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Effectiveness of 1:1 technology in the science classroom

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EFFECTIVENESS OF 1:1 TECHNOLOGY IN THE SCIENCE CLASSROOM

by

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Dedication

I would like to dedicate this manuscript to my parents, Robert and Irene Weiss, my sister and best friend, Cathryn Weiss, my six older siblings, and my husband, Daniel Chromeck. Without their support and encouragement, none of this would have been possible.

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Abstract

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The purposes of this study were: (a) to determine if using e-text technology in a middle school resource science classroom increases student academic performance, (b) to determine if using e-text technology in a middle school science resource classroom increases student engagement/on-task behavior, and (c) to evaluate student comfort and satisfaction in using an electronic textbook or print textbook in a middle school resource science classroom. Ten middle school students, four in grade 7 and six in grade 8 participated in the study using the Discovery Education Science Techbook and the AGS General Science series. A single subject design with ABABA phases was used with the printed textbook from AGS as the baseline and the e-text as the intervention. During the baseline and intervention, students completed vocabulary and guided notes on science content. Their performance was evaluated through homework completion, quiz and test scores. Their on task behaviors were observed and recorded in five-minute time intervals daily. Results showed that even though the students preferred the e-text over the printed textbook, their academic scores and engagement were lower when using the e-text.

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Chapter 1

Introduction

Since the last century, the development of technology has increased exponentially. From a time when technological advances included writing with pen and paper instead of a slate and chalk, to apps that allow students to write while they speak into a microphone. Students with reading disabilities can now hear a passage read aloud from any device they choose, cell phone, computer, or tablet. It seems that there has been an exponential growth in educational technology (Williams, 2011). No longer are students sitting in a one room schoolhouse, sharing a slate to complete their mathematics time tables. Instead, they are sitting in classrooms with a new form of tablet in front of them.

Statement of Problems

The concept of 1:1 technology has been developing with increasing interest, first with iPads, and now with laptops and Chromebooks to assist students in completing their assignments. The question is not whether or not computers belong in the classroom but whether or not students understand how to appropriately use the resources provided to further their own understanding. It is also whether or not teachers truly understand how to implement the technology in order to aid students' learning (Booth, 2010). Students in a resource science classroom may struggle to understand expository passages. The electronic textbook (e-text) may provide digital resources in the form of videos and explorations to assist students in comprehending the material they are reading (Dalton, Morocco, Tivnan, Rawson Mead, 1997).

An e-text, according to Lee (2002), is any text or book, displayed on a computer in a digital form. E-text, according to PC Magazine, is any text in digital form, including plain ACII text, e-books, or other electronic formations (2016). For the purposes of this study, an e-text is defined as a digital textbook consisting of videos, worksheets, digital explorations, virtual labs, and written text to assist a student's learning. E-texts provide students that struggle with reading an opportunity to further their understanding of the text through read-aloud options, interactive glossaries with animation, and videos that progress through the material to describe what was read. These options therefore allow students to interact on a level not seen in the printed textbook. "Research on universally designed e-texts has shown that students benefit from embedded reading supports for word recognition, vocabulary, and comprehension strategies" (Dalton, 2014, p. 39). There is a lack of research available however on the effectiveness of e-texts on teaching science in a resource setting. For example, secondary education students used an e-text in evaluating reading and language arts skills had higher quiz scores relating to the material than those that read a paper textbook (Douglas, Ayres, Langone, Bell, & Meade, 2009). Other studies, such as those by Knight, Wood, Spooner, Browder, and O'Brien, 2014) evaluated the use of e-texts in elementary autism support classrooms. The majority of the studies, such as those by Junco and Clem (2015), Astin (1984), and Bangert-Drowns, and Pyke (2001) focus on student engagement and academic performance in the college classroom. Teachers in secondary schools are beginning to be introduced to the use of e-texts in the science classroom and may benefit from research on how to best meet the needs of their students with this new technology.

Internet usage has been linked to depression among college females, with depression increasing as a result of overuse from a young age (Moreno, Jelenchick, & Breland, 2015). Excessive internet use has also been linked to health risks and a lack of social development in young children (Shields & Behrman, 2000). The information that students can find while searching the internet may boost academic scores, yet socializing and gaming on the computers may lead to decreased grade point averages (Chen & Fu, 2009). Internet searching has been linked to higher tests scores and overall academic performance (Chen & Fu, 2009). The internet allows students to easily access information with very little difficulty, providing details a child may not otherwise be exposed to in the classroom.

Significance of the Study

Presently, there is limited research focusing on the impact of e-texts on students learning science. More studies are needed to determine if e-texts impact student academic performance and /or engagement in academic science content. The present study is designed to address this need by comparing e-texts to traditional print textbooks when teaching science. It explores the impact of e-text usage on student understanding of science materials, and student engagement in e-texts versus print textbooks in the classroom. Printed text has been the norm for many years. With the increase of digital technology, however, schools are moving toward increased use of e-texts. Internet use has been closely linked to academic achievement in elementary school through middle school. What students do online may impact academic performance in the classroom (Chen & Fu, 2009). This includes the use of e-texts accessed via the internet.

