6-7-2019

Effects of using Google Classroom on teaching math students with learning disabilities

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EFFECTS OF USING GOOGLE CLASSROOM ON TEACHING MATH FOR STUDENTS WITH LEARNING DISABILITIES

by

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A Thesis

Submitted to the
Department of Interdisciplinary and Inclusive Education
College of Education
In partial fulfillment of the requirement
For the degree of
Master of Arts in Special Education
at
Rowan University
May 4, 2019

Thesis Chair: Amy Accardo, Ed.D.

Dedications

I would like to dedicate this thesis to my students who continue to inspire and challenge me to be a better teacher everyday. Your honesty, cooperation, and motivation allowed me to grow in this process, thank you.

Acknowledgements

I would like to express my gratitude and appreciation to Dr. Amy Accardo for her continuous help and patience through this process. She turned a seemingly daunting task into a manageable and enjoyable process.

I would like to thank my family and friends for the constant love and support.

Abstract

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The purpose of this study was to examine the effects of Google Classroom on the outcomes of students with learning disabilities in the mathematics classroom. Specifically, the study evaluated students' organizational skills, student achievement, and student satisfaction. The study included 7 high school students, 4 males and 3 females, in an Algebra 2 resource class. A single-subject ABAB design was used. During the baseline phases, students received Algebra 2 instruction as usual. During the intervention, Google Classroom was implemented to assign, complete, and manage all assignments. Homework and classwork assignments were used to measure student organization while quiz and test grades were used to measure student achievement. These scores were recorded throughout all phases. Results indicate that students improved their organization when Google Classroom was being used. However, student achievement did not show much improvement. The student satisfaction survey suggests that students weren't very passionate about using Google Classroom to complete assignments but preferred it for keeping track of assignments. Further research is suggested to investigate Google Classroom and the effects of organization and achievement for students with learning disabilities.

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Chapter 1

Introduction

The exchange of ideas and information is a continuous focus throughout education. Mathematics classes are much more influential to students when ideas and concepts are investigated through discussion (Walshaw & Anthony, 2008; Webb, 2009). Through understanding the origins and reasons behind mathematical theories, students are better able to develop their math and problem solving skills (Walshaw & Anthony, 2008). It is essential, especially in math intervention, to focus on the connection between math concepts and their meanings for student achievement (Butterworth, Varma & Laurillard, 2011). In 2011, Bowers and Stephens focused on a specific framework, Technology, Pedagogy, and Content Knowledge (TPACK), to analyze the implementation of technology in the mathematics classroom. TPACK's goal is to use technology in the classroom in order to explore mathematical relations. Students utilized technology to explore math concepts, further their understanding, and make connections to real life applications. Technology was further used for students to easily participate in a whole- class discussion through a discussion board. Students were able to reflect on their learning and easily share their insights through the use of technology (Bowers & Stephens, 2011).

Technology comes in many different forms in the classroom and can be used in multiple ways. It is recommended that research on integrating technology in the classroom continue to take place (Li & Ma, 2010). A focus on cognitive and affective outcomes is essential for determining the effects on students' mathematics success (Li & Ma, 2010). Google Classroom is one useful educational tool that makes organization and

participation easier for both the teacher and students. Students have shared their satisfaction with this form of technology in that it is easy to use and communicate with the rest of their class (Hemrungrote, Jakkaew, & Assawaboonmee, 2017). Google Classroom allows teachers to focus their planning on student-centered lessons, allowing students to explore mathematical concepts while promoting discourse among classmates (Hemrungrote et al., 2017).

Statement of the Problem

According to the National Assessment of Education Progress (NAEP) mathematics assessment, the 2015 average mathematics score for twelfth grade students, was lower when compared to 2013 scores. Students with learning disabilities generally fall behind in mathematics when compared to their peers without learning disabilities. In 2015, only 25% of twelfth grade students performed at or above proficient level (NAEP, 2015). The twelfth grade scores in mathematics also showed a significant discrepancy between students with learning disabilities and students without learning disabilities. When comparing the two groups, 26% of students without disabilities scored at or above proficient while only 6% of students with disabilities scored at or above proficient (NAEP, 2015). Unfortunately those who struggle with mathematics as students often continue to face difficulties with mathematics later in life and into adulthood (Butterworth, Varma, & Laurillard, 2011).

It is believed that the development of students' competencies and identities is connected to their engagement with mathematical ideas (Walshaw & Anthony, 2008; Webb, 2009). Mathematics provides students with the tools and strategies necessary to navigate through various aspects of life (Walshaw & Anthony, 2008). Unfortunately, in

the United States, student achievement was low in mathematics when compared to other countries. The 1997 Third International Mathematics and Science Study (TIMSS) showed a decline of academic performance in mathematics in the United States in fourth through twelfth grades (Schmidt & Houang, 2008). In response to this issue, the Common Core State Standards (CCSS) were developed and released in 2010.

The Common Core State Standards for Mathematics (CCSSM) represents a significant shift when compared to other state standards; specifically they place more of an emphasis on specific math topics including measurement in grades 3-6. The CCSSM "involve a modest increase in overall cognitive demand when compared with the average of the state mathematics standards" (Cobb & Jackson, 2011). The high school mathematics standards place emphasis on modeling problems and presenting them in physical, public, social, and everyday situations. They also focus on linking mathematics to common problems faced outside the classroom, highlighting connections to everyday situations and applications (Cobb & Jackson, 2011).

It is believed that the constructivism theory is extremely beneficial in education and learning (Aldoobie, 2015; Li & Ma, 2010). This theory focuses on allowing students to construct and build their own knowledge by making connections to their personal experiences and prior knowledge (Aldoobie, 2015; Li & Ma, 2010). In other words, teachers should develop lessons that are student centered rather than teacher led. Integrating constructivism theory with technology into lessons will have a stronger impact for both the teacher and student (Aldoobie, 2015; Li & Ma, 2010). According to a study conducted by Eyyam and Yaratan (2014) students exposed to educational technology showed an increase in their math performance. In fact, it is recommended

that the use of technology continue to be analyzed with students with learning disabilities. Focusing on the various methods and strategies that can be implemented in the classroom is beneficial to students who struggle with mathematics (Li & Ma, 2010).

There are many different types of technology that can be integrated into the math classroom. For example, Geogebra, Kahoot, Google Classroom, and Kahn Academy just to name a few. Specifically, Google Classroom has become a useful course management program; it is a free web-based program available through Google. Google Classroom allows the teacher to "create assignments, send announcements, and start class discussions instantly, as students can share resources with each other and interact in the class stream or by email" (Hemrungrote et al., 2017). Google Classroom allows students to work through problems and/or assignments at their own pace while still receiving support and guidance when necessary. Google Classroom allows students to become self-directed learners, which according to Hemrungrote, Jakkaew, and Assawaboonmee (2017) produces a learning environment that improves students' knowledge and skills in the subject area.

There have been many studies reviewing the impact of technology in education in general. Many studies have also focused specifically on technology's impact on mathematics education and also its impact on students with learning disabilities. Unfortunately not much has been done on the benefits or influence on Google Classroom in the mathematics class. This study will focus on the impact of Google Classroom in teaching math at the high school level for students with learning disabilities.

Significance of the Study

Integrating technology into lessons allows the classroom environment to be more interactive. Students are able to make connections to other content areas and real-life situations through the use of various forms of technology (Hemrungrote et al., 2017). Researchers have found that the integration of technology into math lessons positively impacted overall student success. More specifically, Li and Ma (2010), found through their analysis that special education students benefitted from the integration of technology in their math classes. In addition the majority of student opinions were positive in regards to the use of technology in their math classes (Eyyam & Yaratan, 2014; Hemrungrote et al., 2017). However, there were still many students who were unsure of their views on technology. Many students were not yet comfortable with this integration since it was not a strategy that was continually used in their class (Eyyam & Yaratan, 2014).

Technology comes in many different forms and with that can be integrated into classes in a variety of ways; Google Classroom is one tool that can be used in different subject areas at various grade levels. Although there is a plethora of research on technology in mathematics classes (Bowers & Stephens, 2011; Eyyam & Yaratan, 2014; Li & Ma, 2010) not much has been done to examine the effects of Google Classroom. It is important that educators continue to analyze the use of technology in their classrooms to gain more insight into its influence with their students.

Purpose of the Study

The purpose of this study is to examine the effects of Google Classroom on the outcomes of students with learning disabilities in the mathematics classroom.

Specifically, this study will focus on high school students in an Algebra 2 resource class. The objectives of the study are to evaluate students' organizational skills in their math class, to evaluate students' achievement in math while using Google Classroom, and to evaluate student satisfaction with using Google Classroom in their math class.

Research Questions

1. Will the use of Google Classroom in high school math classes improve students' organizational skills?
2. Will the use of Google Classroom in high school math classes increase student achievement?
3. Are students satisfied with the use of Google Classroom in their math class?

Chapter 2

Review of the Literature

Mathematics education has gone through a progression over the years moving away from a lecture style of teaching. Experts and theories emphasize the importance of self-guided lessons that allow students to use their own knowledge and experiences to make connections to new ideas (Aldoobie, 2015). Discussions and the exchange of ideas in the classroom are influential to building math and problem solving skills (Walshaw & Anthony, 2008; Webb, 2009). Interactive and hands on activities provide students with a better understanding of the reasons behind a mathematical concept and go beyond the monotonous step by step procedures (Walshaw & Anthony, 2008). The incorporation of technology in lessons allows students to use hands on applications to explore new concepts and develop their own conclusions (Bowers & Stephens, 2011).

This chapter provides a review of the research related to the factors and skills associated with mathematics achievement of students with learning disabilities. A review of the literature reveals that consistent implementation of technology in lessons is effective for many students (Bowers & Stephens, 2011; Eyyam & Yaratan, 2014; Li & Ma, 2010). Studies have also shown that students with disabilities show more growth when multiple interventions are implemented (Gersten et al. 2009; Cobb, Lehmann, Newman-Gonchar, & Alwell, 2009). Google classroom has been proven to be a useful and preferred resource tool in the classroom (Hemrungrote, Jakkaew, & Assawaboonmee, 2017; DiCicco, 2016).

Mathematics Achievement of Students with Learning Disabilities

Butterworth, Varma, and Laurillard (2011) reported that 5-7% of students have developmental dyscalculia, a mathematical disorder that causes difficulty in making arithmetic calculations. This disorder can affect a variety of individuals, from those with normal intelligence and working memory to those who suffer from other developmental disorders, including dyslexia and ADHD (Butterworth et al., 2011). Students with disabilities generally perform lower than their general education peers (NAEP, 2015). The 2015 National Assessment of Education Progress (NAEP) results showed that only 6% of students with disabilities scored at or above proficient, while 26% of students without disabilities scored at this level. There is a clear discrepancy in mathematics between students with learning disabilities and students without learning disabilities.

