00%	80.00%	60.00%
3	0.00%	100.00%	100.00%
4	0.00%	80.00%	80.00%
5	30.00%	80.00%	50.00%
6	30.00%	70.00%	40.00%
7	30.00%	60.00%	30.00%
8	100.00%	100.00%	0.00%
9	100.00%	100.00%	0.00%
10	100.00%	100.00%	0.00%
11	7.14%	100.00%	92.86%
Average Range of Pre-Formative Assessment Scores			46.28%

<i>Assessment #</i>	Minimum Post-Formative Assessment Score	Maximum Post-Formative Assessment Score	Range
1	37.50%	87.50%	50.00%
2	0.00%	80.00%	80.00%
3	22.00%	42.00%	20.00%
4	79.00%	92.00%	13.00%
5	50.00%	90.00%	40.00%
6	50.00%	100.00%	50.00%
7	40.00%	70.00%	30.00%
8	100.00%	100.00%	0.00%
9	100.00%	100.00%	0.00%
10	100.00%	100.00%	0.00%
11	21.43%	100.00%	78.57%
Average Range of Post-Formative Assessment Scores			32.87%

There was a total of 11 unique assessments given throughout the research study. Overall, five assessments showed a decrease in the range between the test scores, meaning that the difference between the low and high scores was smaller at the conclusion of the research study compared to test scores prior to the implementation of technology-based formative assessment. Two assessments showed an increase in the range between the test scores, meaning that the difference between the minimum and maximum scores was greater at the conclusion of the research study. Four assessments showed that there was no change in the range between the test scores when comparing test scores that were achieved prior to the implementation of technology-based formative assessment against those obtained at the conclusion of the research study once technology-based formative assessment had been implemented. The average range of pre-

technology-based formative assessment scores was 46.28%. The average range of post-technology-based formative assessment scores was 32.87%. An analysis of the data shows that there was an overall decrease of 13.41% in the range of average scores when comparing assessments that were administered prior to the implementation of technology-based formative assessment to assessments that were administered after the implementation of technology-based formative assessment. The data suggests that technology-based formative assessment does positively shrink the range of assessment scores obtained by students.

Summary & Transition

The data presented above provides answers to the proposed research questions in this research study. However, it is important to keep in mind that the students and type of facility researched is difficult and not a typical school environment. Therefore, while this study presents data from this type of setting, the researcher will make generalizations in the next chapter that could be applicable to all classroom settings.

The data collected included a questionnaire completed by teachers prior to the research study, an additional questionnaire completed at the end of the research study, anonymized student assessment data prior to the implementation of technology-based formative assessment, and anonymized student assessment data after the implementation of technology-based formative assessment.

In the following chapter, the researcher will reach conclusions pertaining to the original three research questions based off of the quantitative data that was presented in this chapter. In addition, the next chapter will outline additional areas that would warrant further research. Lastly, the next chapter will cover recommendations for Colonial Academy to consider relating to how technology-based formative assessment could impact student achievement.

CHAPTER V

Conclusions and Recommendations

Introduction

This past year has been tumultuous for educators. Educators were faced with challenge after challenge and had to quickly adapt their teaching strategies to try and meet the needs of our students. This research study helped to identify that technology-based formative assessment is beneficial and resulted in increased student achievement. Performing this research study during the pandemic was challenging. While it would have been ideal if the entire student population, it was not feasible to do so in the educational environment that we found ourselves in as a result of COVID-19. This was due to a variety of reasons including constant teacher and student absenteeism, whole classes changing between virtual instruction and in person instruction, not having enough laptops for everyone to operate in a completely remote environment, teachers simply being overwhelmed with teaching in the environment that COVID-19 created for everyone, and the stress of COVID-19 on everyone's mental health.

With increased pressure from the school districts and the Pennsylvania Department of Education to score a certain percentage on the PASA (Pennsylvania Alternate System of Assessment) for special education students, teachers are forced to keep up with pacing guidelines. For students with varying disabilities this is an extremely difficult task. Teachers have to be creative in coming up with ways to teach and engage these students so they will comprehend the information being presented. This research study sought to explore the possibility of using technology based formative assessment to try to enhance students' academic achievement.