Purpose of Study

This study will investigate the use of e-texts by students in a resource science classroom. Students will use individual Chromebooks to access e-texts from Discovery Education. These e-texts will provide students with the 5E model of learning. The 5E model of learning consists of an Engage activity to peak the students interest in the material they are learning, an Explore section that develops the ideas being taught into meaningful vocabulary and skills, an Explain portion that introduces the formal definitions, vocabulary, and lesson material, Elaborate which consists of building on the previous three sections to further understanding an allow students to create their own opportunities in order to broaden their understanding through the use of movie makers, photo stories, and web tools. The final section of the 5E model is the Evaluate section, where students complete summative assessments on the material they have been taught. These assessments are in the form of open-ended questions and rubric based assignments that require students to apply all the content they have read and previously completed.

The purposes of this study are to: (a) determine if using e-text technology in a middle school resource science classroom increases student academic performance, (b) determine if using e-text technology in a middle school science resource classroom increases student engagement/on-task behavior, and (c) evaluate student comfort and satisfaction in using an e-text versus a print textbook.

Research Questions

1. Will the use of e-text technology (text, videos, digital labs and explorations) in a middle school resource science classroom increase student academic performance?

2. Will the use of e-text technology (text, videos, digital labs and explorations) in a middle school resource science classroom increase student on-task behavior/ engagement?
3. Are students satisfied with the use of e-text technology in the science classroom?

Chapter 2

Review of Literature

Studies have shown that the use of e-texts have a place in the classroom. Many researchers, however, detail the implementation of these materials in the post-secondary classroom as opposed to the middle school classroom (Moreno, Jelenchick, & Breland, 2015; McIntyre, Wiender, & Saliba, 2015; Drummond, Chinen, Duncan, Miller, Fryer, Zmach, & Culp, 2011; Sheppard, Grace, Koch, 2008; Woody, Daniel, Baker, 2010). As a result, there is little known about the effect that e-texts have on middle school students.

Internet Usage

The overuse of computers is a leading cause of depression in college-aged females, with depression increasing when computers are overused starting at a younger age (Moreno, Jelenchick, & Breland, 2015). A study conducted on graduate and post-graduate university students determined that students who are more introverted tend to be more vulnerable to becoming compulsive internet users (McIntyre, Wiener, & Saliba, 2015). Dennis, McNamara, Morrone, and Plaskoff (2015) describe the generation of students currently in the school systems, "millennials," to be digital natives. They are capable of using technology and gadgets with fluency as well as comfortable expressing their thoughts and feelings online. When they reach college however, they are greeted by paper based textbooks, something that many of them are no longer familiar with because they spend more time around technology than paper-based books and activities. Dennis et al. (2015) believe that this is part of the reasons students may struggle in school, because it does not meet their expectations.

According to researchers at Princeton University, overuse of technology may result in health risks for children, and children using the internet excessively are often lacking in social development (Shields & Behrman, 2000). One recommendation to counteract this effect is to limit technology interaction to no more than two hours a day and to increase involvement in sports and other activities with peers of similar ages (Shields & Behrman, 2000). Students spend an average of 7 hours and 38 minutes a day interacting with technology and actually pack 10 hours and 45 minutes' worth of digital media into that time frame (Rideout, Foehr, & Roberts, 2010). In addition a connection has been identified between the overuse of the internet and low academic grade point averages in students (Kirschner & Karpinski, n.d.).

Despite the negative results reported in internet studies above, computer use has been determined to have no correlation to grade point averages among adolescents (Hunley, Evans, Delgado-Hachey, Krise, Rich, & Schell, 2005). Hunley et al. (2005) studied 101 eighth grade students with various grade point averages (GPAs), from 4.2 to 0.18 on a 4.0 scale. The average GPA was 2.8, the equivalent of a C+. The results of the study determined that hours spent on the computer did not significantly correlate with students GPA. However, a child that spends more time in sports or clubs had a higher GPA and those that spent more time on the telephone, watching television, and playing the stereo had lower GPA's (Hunley, et al., 2005). With students spending so much time around technology it seems important to encourage the use of technology for academic reasons, instead of simply games and communication (Rideout et al., 2010).

E-texts

E-texts have been updated and now involve the use of the internet instead of text on CD's as in the past. "Millennials" according to Dennis et al. (2015) expect and even value digital communication and the current technological capabilities. Since there may be a positive effect of internet usage on learning, e-texts may be beneficial within the middle school classroom. E-texts can be used to provide students with different means of material including digital glossaries and bilingual translation (Dalton, 2014). Studies have shown that students benefit from reading these supports (Dalton, Pisha, Eagleton, Coyne, & Deysher, 2002; Dalton, Proctor, Uccelli, Mo, & Snow, 2011; Dalton & Palinesar, 2013; Coyne, Pisha, Dalton, Zeph, & Cook Smith, 2012). A meta-analysis of e-text and technology enhanced readings found positive comprehension effects for middle school students (Moran, Ferdig, Pearson, Wardrop, & Blomeyer, 2008). For literacy curriculum, children may benefit from using e-texts and educators may find it beneficial to collaborate with digital designers, students, programmers, and publishers to have books that meet the needs of the "struggling reader" (Dalton, 2014). As the availability of technology increases, the educational community must seek ways to integrate it into the classroom to support the goals of education (Shirley, Irving, Sanalan, Pape, & Owens, 2010). High-quality instruction can be determined through the use of formative and summative assessments after using the e-texts (Shirley et al., 2010).

After a conducted study on e-texts, it was determined that there was no academic connection between students who read enhanced e-texts and those that used the traditional printed text (Drummond, et al. 2011). Dalton (2014) states, "teaching children to become successful readers means teaching them to become successful e-readers" (p.