To address the achievement gap in mathematics between general education and students with learning disabilities, Gersten et al. (2009) conducted a meta-analysis on instructional approaches that increase math performance of students with learning disabilities. A total of 42 intervention studies were assessed, all which focused on students with learning disabilities in mathematics. Many of the studies analyzed two or more instructional components. Each component was first reviewed for its effectiveness on its own before comparisons of strengths and weaknesses were made with the remaining instructional strategies. Results reported by Gersten et al. (2009) confirm that several instructional strategies helped improve mathematics achievement in students with learning disabilities. These strategies included explicit instruction, student verbalization of thinking, on-going feedback, and visual representations. There were only two instructional components that did not show a significant effect on student achievement,

self-analyzing goals by students and peer-assisted learning. Gersten et al. (2009) suggests the use of multiple instructional strategies to help improve specific problem areas, such as problem solving, in students with learning disabilities.

In a study conducted by Allen, Pianta, Gregory, Mikami, and Lun (2011) it is suggested that students learn best through interaction with both peers and teachers. The study focused on 78 secondary teachers from 12 different schools with students between 11 and 18 years old and the use of the coaching program My Teacher Partner-Secondary (MTP-S) program. This program is part of the Teaching Through Interactions framework that focuses on the significance of student-teacher interactions and its influence on student achievement. Specifically, the MTP-S program aims at analyzing the quality of motivational and instructional daily interactions of teachers with students (Allen et al., 2011). Participants of this study contributed for 13 months using MTP-S and were randomly placed into two groups, either the intervention group or the control group. After a year, teachers that were part of the intervention group were observed for their interaction qualities in the classroom (Allen et al., 2011). The results from this study suggest that improvement in student achievement, with disregard to subject matter, is influenced by positive, effective teacher-student interaction in the classroom. (Allen et al., 2011). Allen et al. (2011) reported that student's did not show significant growth until after the intervention year, indicating that it takes time for change to occur in both the teacher and the classroom setting. Teachers had to first focus on their own growth with interaction in their classrooms before students could truly benefit from this intervention. The study suggests that interaction plays a major role in education and, in addition, interventions must be analyzed over a significant amount of time to show its

influence. The results from this study advise educators to focus on their growth in the classroom and adjusting to a given intervention prior to analyzing their students' growth (Allen et al., 2011).

Butterworth et al. (2011) go on to suggest that a focus in the connection between mathematical facts and their meanings is essential in intervention; students with disabilities benefit most when they are able to connect new ideas to their own background knowledge and individual skills. This can be accomplished my promoting teacher-student interaction throughout lessons as suggested by Allen et al. (2011). Daily discussions and interactions were noted as successful by Allen et al. (2011) and support the recommendations of Butterworth et al. (2011) in allowing students to be more active in their learning.

Organizational Skills of Students with Learning Disabilities

Cobb, Lehmann, Newman-Gonchar, and Alwell (2009) analyzed seven narrative and systematic reviews on self-determination for individuals with disabilities. Self-determination is achieved through communication to maintain control of one's life and actions. Evidence suggests that students with disabilities who posses strong self-determination skills will have a better quality of life (Cobb et al., 2009). Cobb et al. (2009) found that multicomponent self-determination interventions had a stronger impact than single component interventions. In alignment with Cobb et al. (2009), Getzel and Thoma (2008) confirm that self-determination is necessary for a successful future. Getzel and Thoma (2008) further explored self-determination focusing on specific skills used by college students with disabilities to maintain academic success. This study used focus groups with a semi-structured interview process, consisting of 34 student

participants with learning disabilities, ranging from 18 to 48 years old. Self-management, self-awareness, problem solving, goal setting were some of the skills that participants believed helped them to maintain their success at the college level (Getzel & Thoma, 2008).

Dexter and Hughes (2001) conducted a meta-analysis analyzing 16 articles with 808 students with learning disabilities ranging from grades 4 through 12. The study focused on the use of graphic organizers to teach core content classes including English, science, social studies, and mathematics. Dexter and Hughes (2001) found that students with learning disabilities performed significantly better on their post-test when taught with graphic organizers. The evidence from the study suggests that graphic organizers are most beneficial for assisting students who lack prior knowledge and to make connections between facts and ideas. Graphic organizers help students with learning disabilities to organize information with both basic and higher-level skills (Dexter & Hughes, 2001). In addition, this study found that when complicated graphic organizers were combined with intensive teacher instruction, students benefited the most for immediate factual recall. Dexter and Hughes (2001) suggest that graphic organizers can help improve inference skills and relational knowledge of students with disabilities. It is necessary for teachers to explicitly teach their students how to use each graphic organizer in order for the intervention to be effective (Dexter & Hughes, 2001).

Langberg, Epstein, Urbanowicz, Simon, and Graham (2008) examined the efficacy of an 8-week organization skills intervention for children with ADHD. The study took place in an Ohio school district with 37 student participants with ADHD, 31 boys and 6 girls, from grades four through seven (Langberg et al., 2008). Students were

broken up in to two groups, treatment or wait-list control. Students in the treatment group received organization and homework management interventions for 8 weeks, two days per week during an after-school program. Each student received 20 minutes of individual intervention time and 55 minutes of group intervention each day. A follow-up evaluation was conducted 8 weeks after the completion of the intervention. Once the treatment group completed their eight weeks, the wait-list control students began the same 8-week intervention (Langberg et al., 2008). Student performance was measured in areas of physical organization and homework recording. Langberg et al. (2008) found significant improvements in these areas during the intervention and in the follow up evaluations, which also influenced academic performance. The evidence from this study confirms that targeted interventions have the potential to improve academic performance (Langberg et al., 2008).

Studies have shown that organization plays an important role in a student's academic success (Langberg et al., 2008; Dexter & Hughes, 2001). Students must learn how to properly organize information and use the resources associated with this skill. Graphic organizers and interventions geared at organization have been proven successful for students with disabilities (Langberg et al., 2008; Dexter & Hughes, 2001).

Technology as an Instruction Tool in the Mathematics Classroom

According to Aldoobie (2015) the constructivism theory is an essential theory in all aspects of education. Rather than lecturing and reiterating information, teachers should allow students to use their own knowledge, experiences, and methods to further build upon their understanding (Aldoobie, 2015). Aldoobie (2015) reports that constructivism theory has been easily adapted for the integration of technology into the

classroom. It is emphasized that technology must be used in a meaningful way that allows students to build meaning by collaborating and engaging with classmates (Aldoobie, 2015).

Bowers and Stephens (2011) conducted a case study on Technological Pedagogical Content Knowledge (TPACK) with prospective teachers and the varying technological strategies that they use to explain certain mathematical topics. The study took place at a university in the United States in a 6-week course and its goal was to focus on using Geometer's Sketchpad to both teach and learn mathematics concepts with prospective teachers. The case study consisted of 21 students. Of these students two were statistics majors who were not interested in teaching, the rest were prospective teachers with 16 in mathematics, two liberal studies, and one science (Bowers & Stephens, 2011). The instructor of the course used student's final project to examine their growth in the class and in using TPACK. For the final project, students developed a lesson incorporating Geometer's Sketchpad to investigate a chosen mathematical concept. Bowers and Stephens (2011) reported that 55% of the final projects demonstrating technological knowledge were from prospective mathematics teachers. There were only three students who demonstrated the full use of TPACK in their projects. The results from this study suggest that teachers must take a different approach towards lesson planning when applying TPACK towards mathematics. Bowers and Stephens (2011) propose that this study be used for consideration in future mathematics education classes when focusing on the TPACK guidelines to promote and teacher the effective and appropriate use of technology.

Eyyam and Yaratan (2014) investigated the effects of technology in a mathematics class, focusing on student achievement and their views towards this implementation. This study took place in a school setting with seventh grade students. An experimental approach was taken and, randomly, three classes were assigned to the experimental group and two classes were assigned to the control group. The experimental group teachers were provided with instructional technology to use while teaching while the control groups continue with traditional methods for teaching (Eyyam & Yaratan, 2014). To measure student growth, a pretest and posttest was given. Both tests had ten questions in an open-ended format and covered the same mathematical topics. The data from this study, specifically the mean results of student progress, showed that the experimental groups performed better than the control groups (Eyyam & Yaratan, 2014). Eyyam and Yaratan (2014) report that the majority of students did not have a strong opinion about the use of technology in their lessons. However, almost half of the students preferred the use of technology in their math classes. Since student attitudes toward technology were indecisive Eyyam and Yaratan (2014) suggest that technology be consistently integrated into lessons to build comfortableness and familiarity among students.

In 2010, Li and Ma conducted a meta-analysis on the influence of computer technology (CT) on mathematics education in K-12 classes. Li and Ma (2010) focused on 46 primary studies with a total of 36,793 students. They found that CT in the mathematics classroom had a positive effect overall. Evidence suggests that mathematics achievement when using CT was higher at the elementary level when compared to the secondary level. In addition, special education students showed more growth in

mathematics than general education students (Li & Ma, 2010). Li and Ma (2010) suggest continuing research on this topic with a focus on experimental design with larger sample sizes.

In alignment with Aldoobie (2015), Li and Ma (2010) reported that when CT was integrated with a constructivist approach, students showed more progress than when compared to traditional methods of teaching mathematics. Technology integration impacts both the teacher and students; students become more active and responsible for their learning while teachers learn to adapt their teaching style around student-centered lessons (Aldoobie, 2015). It is recommended that research on the use of technology in mathematics be continued to better understand its impact in different environments and populations (Bowers & Stephens, 2011; Eyyam & Yaratan, 2014; Li & Ma, 2010).

Incorporation of Google Classroom as an Instructional Tool

Hemrungrote, Jakkaew, and Assawaboonmee (2017) examined the outcome of using Google Classroom and its effect on students' self-directed learning (SDL) skills. Google Classroom is a free web-based application that allows instructors to manage class resources and assignments (Hemrungrote et al., 2017). The study took place at a university in Thailand with 3,315 students enrolled in Introduction to Information Technology course in the fall semester of 2015. The focus of this study was the effects of student grades, motivation, on cognitive SDL improvement. Students' satisfaction with using Google Classroom was also analyzed (Hemrungrote et al., 2017). To measure student satisfaction, Hemrungrote and colleagues sent out a satisfaction survey to students that focused on efficiency and benefit, web design, and user support and services. Although the data does not indicate an increase in student grades, the majority

of students showed satisfaction in the implementation of Google Classroom in the course (Hemrungrote et al., 2017).

DiCicco (2016) found similar results to Hemrungrote et al. (2017) when implementing Google Classroom in a middle school social studies class. This study focused on six, male seventh grade students in a middle school in New Jersey. All students who participated in the study had an IEP and data was collected on test scores, vocabulary quizzes, and student and teacher satisfaction (DiCicco, 2016). DiCicco (2016) presented the intervention (Google Classroom) to her students in three phases. Students first learned two units without the intervention, then the next two units were taught with the intervention, and the third phase focused on maintenance without the use of the intervention. DiCicco (2016) reports that Google Classroom did not have much of an impact on students' overall achievement in social studies. Although vocabulary scores improved, other test scores did not improve. It was also found that teachers were satisfied with implementing Google Classroom to assign videos and questions but had concerns about whether it would actually help increase test performance. DiCicco (2016) aligns with the results of Hemrungrote et al. (2017) in regards to student satisfaction with Google Classroom. Students had a positive attitude towards Google Classroom, they enjoyed accessing class materials, playing educational games, and interacting with their peers through the program (DiCicco, 2016).