Conclusions

After analyzing the quantitative data collected during this research study, the researcher was able to conclude that the implementation of technology-based formative assessment positively impacts student achievement. Different pieces of data were collected and analyzed to answer each of the research questions. For each of the questions, the data showed that there was

significant improvement in student achievement. In addition to the anonymized student assessment data that was collected, the pre and post formative assessment questionnaire provided invaluable data that helped to identify that student achievement increased, more frequent technology based formative assessments yields greater student achievement, and the achievement gaps shrinks when technology-based formative assessment is implemented.

While the data generally shows there is a positive impact on student achievement when technology-based formative assessment is implemented, there are still some students in which this instructional strategy didn't yield a positive result. The administrators and teachers at Colonial Academy are continually working on innovative ways to drive student success. I am confident that the staff at this school will implement this strategy for those students that show increased student achievement. If a specific population of students don't seem to benefit from this strategy, I am confident that alternative methods will be identified that will help all students succeed.

Once Mentimeter continues to be shown to be successful and it garners a positive reputation, more program supervisors and teachers will be eager to implement this instructional strategy themselves. From an organization perspective, it is critical that we communicate the success of our staff and students to our community. Doing so demonstrates the ongoing commitment we have to continually being innovative and developing ways to increase student achievement.

Research Question 1

The first question posed in this research study is "Does the use of technology based formative assessment lead to increased student achievement?" The assessment data that was collected prior to the implementation of technology-based formative assessment in conjunction with the assessment data that was collected after technology-based formative assessment was implemented suggests this instructional strategy does result in increased student achievement. When comparing the assessment scores of students prior to and after receiving technology based

formative assessments, the average of the student assessment scores increased by 15.54% when compared to assessments scores prior to the implementation of formative assessment in the classroom. This is a relatively large increase and will be very impactful. Many of the students at Colonial Academy are behind grade level, and the average increase of 15.54% is especially substantial for many of the students.

The pre and post technology-based formative assessment questionnaire showed that most teachers felt that the implementation of this instructional strategy would have a moderate impact on student achievement with some teachers expressing that they felt the impact would be substantial. The data shows that these teachers hypothesis on how effective technology-based formative assessment would be for their students was rather accurate.

The data also shows that teachers became more familiar with Mentimeter as time elapsed during the research study. While not a research question in this project, the possibility exists that how familiar a teacher is with technology-based formative assessment could impact student achievement. More research and data would need to be collected to accurately answer this question.

Over half of the students that had calculable average assessment scores experienced an increase in student achievement. The students that experienced this increases were affiliated with all teachers involved in the research study as well as all grade levels.

Research Question 2

“How does the frequency of using formative assessment affect student achievement” was the second research question answered. The researcher had to analyze multiple sources of data to answer this question. Assessments that were completed by the students prior to and after the implementation of technology-based formative assessment had to be compared against the post research study questionnaire that the teachers completed.

The students that were affiliated with teachers that ended up implementing Mentimeter on a daily basis originally had average assessment scores of 52.38% prior to the implementation

of Mentimeter. At the conclusion of the research study, the same group of students scored an average of 78.57% on an assessment after Mentimeter had been implemented on a daily basis.

The other group of students were affiliated with teachers who used Mentimeter in their classroom one to two times per week. This group of students scored an average of 57.54% on assessments that were administered prior to the implementation of Technology-based formative assessments. The same group of students scored an average of 71.28% on assessments that were administered after the implementation of Mentimeter in the classroom.

The data suggests that the more frequent technology based formative assessment is used, the greater the level of achievement is. Students that were in classrooms in which teachers used technology based formative assessment more frequently ended up with higher assessment scores when compared to other students that participated in formative assessments less frequently. Students in classes where the teachers used Mentimeter on a daily basis experienced an average increase in scores of 26.19%. Students in classes where the teachers used Mentimeter once or twice a week experienced an average increase in scores of 13.74%. The data suggests that students that received technology based formative assessments on a daily basis achieved scores on assessments that were 12.4% higher on average than of those students who received technology-based formative assessments once or twice a week.

This finding is rather significant as it identifies that a higher level of student achievement can be obtained if this instructional strategy is tightly integrated into the teacher's instructional practices and used on a daily basis. It is imperative that teachers are provided with ample professional development on the effective use of technology-based formative assessment tools like Mentimeter. Without meaningful professional development, teachers will not have the knowledge necessary to effectively use this tool with the students.

Research Question 3

The last research question asked, "Does the use of technology based formative assessment narrow the range of achievement when comparing high scores against low scores?"