43). In contrast, Dennis, McNamara, Morrone, and Plaskoff (2015) report that electronic teaching can improve learning in the following four ways:

> (1) Electronic devices and the pervasiveness of network access enable the use of much richer, more engaging multimedia content than the traditional paper book and enable the instructor to tailor that content to the students' learning needs.
> (2) Electronic content with instructor annotations creates new opportunities for instructors to communicate with students as they experience the textbook. These comments are scaffolding that can provide guidance to students beyond the classroom setting.
> (3) Electronic content with student annotation enhances student interest, comprehension, and critical thinking. Learning is not a passive process where students simply receive information but an active process in which students co-construct knowledge.
> (4) Electronic content with a shared annotation as a social medium enables students to communicate with each other and instructors in ways that create new opportunities for active learning (p. 3-4).

The researchers compiled these ideas during a three year time period at Indiana University where the use of e-texts and print textbooks were studied. This study was conducted on 56 juniors in a business course. The participants read the first chapter in a data communications and networking textbook, 27 with photocopies of the chapter and 25 with e-text software on a desktop computer. They then completed a quiz involving 24 multiple choice questions and one open-ended question. The 56 participants all had similar GPA's at the onset of the study. Study participants believed that the print textbook better met their educational needs. Quizzes taken by the students, however demonstrated that students using the e-text performed significantly better than those using the print textbook (Dennis et al., 2015).

Academic Performance

According to Chen and Fu (2009), internet searching for information boosts student academic scores, yet internet socializing and gaming have negative effects on student performance in school. Interactive activities, including videos, explorations, and

laboratories located in an e-text allow students to readily access specific information (Dee-Lucas & Harkin, 1995). In 2005, Al-Maashani studied internet usage factors including perception and student academic performance. Of the 373 students randomly selected from universities in Oman, there was a strong correlation between internet usage and student academic performance. Usage factors determined that at that time, males were more likely to use the internet than females. E-texts have been described as an electronic text meant to serve the same purpose as a conventional printed book, and some e-texts look and feel like a printed book but feature options such as hyperlinks, annotation, text searching, and multimedia objects helpful for those with disabilities (Anurdha & Usha, n.d.).

E-Text in Special Education

Knight, Wood, Spooner, Browder, and O'Brien, (2014) researched the effect that e-texts may have on students with autism spectrum disorder. Students on the autism spectrum often have difficulty comprehending scientific context as a result of background knowledge that needs to be learned and memorized prior to understanding new material (Knight et al., 2014). The study used electronic expository texts created by the teachers to determine student understanding through a different modality. Students listened to audio recordings twice before completing assessments on vocabulary and comprehension questions. The results were consistent, with teachers in both general and special education settings perceiving the strategy to be useful and a means to differentiate instruction and assess student knowledge (Knight et al., 2014).

Moreover, the use of e-text to support students with mild to moderate intellectual disabilities has been researched with positive results (Douglas, Ayres, Langone, Bell, &

Meade, 2009). Douglas et al., (2009) conducted six studies pertaining to the use of e-texts and assistive technology. These studies determined that individuals with intellectual disabilities, including nonreaders and low-level readers, are provided a "multitude of new opportunities" (p. 42) including new job opportunities, better ways to communicate with friends, and a way to interact with the larger world when using technology. Study findings show that digitized or read aloud e-texts provided students with intellectual disabilities with independent access to the material, and provided more support than a simple audio version of the text (Douglas, et al., 2009). The researchers report that students with disabilities may be strong candidates for e-texts as the texts provide an alternative to print based media and an alternative to standardized reading measures (Douglas, et al. 2009).

In another study supporting the use of e-texts, 56 college juniors in a general business course were asked to read a chapter for 35 minutes (Dennis, McNamara, Morrone, & Plaskoff, 2015). Of the 56 participants, 27 participants read a paper photocopy of the chapter and 25 participants used e-text software on a desktop to read the same chapter without audio. The participants then completed a timed 15 minute quiz on the material and answered a post-session questionnaire. Participants that used the e-text had much higher scores on the quiz than those that read a paper textbook. When completing the questionnaire however, participants thought the paper textbook would be more likely to meet their learning needs and result in a higher score (Dennis et. al, 2015).

Students with learning disabilities often have difficulty engaging and drawing inferences from previous science experiences (Dalton, Morocco, Tivnan, & Rawson Mead, 1997). Recently, the Next Generation Science Standards placed more emphasis on

hands-on inquiry and less emphasis on rote learning (The Need for New Science Standards, n.d.). E-texts may provide students with a hands-on learning experience supported by text, video, reading passages, and interactive labs.

For students with disabilities, e-texts are said to increase student achievement and provide a means for teachers to evaluate students through individual handheld devices (Shirley et al., 2010). Wiliam (2006) recommends that when using the e-text as a tool, it must be integrated into the teacher's classroom practices. Ertmer (2005) describes the importance of a professional community to provide examples to teachers of the effective use of technology.

Student Engagement

In 1984, Astin described engagement as "the amount of physical and psychological energy that the student devotes to the academic experience" (p. 518). This theory included five tenets:

> (1) engagement involves investment of physical and psychological energy; (2) engagement occurs along a continuum (some students are more engaged than others, and individual students are engaged in different activities at differing levels); (3) engagement has both quantitative and qualitative features; (4) the amount of student learning and development associated with an educational program is directly related to the quality and quantity of student engagement in that program; and (5) the effectiveness of any educational practice is directly related to the ability of that practice to increase student engagement.