Google Classroom allows teachers to implement lessons using multiple instructional strategies, which as suggested by Gersten et al. (2009) is proven beneficial for students with disabilities. Evidence suggests that Google Classroom has a positive impact on student motivation and satisfaction (Hemrungrote et al., 2017; DiCicco, 2016).

Consistent incorporation of Google Classroom allows lessons to become student led, helping to create more independence. Students learn how to integrate the skills from the course into other courses in their education (Hemrungrote et al., 2017).

Using Google Classroom in the Mathematics Classroom

It is believed that students with disabilities benefit from the use of multiple instructional strategies when learning mathematics (Gersten et al., 2009; Cobb & Jackson, 2011). Google Classroom provides teachers with a platform to easily integrate multiple strategies and representations of a single concept. Allen et al. (2011) proposed that promoting positive interaction in the classroom plays a major role in student achievement. Google Classroom allows teachers to create discussion boards and posts, so that even the shyest of students can become more confident with participating in mathematical discussions. While there is immense research on mathematics achievement (Allen, 2011; Gersten et al., 2009; Butterworth, 2011) and the impact of technology integration in the classroom (Aldoobie, 2015; Bowers & Stephens, 2011; Eyyam & Yaratan, 2014; Li & Ma, 2010) with students with disabilities, there is still more to be done focusing solely on Google Classroom.

Conclusion

Aldoobie (2015) suggests that educators apply the constructivist theory to their lessons in conjunction with technology. This theory has a greater impact on students because it focuses on the individual student applying their own knowledge and experiences to new ideas. The incorporation of technology helps educators to promote this theory offering students the ability to collaborate and engage in various activities (Aldoobie, 2015). Li and Ma (2010) reported that students with disabilities benefit more

from the use of technology when compared to general education students. Overall, students have shown satisfaction with the use of technology in the classroom (Eyyam & Yaratan, 2014; Li & Ma, 2010).

Students with disabilities have shown improvement when multiple interventions are used in the classroom (Gersten et al., 2009; Cobb & Jackson, 2011). Google Classrooms allows teachers to easily post assignments, discussions, and links to various resources. This helps to create an interactive classroom that promotes student independence (Hemrungrote et al., 2017). DiCicco (2016) incorporated Google Classroom with the expectation of improving student achievement in a social studies resource class. Students showed growth in their vocabulary scores while test scores showed little change. This study showed that both students and teachers were satisfied with implementation of Google Classroom (DiCicco, 2016).

Unfortunately, there is a lack of research on the implementation and effects of Google Classroom in mathematics resource classes. Further research is necessary to understand the true effects of Google Classroom in the mathematics classrooms. Li and Ma (2010) believe that there have not been enough previous studies on technology integration to make accurate conclusions on student attitudes. DiCicco (2016) suggests that further research on Google Classroom should focus on a longer time period of instruction in order to better understand its academic impact. This study aims to examine how the use of Google Classroom effects mathematical achievement and organization of students with disabilities in an Algebra II resource setting.

Chapter 3

Methodology

Setting

School. The study took place in a high school located Central New Jersey on a 260-acre campus. The high school is part of a youth services organization that provides services to at risk-youth struggling with therapeutic and social issues. These services include educational, residential, and recreational programs. The high school is a state-approved, private, non-profit school for students with disabilities whose needs cannot be met within the public school. Students who may benefit from the program include those who struggle with depression, anxiety, socialization isolation, oppositional/defiant behavior, school refusal, and mood, attention, or adjustment difficulties. All students at the high school receive counseling weekly and are assigned to a specific counselor that helps them engage in a challenging educational curriculum. The school serves students from grades 9 through 12 who are from various districts throughout the state of New Jersey.

There are a total of 160 students in the high school, 79% of students are white, 8% are Hispanic, 8% are African American, and 4% are Asian. These numbers are constantly changing with discharges, readmissions, and new admissions happening weekly. The high school is an out-of-district placement so students come and go from the high school based on their own needs, their district's willingness to fund their placement, and other related reasons.

Classroom. The classroom where the study took place is used for Math resource classes by one teacher. The classroom consists of one teacher desk and 9 student desks. The student desks are arranged in a "U" shape that faces the front of the room. There is one teacher computer that is connected to an overhead projector and interactive Smart Board. There is also a set of seven Google Chrome Books that remain in the classroom.

The study was conducted in one of the school's Algebra II resource classes. The class is held every day during period 2. There is one student in the class who has a one-to-one teacher aide.

Participants

Students. The study included seven students in grades 10 through 12, three females and four males. These students were determined eligible for special education services under a variety of classifications including: multiply disabled, other health impaired, and emotionally disturbed.

Table 1

General Information of Participating Students

Student	Age (Years)	Grade	Classification	*STAR Math Score
A	16	11	Other Health Impaired	908
B	16	10	Emotionally Disturbed	870
C	18	12	Emotionally Disturbed	883
D	17	11	Multiply Disabled	880
E	16	11	Multiply Disabled	802
F	17	11	Emotionally Disturbed	817
G	16	10	Emotionally Disturbed	877

*STAR: computer-adaptive assessment by Renaissance Learning to evaluate student performance. These are student's scores from the beginning of the school year (September 2018). A score above 815 is considered at/above benchmark.

Participant 1. Student A is a 16-year-old, 11th grade Caucasian female. She is eligible for special education services under the classification Other Health Impaired. In the past this student struggled with school refusal caused by anxiety and depression disorders. Academically, this student shows consistency and engagement in class. She is very responsible with assignments and excels in math. She catches on quickly to new topics and benefits from modeling of new topics. Student A never hesitates to ask a question when confused and advocates for herself on a daily basis. She also has great insight in mathematics and is able to come to her own conclusions about new topics.

Participant 2. Student B is a 16-year-old, 10th grade Hispanic male. Spanish is his native language and is spoken at home. He is eligible for special education services under the classification Emotionally Disturbed. This student was bullied in middle school, which led to depression, suicidal ideation, and school refusal. Academically, this student has consistently performed well throughout the year. However, he can be easily confused at first with new concepts. His confidence grows through practicing and asking questions. He is responsible with assignments and comes in with questions on homework almost daily. He is very respectful of both his teacher and peers and enjoys working with others. This student can be quick to ask for help and many times just needs to take a step back and consider what he already knows. Student B enjoys being active, he is on the school's soccer and basketball teams.

Participant 3. Student C is an 18-year-old, 12th grade Caucasian female. She is eligible for special education services under the classification Emotionally Disturbed. She is an average student who in the past struggled with consistent attendance due to mood and anxiety disorders. Student C is an active learner and asks questions throughout a lesson whenever she is confused. She is able to communicate about what exactly she is confused about; many times simply repeating or rephrasing is helpful for her. Student C is an overall responsible student who never rushes to complete an assignment. This student often lacks confidence in her work and will tell me she failed a quiz when she actually earned an A. She is a member of the Model UN chapter at the school. She plans to attend a two-year community college after graduating in June.

Participant 4. Student D is a 17-year-old, 11th grade Caucasian male. He is eligible for special education services under the classification Multiply Disabled, which includes PDD-NOS, ADHD, and a Specific Learning Disability for reading. This student is energetic, intelligent, a logical thinker, and engaging. When tested, this student scored in the high average range on Broad Math ability. However, this student can struggle behaviorally, losing focus from the lesson, calling out with off topic conversation, and making inappropriate comments. He receives OT services, speech language services, and assistance with navigating peer relationships; a one-on-one teacher aide is present with him in this class. His aide redirects him when he loses focus, helps him to be organized, and reminds him of his goals. This student has a high interest for math and enjoys when we incorporate technology into lessons because it allows him to further explore. He uses logical thinking to come to conclusions about new topics with little probing from the teacher. He enjoys puzzles, especially Sudoku and Rubik's cube.

Participant 5. Student E is a 16-year-old, 11th grade Caucasian male. He is eligible for special education services under the classification of Multiply Disabled, which includes ADHD, depression, and mood disorders. Academically, this student lacks the motivation to be consistently productive in class; he often needs re-direction and assistance to initiate most tasks. He benefits from direct instruction and modeling of new topics. It is beneficial for him to use practice problems done has a class as a reference when working independently. This student is not always responsible with assignments; much of his homework is incomplete and he does not always make up assignments. However, when he is focused and motivated, this student shows good insight into new concepts and can easily recall previously learned topics. He is an active

member of the school community and is a member of the soccer team and involved in the school's musical. He has expressed interest in joining the Armed Forces when he graduates.

Participant 6. Student F is a 17-year-old, 11th grade Caucasian male. He is eligible for special education services under the classification of Emotionally Disturbed and struggles with an anxiety disorder. This student is consistently attentive in class and asks questions when necessary. He can become easily overwhelmed at first with new topics; guided notes and example problems are beneficial to his learning. This student can easily recall previously learned Algebra concepts. He consistently participates in class lessons and discussions but some days can be very quiet if he is feeling anxious. He is currently involved in the school's musical. His interests include drawing, writing, and graphic arts; he plans to attend art school after graduating next year to pursue a career in graphic arts.

Participant 7. Student G is a 16-year-old, 10th grade Caucasian female. She is eligible for special education services under the classification of Emotionally Disturbed. She has been diagnosed with depression, social anxiety, and mild Autism Spectrum Disorder. This student has shown some inconsistencies throughout the school year in regards to participation and engagement. She usually begins class very strong and fully engaged and after about a half hour loses the motivation and says her "brain is mush and can no longer do math." This student has good insight for math and when she is unsure of something, uses her previous knowledge to solve problems. Student G has a good sense of humor and is kind to her classmates, always offering support and words of encouragement. However, she can often lose track of assignments and doesn't always

hand in complete homework. She is a student who is satisfied with passing grades but could easily earn A's all year if she pushed herself a bit more. She is a creative person who enjoys art and video game design; she is a member of the school's musical. After graduating she plans to attend a trade or technical school.

Teacher. The teacher taught math for six years at various grade levels including subjects Algebra I, Geometry, and Algebra II. The teacher has been teaching at this school and in the resource setting for two years, previously working in inclusion settings in public schools. In this study, only the teacher provided instruction.

Instructional Materials

Chromebook. A Chromebook is a personal laptop computer used to search Internet resources and used applications stored in the cloud. The class has a set of 7 Chromebooks that remain in the classroom and are stored in a chargeable cart.

Google Classroom. Google Classroom is a free paperless application that is available to anyone with a Google account. Other Google programs including Google Docs, Google Forms, and Google Presentation work with Google Classroom. Google Classroom provides teacher with an online classroom to create, distribute and grade assignments. It allows teachers and students to communicate in a paperless manner. Google Classroom can be accessed from anywhere, allowing students to complete assignments and check their progress at anytime.