Some schools refer to this as the achievement gap. Multiple data sources needed to be analyzed to answer this question. For all assessments that were administered prior to Mentimeter, the researcher had to identify the minimum score obtained for each unique assessment administered, as well as the maximum score obtained for each of those same assessments. The researcher then needed to identify the minimum and maximum scores for assessments that were administered after Mentimeter was implemented.

For each period in time, the range of scores was identified. The average range of assessment scores that were achieved prior to the implementation of Mentimeter was 46.28%. This means that on average, the difference between the lowest score and the highest score on assessments that were administered prior to the implementation of formative assessment was 46.28%.

The average range of assessment scores that were achieved after the implementation of Mentimeter was 32.87%. This means that on average, the difference between the lowest score and the highest score on assessments that were administered prior to the implementation of formative assessment was 32.87%, which is lower than the range of scores from assessments prior to the implementation of Mentimeter.

The data suggests that the range of assessment scores of students decreased after receiving formative assessments. Not only did the range of scores decrease, but the scores themselves also increased simultaneously. There was a 13.41% decrease in overall range. This means that when comparing the range of scores of assessments prior to the implementation of technology based formative assessment against the range of scores of assessments after the implementation of technology based formative assessment, the range of scores decreased. It is important to note that in this case, a lower number is desirable, as the lower a number is, the smaller the achievement gap is.

Fiscal Implications

Mentimeter is a web-based application that allows teachers to quickly engage all students in class and collect feedback from all students at once. A Mentimeter educational basic license will provide teachers with the ability to have an unlimited number of students when presenting, an unlimited number of slides in their presentation, and an unlimited number of quizzes in their presentation. Mentimeter licenses currently cost \$ 83.88 per license. A license is needed for each teacher that will be using Mentimeter. Licenses are not needed for students.

Professional development on the effective use of Mentimeter in the classroom will cost \$2,841.40 per 100 teachers. Training will cover topics including creating quizzes, increasing engagement, and using the application in a digital classroom. This cost will cover 4 sessions of professional development for 25 teachers in each session.

Teachers can participate in professional development on days previously designated as such by the local school district. Paper instructional materials will also be needed for those that express a need for a paper instructional packet. A conference room equipped with a projector, laptop, remote presenter, microphone, and speakers will be needed to facilitate the workshop. In addition, each teacher / participant must have their own device (laptop / tablet) to create and participate in the learning exercises.

Alternative Education Setting

This research study proved to be beneficial in the alternative education setting. It proves that academic achievement increased using technology based formative assessment in an alternative education setting. As shown by the post survey results, most teachers increased their use of technology based formative assessment in the classroom and had a positive outlook of its effectiveness. Even with the impact of COVID-19, the teachers that were willing to participate in the research study took on the challenge and successfully implemented this instructional strategy. When speaking with teachers after the study, it was expressed how valuable the tool was and how much more they felt the students were engaged.

A majority of students grow up with a device in their hands at such a young age but there is such a fight in the educational setting to get and keep these devices in their hands for educational purposes with some staff. It is essential that schools get a dedicated device in every child's hand so they have an equal opportunity to benefit from this amazing chance to grow academically. It is also essential that every teacher get professional development to learn how to implement technology based formative assessment. The challenge always has been, is, and will likely be in the future, when and how to implement the professional development as teachers are already inundated with so much already. In addition, I have seen professional development hours end up on the negotiating table when trying to settle new teacher contracts. Administrators need to continually work with teachers and their union leadership to establish how important professional development is.

To introduce one more initiative to many teachers creates discord and angst among the teachers. The results of this research study could be used to demonstrate that the implementation of technology-based formative assessment is worth the effort and truly does result in increased student achievement. My hope is that the results that were obtained in this research study will give teachers and administrators the confidence they need to implement this strategy and ultimately allow students the achieve higher levels of success.

Future Directions for Research

This research study helped the researcher to uncover valuable data that impacts the alternative education setting at Colonial Academy in regards to academic achievement. This researcher would like to use this information to help expand the strategy to all classrooms in Colonial Academy. This researcher would like to continue to research the effect on academic achievement when using technology based formative assessment and suggests the following research topics.

Suggested Future Research Topics

This researcher feels it would be valuable to conduct this study again when the world is not in a pandemic. The researcher believes that a larger data set (more participants and more teachers) could be involved in a future study and there would be fewer invalid results. Those invalid results occurred due to participants being absent due to COVID-19 as well as schools and classes temporarily closing.