This theory still holds true today, as engagement can be defined as the time and effort students put forth on their educational activities (Kuh, 2009).

Educators often feel that engaged learners are more involved in their learning tasks, behaviorally, intellectually, and emotionally (Bangert-Drowns & Pyke, 2002). In 2001, Bangert-Drowns and Pyke described engagement as cognitive, affective, and motivational strategies for learning. Engagement is the motivation involved in creating,

problem-solving, reasoning, decision-making, and evaluation (Kearsley & Shneiderman, 1998).

Students with learning disabilities often have negative attitudes about science as a result of difficulty understanding complex expository texts which may lead to a lack of engagement (Marino, Gotch, Israel, Vasquez III, Basham, & Becht, 2014). Using video games to explain this difficult material, however, students demonstrated a connection between virtual worlds and classroom experience, helping them gain an understanding of the scientific content (Marino et al., 2014). Technology has become more important in science classrooms supporting students through tasks such as drawing, word processing, videos, and digital images (Krajcik, 2015). Since students can also highlight, annotate, underline and bookmark material, they are able to follow the material that may have otherwise been difficult in a printed textbook (Anuradha & Usha, n.d.). Rockinson-Szapiw, Courduff, Carter, and Bennett (2013) described students that use e-texts as able to learn more actively and thereby focus more consistently.

Kinash (2011) points out that in order to maintain appropriate use of the technology, teachers must focus on creating "robust educational tasks" to promote student engagement throughout the entire lesson. By engaging the student in exciting tasks, they are less likely to find themselves on websites that are not appropriate to the material they are learning. Students need the opportunity to create, construct, invent and share their ideas with each other as well as the teacher to heighten the inquiry-based learning and maintain engagement in the material (Kinash, 2011).

Junco and Clem (2015), when studying student engagement and academic outcomes, determined engagement did not have an effect on student outcomes. The

researchers determined that while engagement was a good predictor for student comprehension, what really mattered was whether or not they read the material thoroughly. Time-on-task made a difference but was not a significant factor in student comprehension (Junco & Clem, 2015).

Using video games to enhance student engagement is not a successful method on its own, just as using films for education are not completely successful in stimulating a child's desire to learn (McMahon & Henderson, 2011). Motivation is based upon four main aspects: challenge, control, curiosity, and fantasy (Malone, 1981). To engage the students, one must focus on meeting student interests in order to achieve full engagement, be it with video games or other uses of technology (McMahon & Henderson, 2011).

Student Text Preferences

When Sheppard, Grace, and Koch (2008) published a study on electronic text, e-texts were still available on CD or DVD but offered all of the advantages that students have today including less expense as well as a lighter, less bulky and environmentally friendly options to traditional books. Unfortunately, Sheppard et al. (2008) also noted the downside of e-texts, including the fact that students need to have regular access to a computer, something that is not always the case in a middle school classroom. The results of the study revealed that students were neutral in their liking of the textbook despite its ease of usage. Their grades did not differ significantly but students who used an e-text were less likely to read through the material in its entirety and often skimmed the material (Sheppard et al. 2008).

In a study that involved assessment of student satisfaction with e-texts (Marino, et al., 2014) many students responded positively to the technology. The majority of

students stated that they prefer to access and recognize scientific information through technology rather than through a printed text (Marino et al., 2014). Students also reported that if they were given a game to achieve a grade rather than a written test, they would try harder and be more engaged in their actual learning (Marino et al., 2014). When asked, students reported that they preferred the options available in e-texts over conducting traditional science experiments (Marino et al., 2014).

In a study conducted at the Indian Institute of Research, one third of users in a university study reported being very satisfied with an e-text. Out of the remaining two thirds of the users, another half of them were somewhat satisfied when using the e-text in place of a printed textbook (Anuradha & Usha, n.d.). On the contrary, however, findings from another study of students who used e-texts show they were neutral in their ratings but reported plans to purchase a traditional print text in the future instead (Shepperd et al., 2008). As a result of yet another study, it was determined that gender had no effect on a college student's preference to use e-texts (Woody, Daniel, Baker, 2010). Woody et al. determined that undergraduate students on a whole had an aversion to using e-texts, and that students who repeatedly used e-texts were comfortable in using them for classes but those that were newly exposed for the purpose of the study were disappointed in the e-text (2010).

Conclusion

With the continuous improvement of technology, more technological resources are available to improve student learning. Interactive lessons allow readers to access sections of e-texts without having to read through the entire text (Dee-Lucas & Larkin, 1995). Technology allows students to create artifacts as well as highlight text, create

notes, and make annotations directly in the text as they read rather than on separate material (Krajcik, 2015). Students have become more involved in their learning when they are able to make connections between virtual worlds in games, digital text, and the scientific content they are learning (Marino et al., 2014).

This study will investigate the use of e-texts by students in a resource science classroom. Students will use individual Chromebooks to access their e-texts from Discovery Education. The e-texts provide students with the 5E model of learning as detailed in Chapter 1 (Discovery, 2009). The purposes of this study are to: (a) determine if using e-text technology in a middle school resource science classroom increases student academic performance, (b) determine if using e-text technology in a middle school science resource classroom increases student engagement/on-task behavior, and (c) evaluate student comfort and satisfaction in using an e-text versus a print textbook.

Chapter 3

Method

Setting

School. This study was conducted in a rural community in Northern New Jersey. The school is a public middle school with students in grades 6-8. During the 2015-2016 school year, 350 students were enrolled in the middle school with 79 students classified to receive special education services in district, and 7 additional students in out of district placement. All participating students were enrolled in the Special Education program. Four of the students were involved in a self-contained class setting. Six of the students were involved in a pull-out resource class setting.