Handouts. Various printed handouts were given to students during the Baseline, or Phase A. These included: graphic organizers, guided notes, practice worksheets (classwork/ homework), quizzes, and tests. During Intervention, or Phase B, electronic

handouts from Google Classroom were given which included: exit tickets (Google forms), graphic organizers, practice worksheets, and guided notes.

Measurement Materials

To measure student's performance a variety of assessments were used. These included quizzes and tests. To measure student's organization, completion of classwork and homework assignments was examined. A survey was given to students to measure their satisfaction with Google Classroom.

Quizzes. Quizzes were given in two forms: as short "mini" quizzes with 2-4 questions on one topic or quizzes focusing on more than one section with about 10-15 questions. During Phase A, quizzes were given in a paper format. During Phase B students completed the quizzes as a Google Form while using scrap paper to write down their work. Scrap paper was collected but only looked at to examine incorrect errors.

Tests. Tests were given twice within each unit: Graphing Quadratics, Solving Quadratics, Graphing Polynomials, and Solving Polynomials. Each test contained only open-ended questions and was given on paper. Each test was a total of 100 points.

Homework/classwork assignments. Homework and classwork assignments were given on a daily basis. These assignments consisted of a set of problems that focused on the concept from the day. After a topic was introduced, discussed, and practiced as a class homework and/or classwork was assigned. Students were expected to complete these assignments independently, utilizing class resources and the teacher for help as needed. Homework and classwork was not graded for correctness but rather completeness; the teacher prefers the students to focus on practicing the new concept

rather than worrying about being correct. Homework and classwork assignments were reviewed in class where the students were able to ask questions and check their answers.

Student survey. The survey included 16 questions based on using Google Classroom and students' opinions regarding various aspect of its use. All questions were developed in a Likert scale of 1 to 5 with 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree.

Statements	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1
1. Liked using Google Classroom to learn math					
2. Google Classroom helped me to be more organized					
3. Google Classroom was easy to use					
4. I prefer using Google Classroom					
5. I liked doing notes and Exit Tickets on Google Classroom compared to writing them on paper					
6. I liked doing discovery activities on the Classroom board compared to the old way of writing them on paper.					
7. I felt more comfortable in interacting with my classmates and teacher					
8. I liked listening to music while working					

Figure 1 (continued)

9. Writing on the Google Classroom was better than paper notes
10. Google Classroom made handing in assignments easier
11. Google Classroom helped me to be more aware of my missing/ incomplete assignments
12. Google Classroom helped me find the appropriate links needed (Kahoot, Kahn academy, desmos, etc.)
13. My grade increased because of Google Classroom
14. Google Classroom helped me become more aware of the math content
15. Playing games helped me learn
16. I utilized the resources provided by the teacher to assist with assignments

Figure 1. Student Satisfaction Survey

Research Design

The research study utilized a single-subject ABAB design. This study explored the effect of the independent variable, Google classroom, on the dependent variables of student organization and achievement in mathematics. The organization skills and achievement of students were measured throughout the study. During Phase A, instruction and class routines remained the same. This happened over a three-week

period and baseline data was collected to establish students' current math levels. Several data points were collected; majority of data came from student grades, in particular quiz and test scores. Assignment completion during this phase was also documented and recorded. Also, students took the STAR assessment, through Renaissance, which provided insight into student's current math knowledge and capabilities.

During Phase B, Google Classroom was introduced and implemented into the majority of weekly lessons. Students participated in this intervention for three weeks and progress was collected and recorded throughout. Again, student scores from tests and quizzes as well as assignment completion was be looked at.

During the second Phase A, Google Classroom was not used and students returned to baseline conditions for two weeks. During the second Phase B, Google Classroom was reintroduced for two weeks. Data was collected for each phase. At the end of the thirteen weeks, students took the STAR assessment again and results from both tests were compared. Students were also asked to fill out a Likert scale about their satisfaction with Google Classroom.

Procedures

This study took place over the course of 10 weeks, beginning the last week of January 2019 and ending the first week of April 2019. During the first three weeks, instruction continued as normal. The teacher used guided notes, activities, and homework/classwork assignments in the form of paper. Baseline data was collected during this time on students' homework/classwork completion and test and quiz grades. Students participated in class through whole class discussions and asking questions. Activities and assignments were all done with pencil and paper.

Weeks 4-6 were intervention weeks and Google Classroom was introduced and expectations were explained. The teacher kept instruction the same but the delivery of assignments and lessons was all done through Google Classroom. Students would log in at the start of class and find the day's agenda. Class notes and activities were all assigned through Google Classroom and students were expected to hand in their work through this platform. For each new lesson, the teacher shared various instructional videos. Students would watch the videos, take their own notes, and participate in discussion with their classmates via Google Classroom. Activities through Google Classroom utilized various interactive math applications and websites such as Desmos and Geogebra. Mini quizzes were given through Google Forms. However, other quizzes and tests were still given on paper during this phase. Again, data was collected during this time on students' homework/classwork completion and test and quiz grades.

Weeks 7-8 returned back to the baseline conditions with traditional instruction and the use of paper instructional materials and assignments. Weeks 9-10 went back to intervention conditions and using Google Classroom to create, assign, and collect assignments. At the end of week 10, students were asked to complete an anonymous survey regarding their satisfaction with the use of Google Classroom to learn math.

Measurement Procedures

Organization. Student organization was measured based off their completion of classwork and homework assignments. These assignments were all worth 5 points each. If students did not hand in an assignment a 0 was given; if the assignment wasn't fully completed then partial credit was given accordingly. Students who have good organizational skills are able to keep track of their missing or incomplete assignments

and make these up in a timely manner. Students who struggle with organization generally have many incomplete assignments and do not make them up consistently.

Student achievement. Student achievement was measured by collecting data on students' quiz and test grades. All tests, which were given twice per unit for a total of four tests, were given in a paper format and were worth 100 points each. Quizzes were given in a variety of formats. During the intervention phases mini quizzes, that contained only 2-4 questions and covered only one topic, were given via Google Classroom through Google Forms. Mini-quizzes were given for each new topic. Other quizzes, which covered more than one topic with about 10-15 questions, were given via paper during both the baseline and intervention phases. For both quizzes and tests, students were required to show all their work in an organized manner. Students worked independently and were allowed to ask questions for clarification or rephrasing.

Student satisfaction. Student satisfaction with Google Classroom was measured through the use of a survey. The survey was given through Google Classroom via Google Forms. The survey used a Likert scale to measure their satisfaction with various aspects of Google Classroom. Students were encouraged to answer each question honestly; results were submitted anonymously. Students answered 16 questions with a rating of 1-5 with 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree.

Data Analysis

Survey results were compiled and reported in a table. Students' quiz grades, test grades, and homework/classwork points were recorded and entered in a spreadsheet. The scores gathered from the students' test and quiz grades were all converted into percentages. The same was done to the data collected from students' classwork and

homework grades. The data from these variables are displayed in visual line graphs. Results were compared between the baseline and intervention phases. Mean and standard deviations for student grades and homework completion were calculated. A comparison of results between the baseline and intervention phases helped to determine the effects of using Google Classroom in an Algebra II resource classroom.

Chapter 4

Results

Organizational Skills

Research question one asked if the use of Google Classroom in high school math classes would improve students' organizational skills. Student organization was measured based off their completion of classwork and homework assignments. These grades were converted into percentages. Table 2 shows the individual means and standard deviation of students' homework and classwork grades with and without using Google Classroom.

Table 2

Homework and Classwork Grades

	Baseline 1(A)		Intervention 1(B)		Baseline 2(A)		Intervention 2(B)	
	Mean %	SD %	Mean %	SD %	Mean %	SD %	Mean %	SD %
Student A	60.0	37.4	80.0	40.0	55.0	39.4	75.0	43.3
Student B	56.0	36.1	70.0	40.0	41.2	31.2	50.0	50.0
Student C	46.0	40.8	70.0	40.0	50.0	40.8	57.5	40.0
Student D	32.0	26.4	54.0	44.5	63.3	45.0	63.8	39.6
Student E	47.0	33.7	40.0	37.9	36.7	26.2	60.0	39.4
Student F	66.0	37.2	84.0	18.5	50.0	40.8	62.5	41.5
Student G	58.0	31.2	90.0	12.6	16.7	23.6	57.5	37.7

Homework Completion

Student A. During the first baseline, Student A's mean homework completion score was 60%. Student A's mean score increased to 80% during the first intervention phase. During the second baseline, her mean score fell to 55% but rose again during the intervention phase to 75%. Her standard deviation throughout was consistent, ranging between 37 and 43. It actually rose slightly from baseline to intervention phases. Student A's homework completion data is shown in Figure 2.

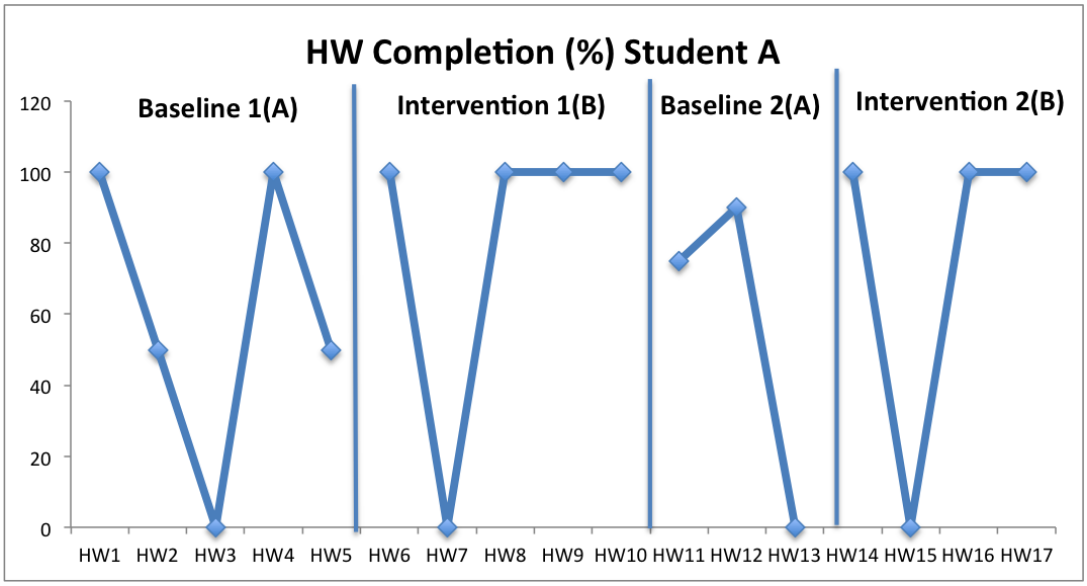

Figure 2. Homework Completion Scores Student A

Student B. During the first baseline, Student B's mean homework completion score was 56%. Student B's mean score increased to 70% during the first intervention phase. During the second baseline, his mean score fell to 41.7% but increased again during the intervention phase to 50%. His standard deviation increased between baseline

and intervention phases. During the first set of phases it went from 36.1 to 40 while during the second set of phases it went from 31.2 to 50. Student B's homework completion data is shown in Figure 3.