The researcher would like to expand the study to all school districts, and not just to an alternative education setting. This study can easily be applied to all classrooms K-12 in any building. Prior to doing so, the researcher should make sure every child has a device and that teachers receive professional development on technology based formative assessment.

The researcher would like to see what effect a leaderboard has on student achievement as it relates to technology-based formative assessment. Would students be more motivated, more engaged, more focused if they can see a leaderboard and be able to compare themselves to their classmates or would they become more depressed, less engaged, more frustrated? Does it provide enough feedback for the student and are the results meaningful?

Lastly, the researcher would like to identify or measure student engagement and satisfaction. Are students actively engaged more? Do they answer questions and interact more with the teacher and each other? Do they feel like they get more attention than they did prior to introducing technology based formative assessment? Are they more satisfied with the instruction taking place?

Conclusion

This research study supports the need for technology based formative assessment to help grow student academic achievement. This data suggests that Colonial Academy look at implementing professional development for their teachers to learn formative assessment to help children with disabilities improve their academic success.

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Appendix A. IRB Approval Letter

**Institutional Review Board
California University of Pennsylvania
Morgan Hall, 310
250 University Avenue
California, PA 15419
instreviewboard@calu.edu
Melissa Sovak, Ph.D.**

Dear Thomas,

Please consider this email as official notification that your proposal titled “Education Administration and Leadership” (Proposal #19-089) has been approved by the California University of Pennsylvania Institutional Review Board as submitted.

The effective date of approval is 9/19/20 and the expiration date is 9/18/21. These dates must appear on the consent form.

Please note that Federal Policy requires that you notify the IRB promptly regarding any of the following:

- (1) Any additions or changes in procedures you might wish for your study (additions or changes must be approved by the IRB before they are implemented)**
- (2) Any events that affect the safety or well-being of subjects**
- (3) Any modifications of your study or other responses that are necessitated by any events reported in (2).**
- (4) To continue your research beyond the approval expiration date of 9/18/21 you must file additional information to be considered for continuing review. Please contact instreviewboard@calu.edu**

Please notify the Board when data collection is complete.

Regards,

**Melissa Sovak, PhD.
Chair, Institutional Review Board**

Appendix B. Participant Consent Form

Dear Faculty Member,

As an educational professional at the Colonial Academy Alternative Education Program, you are being asked to participate in a research study to examine how the use of technology based formative assessment tools impacts student achievement . Your participation in this study will help the researcher learn how familiar teachers are with formative assessments and how often they use formative assessments in their daily lessons.

What will I be asked to do if I take part in this study?

If you agree to participate in this study, you will be asked to (1) complete one pre Google Form electronic survey questionnaire (2) participate in professional development on formative assessments, (3) use the techniques that you learned in your professional development in the classroom, and (4) complete one post Google Form electronic survey questionnaire.

The pre- and post-questionnaire will ask you questions about your background in teaching and using formative assessments.

Where will this study take place?

The surveys will be available via an online survey tool (Google Forms) using a secure website. Professional development will occur at the Colonial Academy Alternative Education facility. The teaching will occur at Colonial Academy Alternative Education facility.

How long will the study last?

The study is projected to last approximately 8 weeks. Total participation time will vary. The pre- and post-surveys may take up to 30 minutes each or 60 minutes total to complete. Each teaching lesson will vary depending on the class. Each professional development will vary depending on the level of need of the participants.

What happens if I don't want to participate?

Your participation is voluntary; you can choose whether you want to participate in the study or not. There will be no penalty if you choose not to participate.

Can I quit the study before it ends?

You can withdraw from the study at any point by notifying the researcher. There will be no penalty should you choose to withdraw. The researcher will not ask you why you opted to withdraw.

What are the risks?

There is minimal risk involved for the participants, as the pre and post surveys will only seek the participants to rate their knowledge of and frequency of use of technology based formative assessment strategies. Participants are reminded that they are not required to answer any questions of which they choose. Participants can also stop their participation at any time without question.

How will I benefit from participating?

If you decide to be in this study, you will assist the researcher in better understanding whether using formative assessments impacts student achievement.

Will my responses be kept confidential and private?

Identifying information will not be collected from participants. All electronic responses will be password protected and will additionally be protected by two factor authentication. No names or other personally identifying information will be collected or shared. Only the researcher will have access to the responses.