Classroom. The science classes took place in a small room located on the second floor of the school building. It contains three standing student desks and six sitting student desks. There were two extra computers for the students to use as needed. The room has a SMART Board at the front connected to one of the extra computers in which lessons and notes are displayed for student viewing. The classroom has extra desks throughout the room to divide the students up for test-taking purposes. There is a larger teacher desk at the front of the room where students have the opportunity to sit on a rotating basis when completing tests and quizzes. In the back of the room are two more desks for the teacher along with a computer and filing cabinet. For the months of April and May the classroom included 35-45 quail chicks in a brooder box as part of the Quail in the Classroom initiative.

The school day ran on a schedule with each class period lasting for 44 minutes and student passing time limited to 3 minutes. The science classes occurred in the second

and third periods of the school day, between 9:29 and 11:00. The 7th grade students were in attendance during second period with the 8th graders arriving after they left for 3rd period.

Participants

Students. This study included 10 participants, the total number of students in the 7th and 8th grade science classes. Four students comprised a small group 7th grade self-contained science class for language learning disabilities and behavioral/emotional disabilities, and six students comprised an 8th grade resource science class. Table 1 presents the general information of the participants.

Table 1

General Information of Participating Students

Student	Age	Gender	Grade	Classification	Average Test Score (%)	Average Quiz Score (%)	Average Engagement Score (%)
1	12	F	7	CI	75.3	78.7	83.0
2	13	M	7	SLD: Math	93.3	98.3	32.5
3	12	M	7	OHI: ADHD	69.3	66.3	74.0
4	12	M	7	SLD: Reading, Writing, Math	90.7	97.7	77.0
5	15	M	8	CI	72.3	76.0	89.0
6	13	M	8	SLD	92.3	96.5	91.5
7	14	F	8	SLD: Math	74.3	83.5	65.0
8	14	M	8	Autism	92.7	92.5	97.5
9	13	M	8	CI	64.7	68.0	89.5
10	13	F	8	SLD: Reading, Writing, Math, Listening	88.0	92.5	68.0

The first class period consisted of four self-contained students. Student 1 was a female student classified as communication impaired. She had a shared teacher assistant assigned to her that she would rely on regularly if granted the opportunity. This student was capable of completing independent classwork.

Student 2 was a male student classified with a specific learning disability for math comprehension. He had been diagnosed with Oppositional Defiant Disorder as well as Attention Deficit Hyperactivity Disorder (ADHD). This student was capable of working at grade level and was moving into the in-class-support setting next year for science. He often missed class as he prefers "to only attend the required four hours of school a day." Student 2 was argumentative and would not complete missed work as a result of his absence.

Student 3 was a male student classified as Other Health Impaired for ADHD. This student was often seen late at night walking around town and riding his bicycle. As a result, he came to school tired and struggled to remain awake while completing his work. When he was tired, he would often shut down and would not complete the material placed before him.

Student 4 was a male student classified with a specific learning disability for reading comprehension, written expression, and mathematics calculation. He was diagnosed with ADHD and often became angry and aggressive when he struggled with his work.

The second class period consists of six pull-out/resource students. Student 5 was a male student classified as communication impaired. This student worked hard to please everyone and to exceed at all he attempted. Unfortunately, his speech abilities made it difficult for people to understand him. This student had significant psychosocial stressors

relating to his upbringing, though he worked hard to maintain an upbeat and bubbly personality in the classroom.

Student 6 was a male student classified as specific learning disability though no specific disability is noted. He was interested in hands-on engineering and robotic activities. This student strived to complete all of his tasks in the math and science classrooms though it is noted that he often argued and complained to the other teachers when he felt he had been treated unfairly.

Student 7 was a female student classified with specific learning disability in mathematics problem solving. She was interested in a hands-on cosmetology program when she finished middle school. Her test taking skills were lacking and she struggled to complete tests and quizzes correctly. Despite this, she was always upbeat, smiling, happy, and ready to do any work asked of her.

Student 8 was a male student diagnosed with autism. He was extremely interested in computers and spent his free time creating animations for his YouTube channel. He worked slowly but efficiently, earning high scores on every assignment he completed.

Student 9 was a male student classified as communication impaired. He was diagnosed with ADHD which affects his ability to concentrate and complete his work. Grades had declined since the start of the school year, possibly as a result of a lack of medication.

Student 10 was a female student classified with specific learning disability in reading comprehension, basic reading skills, written expression, mathematics problem solving, and listening comprehension. She read at an 8th grade reading level, however, and was a

strong student in science, completing all of her work and maintaining high academic scores.

Teacher. The science classes were instructed by a certified middle school science teacher for the entire 45 minute period. This teacher had two years of experience in math and science special education. She was responsible for creating stimulating and engaging lessons that encompass the Next Generation Science Standards and the mathematics Common Core standards.

Materials

A Chromebook or computer with access to the internet was required for each student to access the Discovery Education Techbook. The students were guided to sign into the website when working on lesson material from the site. This website allowed the students to read and listen to videos. Headphones or earbuds were used to assist students in watching the videos independently without interfering with other lessons.

A traditional printed textbook was required for the students to read and complete the lessons during each baseline phase. Related videos including Bill Nye and the Magic School Bus were used along with the print textbook to eliminate the video component interfering with comparing the two types of textbook.