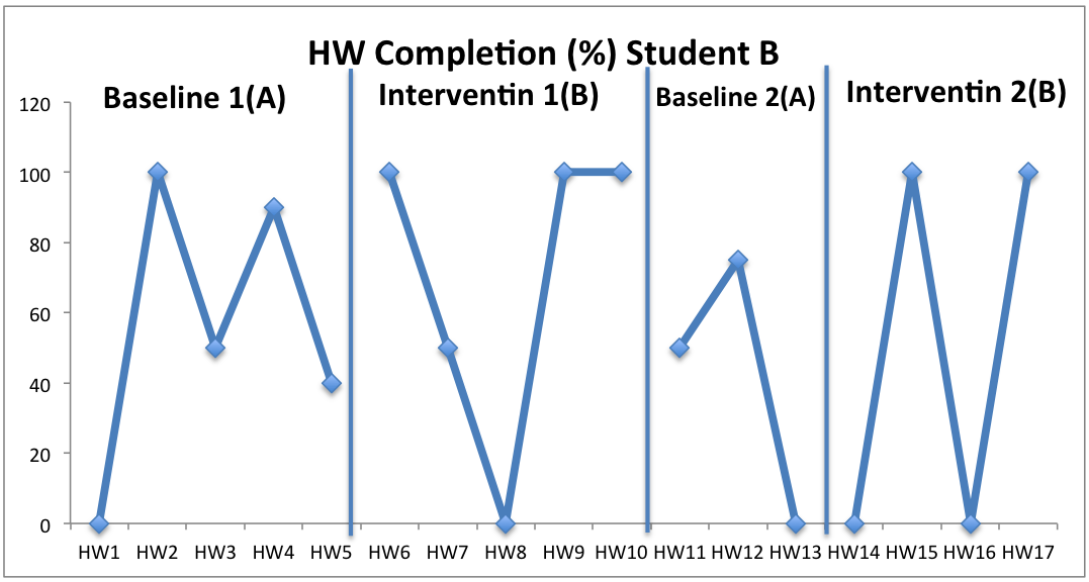

Figure 3. Homework Completion Scores Student B

Student C. During the first baseline, Student C's mean homework completion score was 46%. Student C's mean score increased to 70% during the first intervention phase. During the second baseline, her mean score was 50% and only slight increased during the intervention phase to 57.5%. Her standard deviation remained pretty consistent between phases. It was 40.8 and 40 for both the first baseline and intervention phases, respectively. It slightly decreased between the second baseline and intervention phases going from 40.8 to 37. Student C's homework completion data is shown in Figure 4.

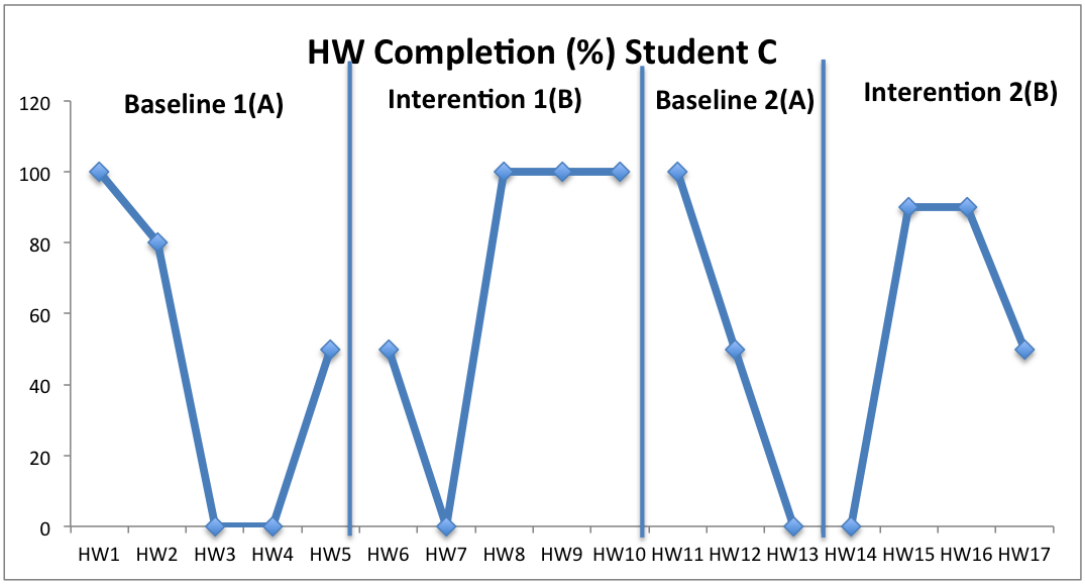

Figure 4. Homework Completion Scores Student C

Student D. During the first baseline, Student D's mean homework completion score was 32%. Student C's mean score increased to 54% during the first intervention phase. His mean score continued to increase but remained consistent between the second baseline, with 63.3%, and the second intervention, with 63.8%. His standard deviation was inconsistent between phases. It was 26.4 for the first baseline and increased to 44.5 for the first intervention phase. The standard deviation was 45 for the second baseline and then slightly decreased to 39.6 for the second intervention phase. Student D's homework completion data is shown in Figure 5.

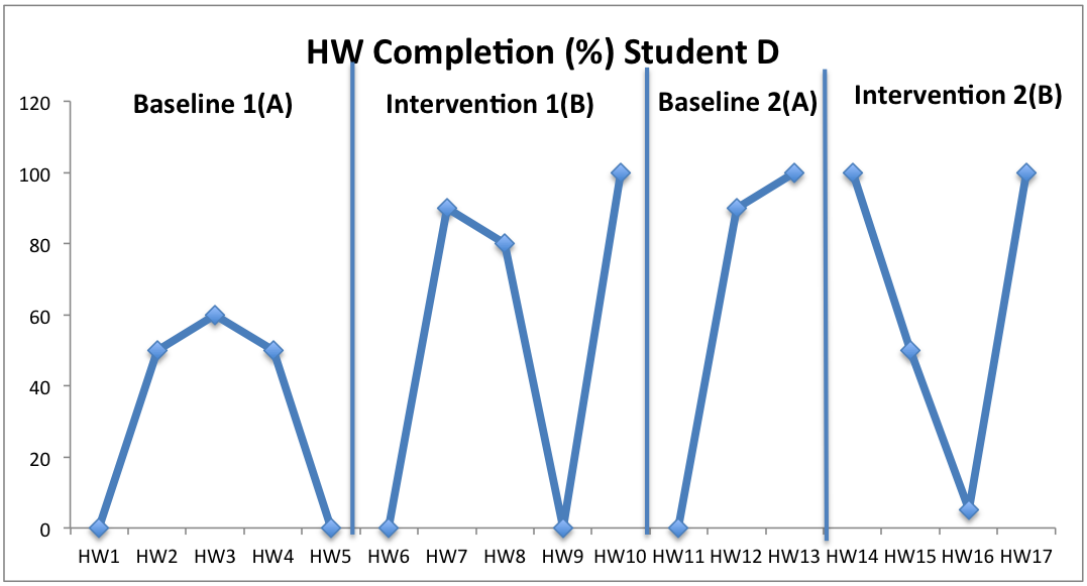

Figure 5. Homework Completion Scores Student D

Student E. During the first baseline, Student E's mean homework completion score was 47%. Student E's mean score decreased to 40% during the first intervention phase. His mean score slightly increased during the second phases. It was 36.7% during the second baseline phase and 39.4% during the second intervention. His standard deviation increased between phases. It was 33.7 for the first baseline and increased slightly to 37.9 for the first intervention phase. The standard deviation was 26.2 for the second baseline and then slightly increased to 39.4 for the second intervention phase. Student E's homework completion data is shown in Figure 6.

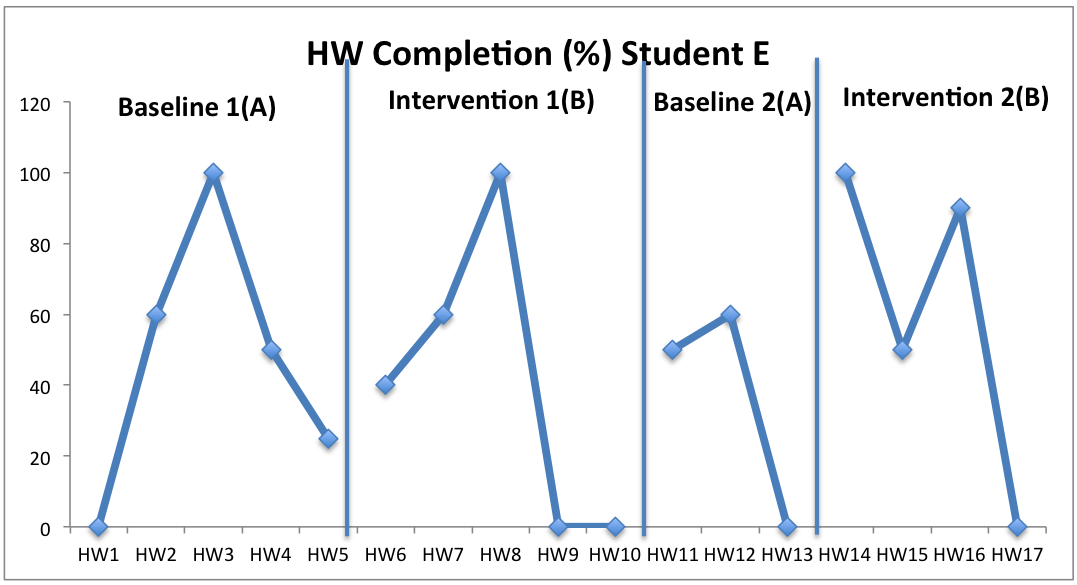

Figure 6. Homework Completion Scores Student E

Student F. During the first baseline, Student F's mean homework completion score was 66%. Student F's mean increased significantly to 84% during the first intervention phase. His mean during the second baseline was 50% and increased again to 62.5% during the second intervention. His standard deviation varied between phases. It was 37.2 for the first baseline and then decreased to 18.5 for the first intervention phase. The standard deviation was 40.8 for the second baseline and then increased to 41.5 for the second intervention phase. Student F's homework completion data is shown in Figure 7.