Who do I contact if I have questions about this study?

If you have questions about this study, please contact the researcher, Thomas Kalinoski, at kal1795@calu.edu or at 484-293-1607. If you would like to speak with someone other than the researcher, please contact Dr. Todd Keruskin, Assistant Professor at California University of Pennsylvania, at keruskin@calu.edu.

I have read this form. Any questions I have about participating in this study have been answered. I agree to take part in this study, and I understand that taking part is voluntary. I do not have to take part if I do not wish to do so. I can stop at any time for any reason. If I choose to stop, no one will ask me why.

By signing below, I agree to participate in this study. By doing so, I am indicating that I have read this form and had my questions answered. I understand that it is my choice to participate and I can stop at any time.

Signature:

Date:

Approved by the California University of Pennsylvania Institutional Review Board. This approval is effective 09/19/2021 and expires 09/18/2021.

Appendix C. Colonial Academy Pre-Research Study - Formative Assessment

5/5/2021

Colonial Academy Pre-Research Study - Formative Assessment

Colonial Academy Pre-Research Study - Formative Assessment

The purpose of this survey is to gather information regarding which formative assessment practices teachers use in their respective subject areas and which are found to be most effective. Certainly, no one teacher will find all formative instructional practices appropriate for his or her setting. The information gathered from this survey is for a capstone project and should provide educators with a more realistic understanding of what formative assessment practices fit best into different subject areas. All the information from this survey will be reported anonymously. The responses will be collected using Google Forms and will be password protected. This software will not collect any names, email, or other identifiable information. No one will be able to identify the participant or determine if one did or did not participate in this survey. Participation in this survey is voluntary. Participants can end the survey at any time without consequence. Completing and submitting this anonymous survey will be considered written consent. There are no foreseeable risks to the participant. This survey is just a reflection on educational practices. This survey was derived in part by Dr. Scott Evan Goggin, as a part of his dissertation. Permission to use this survey was secured on July 2, 2020. If you have questions about the survey, please contact Thomas Kalinoski at kai1795@calu.edu. Concerns can also be directed to the Human Subject Review Board at California University of Pennsylvania at jnstreviewboard@calu.edu. This survey should take from 5 to 10 minutes to complete. Thank you in advance for participating in this survey.

* Required

1. I teach students in the following grade band(s). (Select all that apply.) *

Check all that apply.

- Kindergarten - 1st Grade
- Second - Third Grade
- Fourth - Fifth Grade
- Sixth - Seventh Grade
- Eighth - Ninth Grade
- Tenth - Twelfth Grade

2. I teach the following subject(s). (Please check all that apply.) *

Check all that apply.

- Art
- English/Language Arts
- Mathematics
- Music
- Physical Education Science
- Social Studies
- World Language(s)

Other: _____

5/5/2021

Colonial Academy Pre-Research Study - Formative Assessment

3. On average, I teach the following number of students each day: *

Mark only one oval.

- 1 - 20
- 21 -25
- 26 - 30
- 31 - 40
- 41 - 60
- 60 or above

4. The majority of my students can best be described as follows. *

Please choose the single option that generally applies to the highest percentage of your students.

Mark only one oval.

- Typically developing students
- Students identified as needing special education
- Students identified as gifted and talented
- Students identified as second language students
- My students are diverse; there is not a major type of any type.
- Other: _____

5. One a scale of one to five, one being not familiar with formative assessment as all and five being formative assessment is continually integrated into your teaching strategies, how would you rate your familiarity with formative assessment? *

Mark only one oval.

	1	2	3	4	5	
not familiar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	continually integrated into my teaching strategies

5/5/2021

Colonial Academy Pre-Research Study - Formative Assessment

6. My perception of how effective technology based formative assessment is that it will: *

Mark only one oval.

- Have no impact of student achievement
- Have minimal impact on student achievement
- Have moderate impact on student achievement
- Have substantial impact on student achievement
- Have enormous impact on student achievement

7. Please briefly provide your definition of formative assessments. *

8. What technology based tools do you currently use for formative assessment? *

5/5/2021

Colonial Academy Pre-Research Study - Formative Assessment

9. Different teachers implement formative assessment techniques more frequently than other formative assessment techniques. Please indicate how often you implement each of the following formative assessment techniques. (5 - Daily, 4 - Once or twice a week, 3 - Monthly, 2 - Quarterly, 1 - Do not use) *

Mark only one oval per row.