Measurement Materials

Engagement observation checklist. An observation checklist was developed using boxes to list the number of minutes a student spent on task for each interval. The researcher and teacher assistant scored students as on and off task using interval recording for 5 minute intervals during a 40 minute duration. A copy of the observational checklist can be found in Appendix A.

Assignments. The students worked on competing vocabulary, homework assignments, guided notes, vocabulary quizzes, section quizzes, and section tests. These assignments determined the percentage that resulted in the academic progress score.

Student interest survey. At the end of the study, students participated in a survey of perceived understanding and learning that occurred when using the different educational modalities. The questions inquired about ease of text use, understanding the information as it was presented, and whether or not the material was interesting. Students then responded in a short response section about their textbook preference and the reason they chose this preference. A copy of the student survey can be found in Appendix B.

Research Design

A single subject design with ABABA phases was used. Phase A began with the students using the print textbook to complete definitions of the material they were learning, and completing a related quiz on the vocabulary words. The students were next responsible for completing guided notes and homework assignments on the lesson material. Finally, students completed a test at the end of the phase. During Phase B, students used the Discovery Education Techbook (the e-text) to again complete vocabulary definitions and a related quiz. The students were next responsible for completing guided notes and homework assignments in response to the traditional print textbook materials, and for completing a test at the end of the phase. This procedure was repeated for a second Phase A, a second Phase B, and a final return to baseline (Phase A) with each phase lasting one week.

Procedure Design

Instructional design. Instruction was provided and data collected over the course of five class sessions a week for five weeks. During weeks one, three and five (Phase A), students worked using the traditional print textbook to complete a vocabulary assignment, guided notes, and homework assignments. Throughout each one week time frame, the students completed three homework assignments, a vocabulary quiz and a test on the material. Any additional time during the week provided the students the opportunity to create a Kahoot quiz or Quizlet section on the internet to study for the various activities. Students had the opportunity to work at their own pace to complete the material, however the test and quizzes were on a set date.

During weeks two and four (Phase B), the Discovery Education Techbook was used to complete the vocabulary, notes, and homework assignments. The quizzes and tests occurred in the same time frame as they did during the print textbook phases. Then, the research repeated itself on a weekly basis for a total of five weeks.

Measurement Procedures

Observations. The researcher observed and recorded student engagement for a 40 minute session divided into 5 minute intervals daily. A vibrating alarm was used to prompt the researcher to note the time at each interval. The researcher observed the students from the side of the classroom to determine student engagement. For each of the five minute intervals, the number 1-5 was used to denote the number of minutes on task for each student on an observational checklist (see Appendix A).

Survey. At the end of the study, the students participating in the study were asked to complete a survey. The survey was used to determine student reported ease of use and

preference in textbook format. The researcher read each statement aloud and directed the student to mark their agreement or disagreement to the statement in the appropriate column (see Appendix B).

Academic grades. All completed assignments were recorded as data for the academic progress portion of the project. The teacher stored and accessed this information using the district's Realtime gradebook as well as a traditional written gradebook.

Data Analysis

Student engagement was recorded in visual graphs representing each phase. The timing was converted into percentages of the period that students were on task. Academic grades were also compared in graphs according to percentages to provide a visual representation of student data at each phase. Means and standard deviations were displayed in table format. Student satisfaction survey scores were calculated in percentages.

Chapter 4

Results

Academic Performance

Academic Performance was evaluated using five graded assignments: three homework assignments, one vocabulary quiz, and one section test for each portion of material learned. Student academic performance means were calculated and are presented in Table 2. Figures 1-10 represent the students' grades in graphical format.

Table 2

Mean and Standard Deviation (SD) of Academic Performance

	Baseline 1		Intervention 1		Baseline 2		Intervention 2		Baseline 3	
Student	**Mean (%)**	**SD**	**Mean (%)**	**SD**	**Mean (%)**	**SD**	**Mean (%)**	**SD**	**Mean (%)**	**SD**
1	61.0	34.69	83.2	23.27	83.2	19.52	63.0	26.12	77.0	5.66
2	56.4	33.61	60.0	54.79	66.0	13.55	82.2	13.70	68.6	34.77
3	65.6	31.53	72.0	18.81	65.2	31.58	64.2	32.76	61.4	23.29
4	78.6	38.95	97.6	3.36	93.2	8.47	91.6	9.50	96.0	6.16
5	60.2	36.69	74.2	27.35	64.6	20.32	75.4	22.67	79.0	13.42
6	96.2	5.85	95.8	6.26	98.6	3.13	92.0	8.46	85.8	11.54
7	66.7	21.81	81.3	8.04	66.4	22.37	75.6	30.41	70.4	10.71
8	98.0	4.47	98.2	4.60	93.4	7.09	93.6	9.21	81.6	13.15
9	74.8	31.03	64.0	28.15	71.6	18.85	68.6	19.44	81.4	15.96
10	75.0	24.99	90.6	8.71	82.8	10.42	85.4	21.70	89.0	7.42

In the area of academic performance measured by a vocabulary quiz, three homework assignments, and a test, the group mean at baseline 1 was 79.02%. The group mean at intervention 1 was 73.25%. The group mean at baseline 2 was 81.69%. In intervention 2, the group mean was 78.5% and baseline 3 was 79.16%. Each of the interventions showed a group mean lower than that of the baseline results.