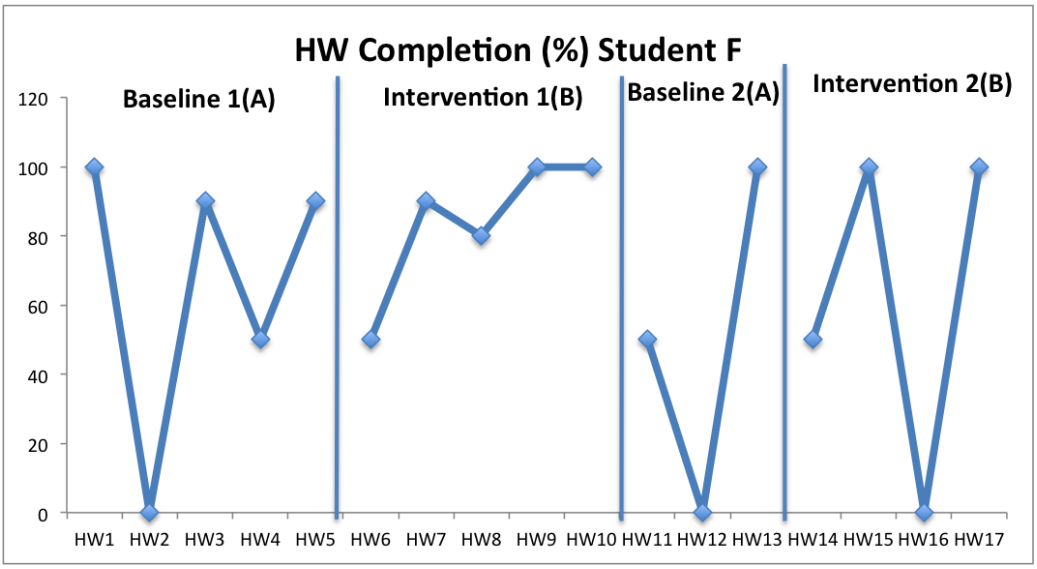

Figure 7. Homework Completion Scores Student F

Student G. During the first baseline, Student G's mean homework completion score was 58%. Student G's mean drastically increased to 90% during the first intervention phase. Her mean during the second baseline was 16.7% and increased again to 57.5% during the second intervention. Her standard deviation varied between phases. It was 31.2 for the first baseline and then decreased to 12.6 for the first intervention phase. The standard deviation was 23.6 for the second baseline and then increased to 37.7 for the second intervention phase. Student G's homework completion data is shown in Figure 8.

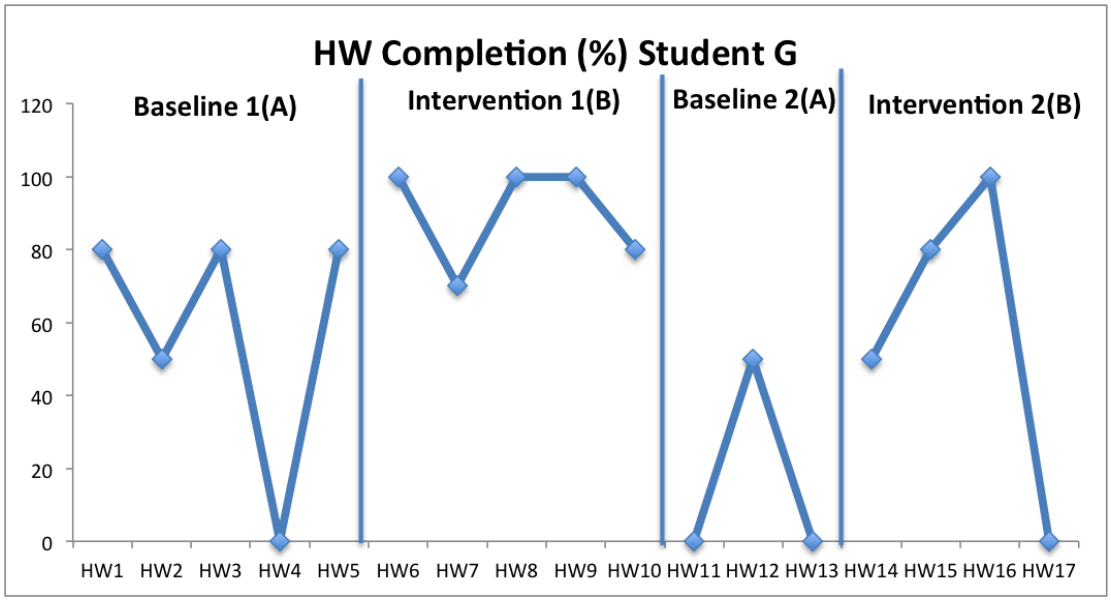

Figure 8. Homework Completion Scores Student G

Student Achievement

Research question two asked if the use of Google Classroom in high school math classes would increase student achievement. Student achievement was measured by collecting data on students' individual quiz and test grades. Each assessment grade was converted into a percentage. The means and standard deviation of students' quiz and test scores were calculated and are shown in Table 3.

Table 3

Quiz and Test Grades

	Baseline 1(A)		Intervention 1(B)		Baseline 2(A)		Intervention 2(B)	
	Mean %	SD %	Mean %	SD %	Mean %	SD %	Mean %	SD %
Student A	86.5	11.0	88.3	5.4	86.3	3.4	81.8	3.1
Student B	86.3	11.8	89.0	8.7	72.7	2.5	85.5	6.5
Student C	79.0	16.2	82.5	13.0	83.3	9.4	77.8	9.1
Student D	72.8	22.1	82.8	10.4	63.3	16.5	81.3	11.6
Student E	70.8	19.3	73.3	19.7	78.7	8.7	69.5	17.4
Student F	76.0	12.2	78.5	14.0	75.3	9.0	76.0	11.0
Student G	81.0	5.8	60.8	29.7	84.3	7.9	79.5	10.8

Quiz and Test Scores

Student A. During the first baseline, Student A's mean quiz and test score was 86.5%. Student A's mean score slightly increased to 88.3% during the first intervention phase. During the second baseline, her mean score fell to 86.3% and fell again during the intervention phase to 81.8%. Her standard deviation decreased during each phase. It was 11 during the first baseline and 5.4 during the first intervention phase. Then it was 3.4 for the second baseline and 3.1 for the second intervention phase. Student A's quiz and test data is shown in Figure 9.

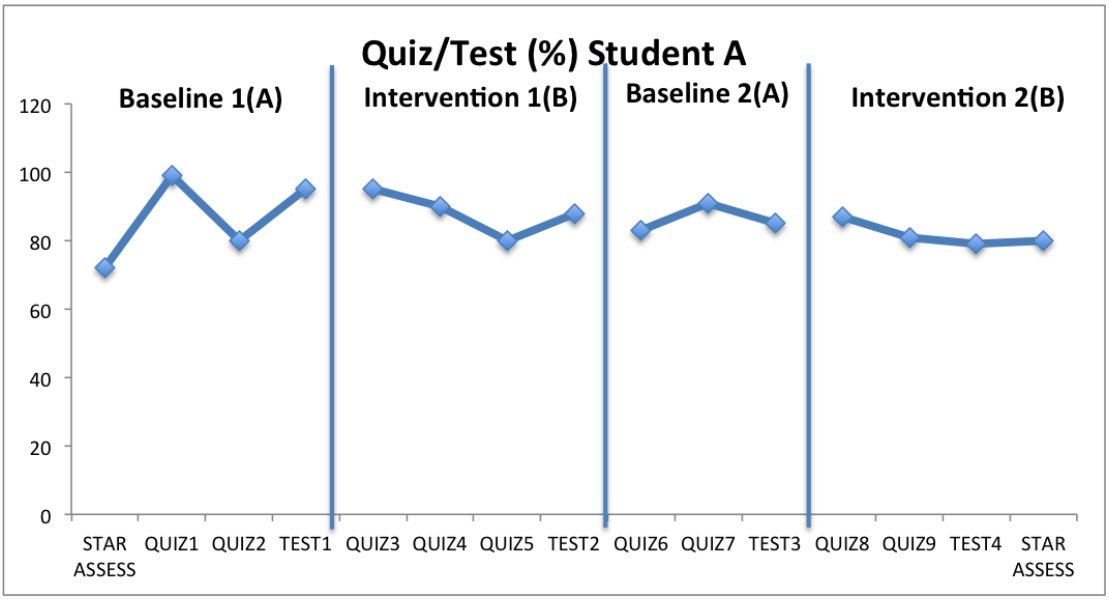

Figure 9. Quiz and Test Scores Student A

Student B. During the first baseline, Student B's mean quiz and test score was 86.3%. Student B's mean score slightly increased to 89% during the first intervention phase. During the second baseline, his mean was 72.7% but increased again during the intervention phase to 85.5%. His standard deviation was inconsistent throughout. During the first set of phases it went from 11.8 to 8.7. It decreased to 2.5 during the second baseline phase but then increased to 6.5 for the second intervention phase. Student B's homework completion data is shown in Figure 10.

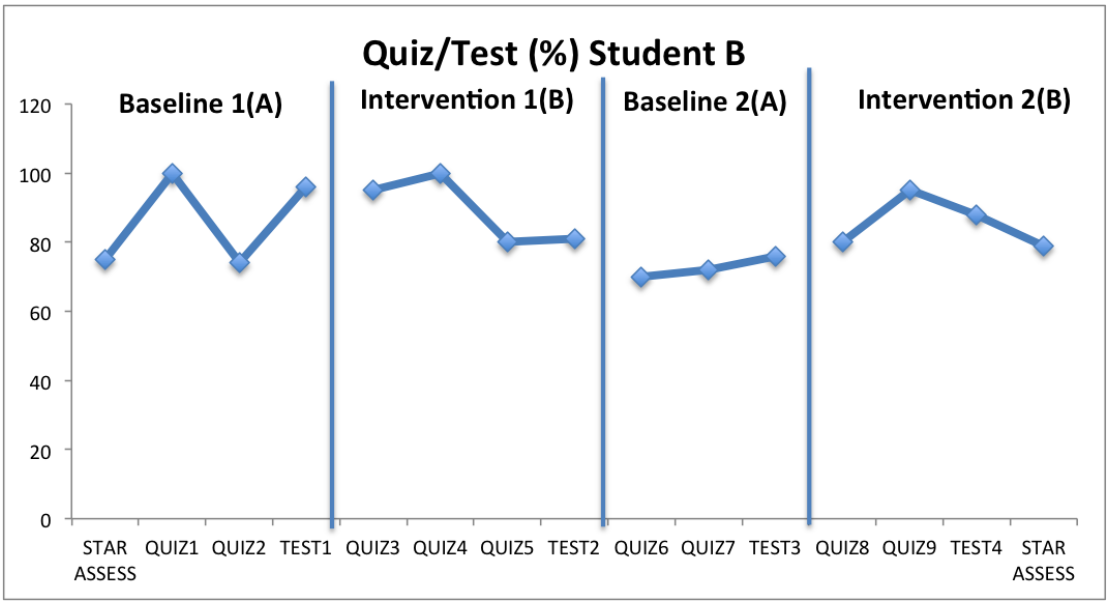

Figure 10. Quiz and Test Scores Student B

Student C. During the first baseline, Student C's mean quiz and test score was 79%. Student C's mean score increased to 82.5% during the first intervention phase. However, during the second baseline, her mean score was 83.3% and then decreased during the intervention phase to 77.8%. Her standard deviation during the first phases slight decreased with 16.2 for the baseline and 13 for the intervention phases. It slightly decreased between the second baseline and intervention phases going from 9.4 to 9.1. Student C's homework completion data is shown in Figure 11.