	5 - Daily	4 - Once or twice a week	3 - Monthly	2 - Quarterly	1 - Do not use
I gather real time evidence of student learning simultaneously from all of my students with quick check techniques using clickers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I gather real time evidence of student learning simultaneously from all of my students with quick check techniques using an application in which students can provide feedback.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I adjust the sequence and pacing of my instruction, based upon information gathered from ongoing formative assessments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I target my instruction to learning gaps, misconceptions, or other incomplete understandings identified through formative feedback.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I provide descriptive feedback to my students about their performance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Google Forms

Appendix D. Colonial Academy Pre-Research Study - Formative Assessment

5/5/2021

Colonial Academy Post-Research Study - Formative Assessment

**Colonial Academy Post-Research Study -
Formative Assessment**

The purpose of this survey is to gather information regarding which technology based formative assessment practices teachers use in their respective subject areas and which are found to be most effective after receiving training and given some time to implement them. Certainly, no one teacher will find all formative instructional practices appropriate for his or her setting. The information gathered from this survey is for a capstone project and should provide educators with a more realistic understanding of what formative assessment practices fit best into different subject areas. All the information from this survey will be reported anonymously. The responses will be collected using Google Forms and will be password protected. This software will not collect any names, email, or other identifiable information. No one will be able to identify the participant or determine if one did or did not participate in this survey. Participation in this survey is voluntary. Participants can end the survey at any time without consequence. Completing and submitting this anonymous survey will be considered written consent. There are no foreseeable risks to the participant. This survey is just a reflection on educational practices. If you have questions about the survey, please contact Thomas Kalinoski at kal1795@calu.edu. Concerns can also be directed to the Human Subject Review Board at California University of Pennsylvania at instreviewboard@calu.edu. This survey should take from 5 to 10 minutes to complete. Thank you in advance for participating in this survey.

* Required

1. I teach students in the following grade band(s). (Select all that apply.) *

Check all that apply.

- Kindergarten - 1st Grade
- Second - Third Grade
- Fourth - Fifth Grade
- Sixth - Seventh Grade
- Eighth - Ninth Grade
- Tenth - Twelfth Grade

2. I teach the following subject(s). (Please check all that apply.) *

Check all that apply.

- Art
- English/Language Arts
- Mathematics
- Music
- Physical Education Science
- Social Studies
- World Language(s)

Other: _____

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3. On average, I teach the following number of students each day: *

Mark only one oval.

- 1 - 20
- 21 - 25
- 26 - 30
- 31 - 40
- 41 - 60
- 60 or above

4. The majority of my students can best be described as follows. *

Please choose the single option that generally applies to the highest percentage of your students.

Mark only one oval.

- Typically developing students
- Students identified as needing special education
- Students identified as gifted and talented
- Students identified as second language students
- My students are diverse; there is not a major type of any type.
- Other: _____

5. One a scale of one to five, one being not familiar with formative assessment as all and five being formative assessment is continually integrated into your teaching strategies, how would you rate your familiarity with formative assessment after receiving professional development? *

Mark only one oval.

	1	2	3	4	5	
not familiar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	continually integrated into my teaching strategies

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6. My perception of how effective technology based formative assessment is that it *

Mark only one oval.

- Had no impact of student achievement
- Had minimal impact on student achievement
- Had moderate impact on student achievement
- Had substantial impact on student achievement
- Had enormous impact on student achievement

7. What technology based tools did you use for formative assessment? *

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8. Different teachers implement formative assessment techniques more frequently than other formative assessment techniques. Please indicate how often you implemented each of the following formative assessment techniques after receiving professional development. (5 - Daily, 4 - Once or twice a week, 3 - Monthly, 2 - Quarterly, 1 - Do not use) *

Mark only one oval per row.

	5 - Daily	4 - Once or twice a week	3 - Monthly	2 - Quarterly	1 - Do not use
I gather real time evidence of student learning simultaneously from all of my students with quick check techniques using clickers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I gather real time evidence of student learning simultaneously from all of my students with quick check techniques using an application in which students can provide feedback.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I adjust the sequence and pacing of my instruction, based upon information gathered from ongoing formative assessments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I target my instruction to learning gaps, misconceptions, or other incomplete understandings identified through formative feedback.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I provide descriptive feedback to my students about their performance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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