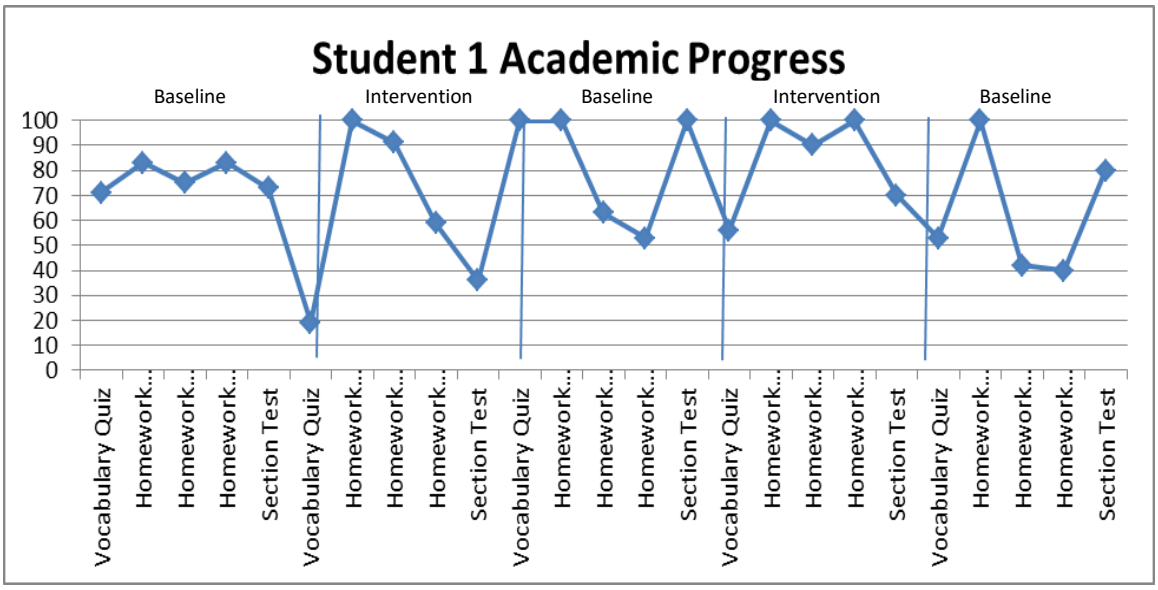

Figure 1. Student 1. Academic Performance

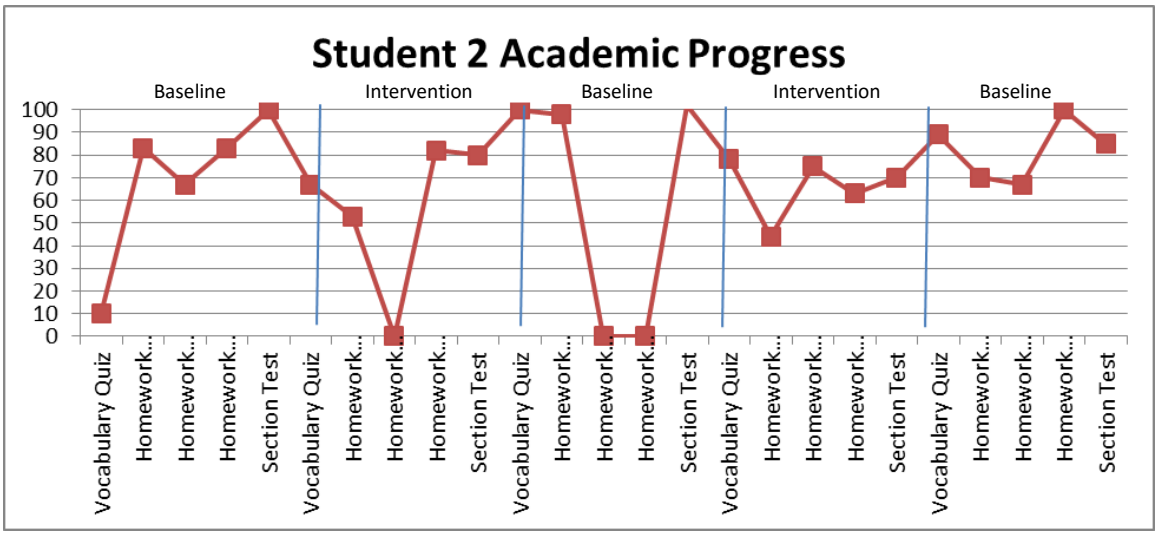

Figure 2. Student 2. Academic Performance

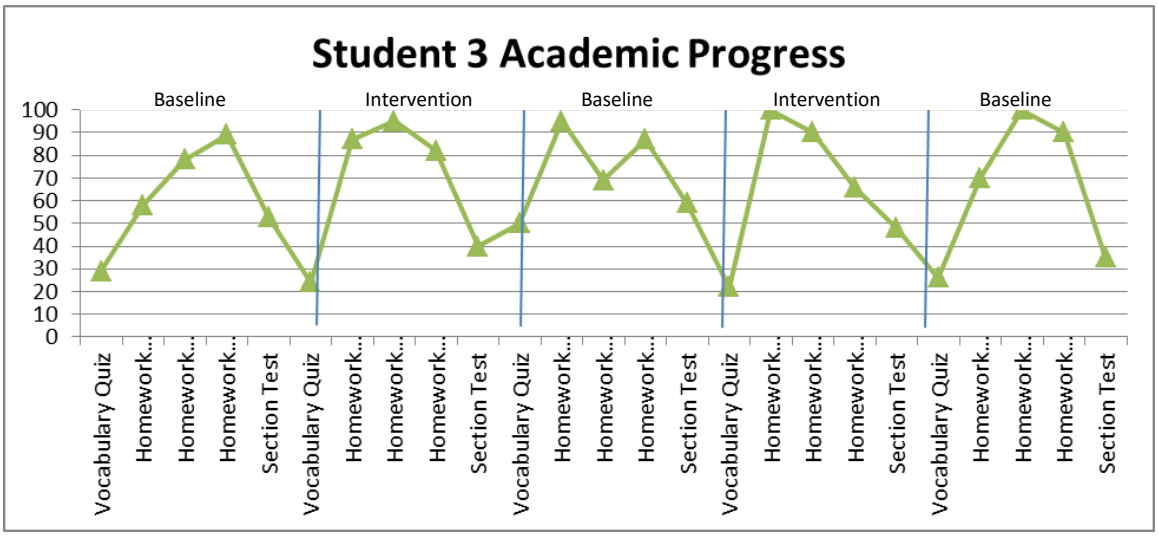