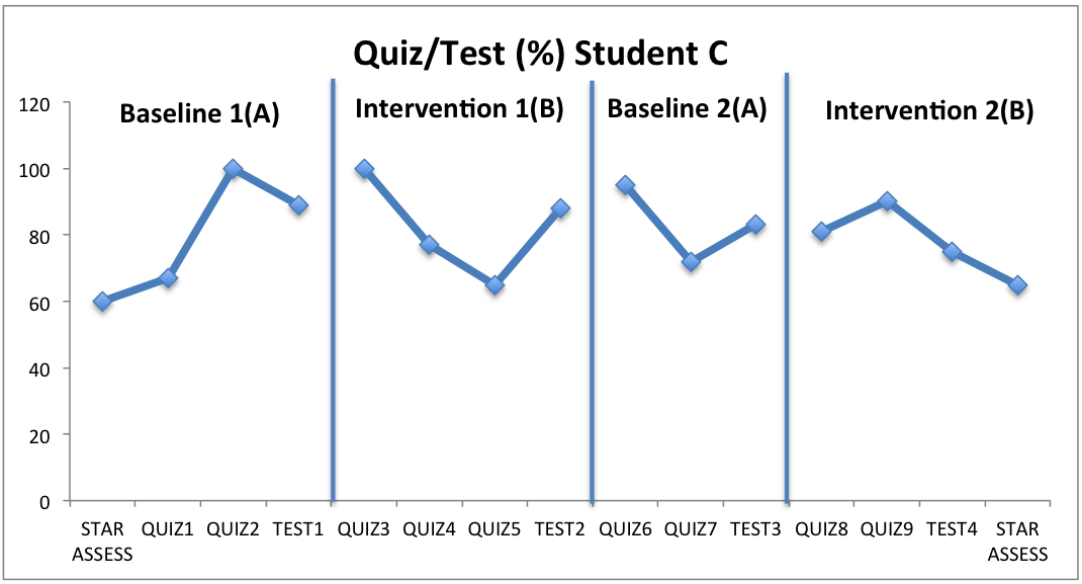

Figure 11. Quiz and Test Scores Student C

Student D. During the first baseline, Student D's mean quiz and test score was 72.8%. Student C's mean score increased to 82.8% during the first intervention phase. His mean score continued to increase with 63.3% for the second baseline and 81.3% for the second intervention phases. His standard deviation was decreased between phases. It was 22.1 for the first baseline and 10.4 for the first intervention phase. The standard deviation was 16.5 for the second baseline and then 11.6 for the second intervention phase. Student D's homework completion data is shown in Figure 12.

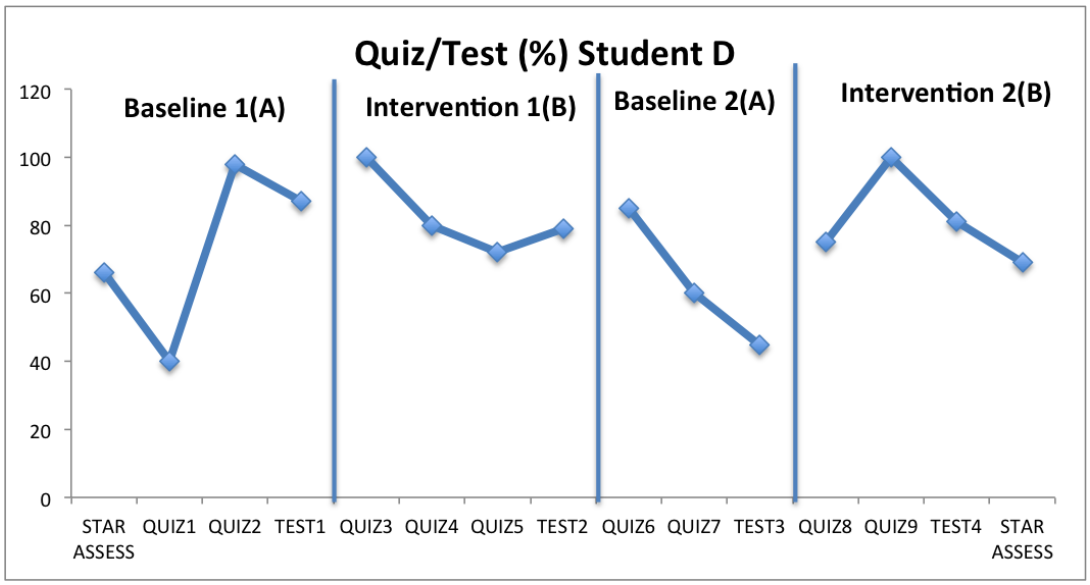

Figure 12. Quiz and Test Scores Student D

Student E. During the first baseline, Student E's mean quiz and test score was 70.8%. Student E's mean score slightly increased to 73.3% during the first intervention phase. However, his mean score decreased during the second phases. It was 78.7% during the second baseline phase and 69.5% during the second intervention. His standard deviation was 19.3 for the first baseline and barely changed for the first intervention phase at 19.7. The standard deviation decreased to 8.7 for the second baseline but then increased to 17.4 for the second intervention phase. Student E's homework completion data is shown in Figure 13.

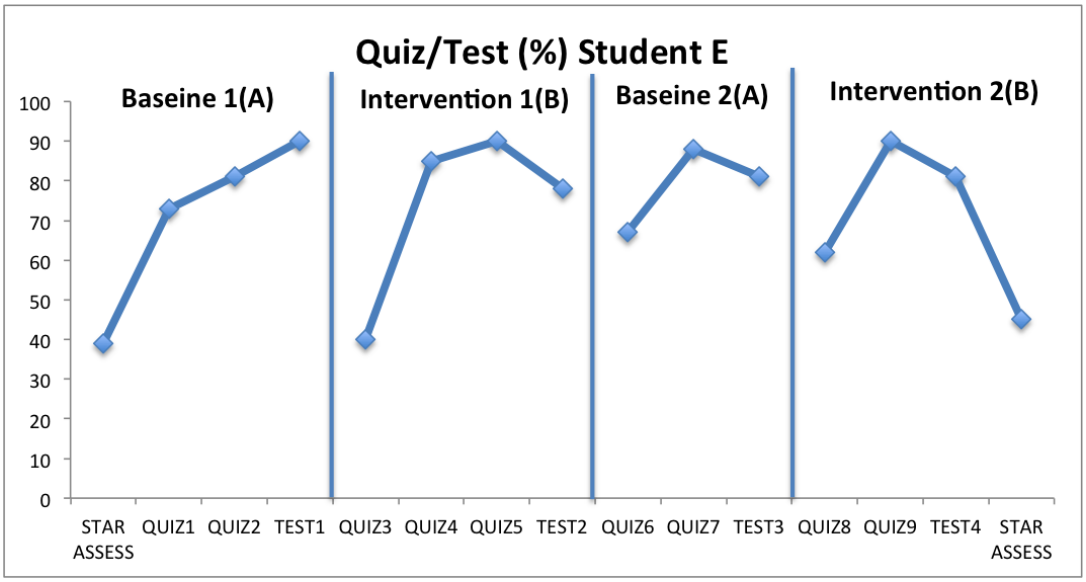

Figure 13. Quiz and Test Scores Student E

Student F. During the first baseline, Student F's mean quiz and test score was 76%. Student F's mean increased slightly to 78.5% during the first intervention phase. His mean remained consistent during the second baseline at 75.3% and 76% during the second intervention. His standard deviation slightly increased between phases. It was 12.2 for the first intervention and then 14 for the first baseline phase. The standard deviation was 9 for the second baseline and then 11 for the second intervention phase. Student F's homework completion data is shown in Figure 14.

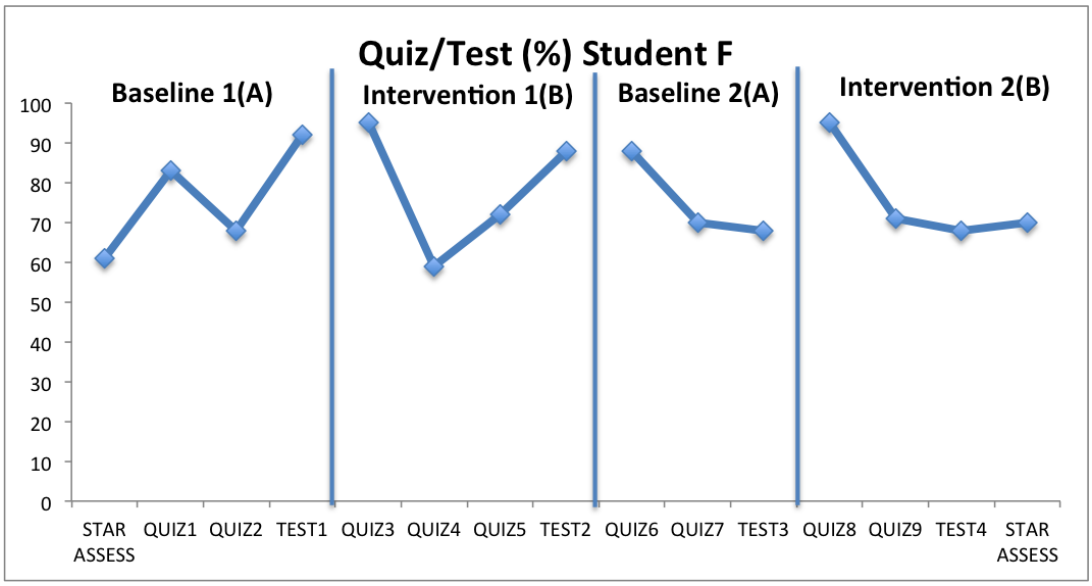

Figure 14. Quiz and Test Scores Student F

Student G. During the first baseline, Student G's mean quiz and test score was 81%. Student G's mean drastically decreased to 60.8% during the first intervention phase. Her mean during the second baseline was 84.3% and decreased again to 79.5% during the second intervention. Her standard deviation was 5.8 for the first intervention and then increased to 29.7 for the first baseline phase. The standard deviation was 7.9 for the second baseline and then increased to 10.8 for the second intervention phase. Student G's homework completion data is shown in Figure 15.

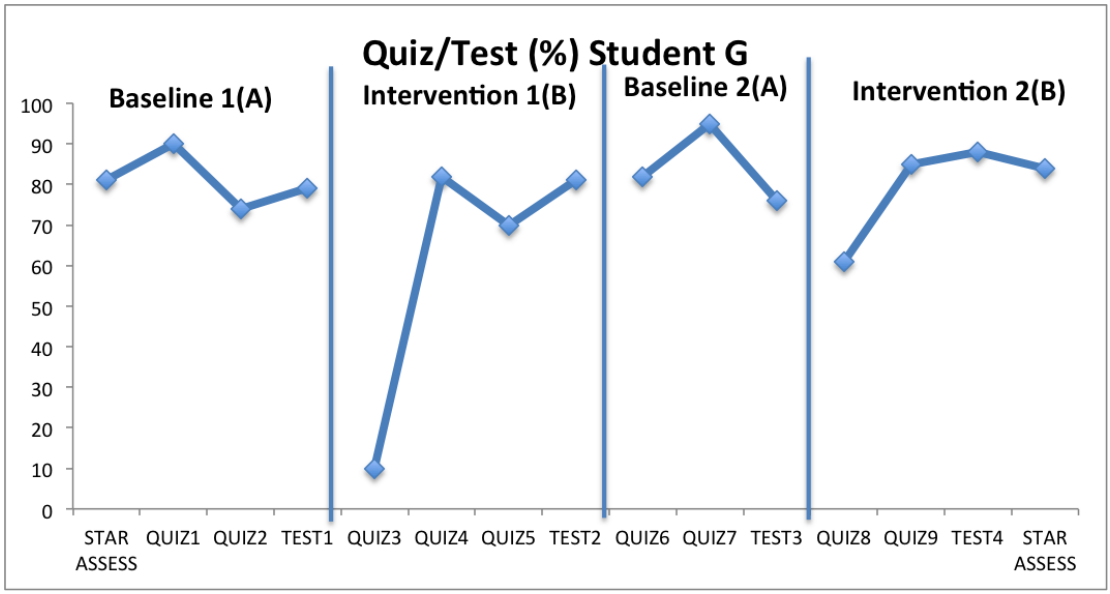

Figure 15. Quiz and Test Scores Student G

Survey Results

Research questions three asked if the students were satisfied with the use of Google Classroom in their math class. A Likert scale satisfaction survey was given at the conclusion of the second intervention phase. Results were tallied and then calculated into percentages. Table 4 represents the percent of students that responded in each category for each statement.

Table 4

Student Satisfaction Survey Percentage Results

Statements	Strongly Agree (%) 5	Agree (%) 4	Neutral (%) 3	Disagree (%) 2	Strongly Disagree (%) 1
1. Liked using Google Classroom to learn math	14	14	58	14	0
2. Google Classroom helped me to be more organized	14	43	29	14	0
3. Google Classroom was easy to use	42	29	29	0	0
4. I prefer using Google Classroom	14	29	14	43	0
5. I liked doing notes and Exit Tickets on Google Classroom compared to writing them on paper	14	14	43	29	0
6. I liked doing discovery activities on the Classroom board compared to the old way of writing them on paper.	14	0	43	43	0
7. I felt more comfortable in interacting with my classmates and teacher	14	29	43	14	0
8. I liked listening to music while working	29	29	42	0	0
9. Writing on the Google Classroom was better than paper notes	14	0	29	43	14

Table 4 (continued)

10. Google Classroom made handing in assignments easier	42	29	29	0	0
11. Google Classroom helped me to be more aware of my missing/ incomplete assignments	29	42	29	0	0
12. Google Classroom helped me find the appropriate links needed (Kahoot, Kahn academy, desmos, etc.)	43	14	43	0	0
13. My grade increased because of Google Classroom	14	0	72	14	0
14. Google Classroom helped me become more aware of the math content	0	29	71	0	0
15. Playing games helped me learn	14	0	72	14	0
16. I utilized the resources provided by the teacher to assist with assignments	29	29	42	0	0

In terms of student satisfaction, the majority of students, 58% were neutral when asked if they liked using Google Classroom to learn math. Only 28% of students agreed with this statement. When asked if they prefer using Google Classroom, students were split down the middle with 43% of students each agreeing and disagreeing. However, 71% of students agreed that Google Classroom was easy to use. Many students were

neutral in their satisfaction with Google Classroom; 43% of students were neutral in regards to notes and Exit Tickets and doing discovery activities through Google Classroom. When asked if they felt more comfortable interacting with their classmates and teacher through Google Classroom, 43% of students agreed. Students were split when asked if they liked listening to music while working, 58% agree but 43% felt neutral about this statement. But the majority of students, 57%, disagreed that writing on Google Classroom was better than paper notes. In regards to organization, 57% of students agreed that Google Classroom helped them to be more organized. The majority of the class, 71% felt that Google Classroom made handing in assignments easier and also helped them to be more aware of their missing and incomplete assignments. Students also felt that Google Classroom helped them to find appropriate links needed for lessons and they utilized the resources provided by their teacher. About 72% of students were neutral in regards to their achievement. Only 14% of students felt their grade increased because of Google Classroom; 14% of students also disagreed with this. Students were split at 14% each in agreeing and disagreeing about whether they felt playing games helped them to learn math. About 29% of students felt that Google Classroom helped them to become more aware of the math content.

Chapter 5

Discussion

The purpose of this study was to determine the effectiveness of using Google Classroom as an intervention for improving the achievement and organizational skills of students with learning disabilities in an Algebra 2 classroom. At the end of the study, participants were asked to complete a satisfaction survey to assess their attitudes and opinions towards the Google Classroom intervention.

Findings

Research has suggested that the use of Google Classroom can be an effective intervention for improving academic success for students with disabilities (DiCicco, 2016). The current study confirms the results of DiCicco (2016) in that quiz and test scores showed small improvements in the majority of the seven participants. The results from this current study also align with the findings of Eyyam and Yaratan (2014) and Li and Ma (2010) in that technology has a positive impact on student success. All seven students showed improvements in at least one area, many showed improvements in both, when Google Classroom was used as an intervention. Students shared their opinions in the survey, which were similar to the results of DiCicco (2016) and Hemrungrote et al. (2017). They felt Google Classroom had a positive impact on their day-to-day tasks and enjoyed accessing class materials.

The results of the current study confirm the findings of DiCicco (2016), showing improvements in one area, homework completion, but only small improvements in another area, quiz and test grades. All students', except student G's, mean scores for quiz and test grades increased from the first baseline to the first intervention phase. Student

D's mean score increased 10% and was the only participant that increased by more than 3%. When the intervention was removed the mean scores of Student A, Student B, Student D, and Student F decreased. Student B, Student D, and Student F showed consistency in the second phases; their quiz and test scores increased from the second baseline to the second intervention. Again, Student D showed the highest improvement between phases, and increased by almost 18%. The other participants decreased in their mean quiz and test scores. Student G was the only participant who showed no improvement; her scores were higher during both baseline phases than the intervention phases.

Similar to the findings of Langberg et al. (2008), this study showed that organization plays an important role in a student's academic success. The data from the current study shows that all students, except student E, increased their mean scores in homework completion between the first baseline and first intervention phase. However, between the second baseline and intervention phase, all seven participants showed improvements in their mean scores. This indicates that students were able to use Google Classroom to keep track of and maintain their assignments and due dates. The mean scores of all participants, except Student D, decreased when the intervention was taken away. This could be a result of students utilizing and relying on Google Classroom; when the intervention wasn't being used students had a harder time maintaining organization for their assignments. Student A was consistent and increased by 20% both times when the intervention was implemented. Similarly, Student F increased 42% at the first phase and then 40% during the second phase. Student B, Student C, Student D, and Student F showed a bigger increase during the first phase, than in the second phase.

Unlike the results from Hemrungrote et al. (2017), that showed a strong student satisfaction with Google Classroom, the participants of this study did not express strong opinions about the intervention. Student satisfaction in this study aligned with the results of Eyyam and Yaratan (2014). The majority, 58% responded neutral when asked if they liked Google Classroom for their math class. However, 71% of students agreed that Google Classroom was easy to use. Students preferred Google Classroom but also had indecisive attitudes towards its overall implementation. In regards to specific aspects of Google Classroom, the survey results aligned with the findings of DiCicco (2017) and students showed an overall positive attitude. The majority of participants felt that the intervention helped them to be more organized with their assignments while also providing easy access to various resources.

Limitations

The current study has several limitations. The most influential limitation is the school in which the study took place. The high school is a private, alternate school, therefore, all students are provided transportation to and from school by their home school districts. For this reason, all school activities and events take place during school hours. During the time frame that the study took place, the Drama Club was preparing and rehearsing for the upcoming Spring Musical. Three of the seven participants were part of the musical and missed about 1-2 days of math class each week for drama practice. This influenced their participation in the study. They often missed instruction and in order to keep up with the pace of the class, were required to work on lessons and assignments at home that their classmates worked on in class where the teacher was available to help and assist as needed.

A second limitation was the time frame in which the study was conducted. There was a time limit in place in order for the study to be completed in time. The weather interfered with collecting data. Due to inclement weather the school closed one day and had a few early dismissals and delayed openings. These changes to the school day shorted class periods from 40 minutes to 30 minutes. This definitely interfered with some aspects of teaching as plans had to be changed and pushed back. There were some activities and lessons that were modified or skipped to better suit the time constraints. In addition to the change in weather, the overall study only took place over a 10-week period, where Google Classroom was used for five of those weeks. Although students had used Google Classroom in the past for other subjects, they had never experienced using it in a math classroom. Five weeks is not a substantial amount of time for students to get comfortable and used to this new intervention for math.

Lastly, an important limitation to this study is its sample size. There were only seven students that participated in this study. This small sample size does not provide enough information to generalize its findings for a larger population. In order to truly understand the effects of Google Classroom on teaching math to students with disabilities it is essential to continue research with a larger sample size over a longer period of time.

Implications and Recommendations

The results from this study build upon previous research on using technology in the math classroom. Implementing technology, such as Google Classroom, may have a positive impact on the performance of students with learning disabilities. An important implication of this research is that Google Classroom is an easy to use tool for students with learning disabilities; it helps them manage assignments and access various

resources. It may be useful to consistently implement Google Classroom as an organizational tool for students with disabilities.

The data from this study showed that Google Classroom does not have a significant effect on quiz and test grades. Although this intervention did not have a strong impact on overall student achievement, it may still improve in this area over a longer period of implementation. It is unclear if an improvement in homework completion will influence quiz and test grades. Further research is needed to determine the long-term impact of Google Classroom.

In this study, all seven participants showed increases in their homework completion while Google Classroom was implemented. To better understand its effectiveness on other populations, research should be conducted with students with other types of learning disabilities and also with students without disabilities.

The survey results were generally vague; participants did not have very strong opinions on using Google Classroom in their math class. The majority, however, found it easy to use and keep track of assignments. Further research should be conducted to determine if students develop a stronger satisfaction over a longer period of implementation. Research should also be conducted to determine if students prefer managing assignments through Google Classroom in other academic settings.

Conclusions

Overall, it appears that Google Classroom helped students with learning disabilities increase their homework completion and organizational skills. The intervention did not have a big impact on student achievement in regards to quiz and test grades. Additionally, students with learning disabilities had a positive attitude toward

Google Classroom and felt it helped them to keep track of and maintain their assignments. Many students were impartial to its overall use in their math class. Further research is needed to determine how affective this intervention will be long-term and also with students of other learning disabilities. This research should be conducted with a larger population over a longer period of time.

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