Figure 3. Student 3. Academic Performance

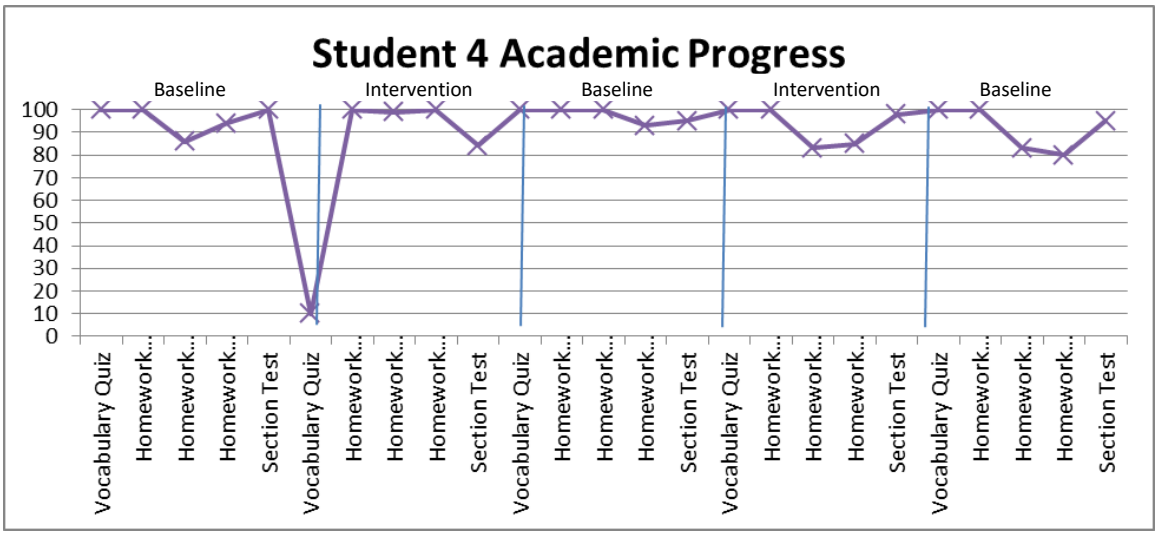

Figure 4. Student 4. Academic Performance

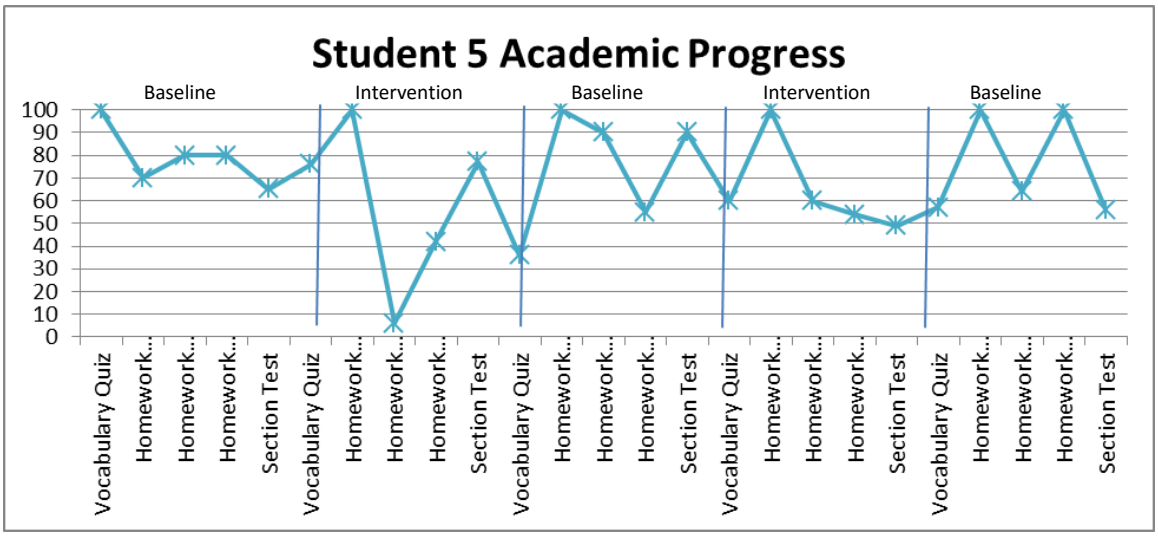

Figure 5. Student 5. Academic Performance

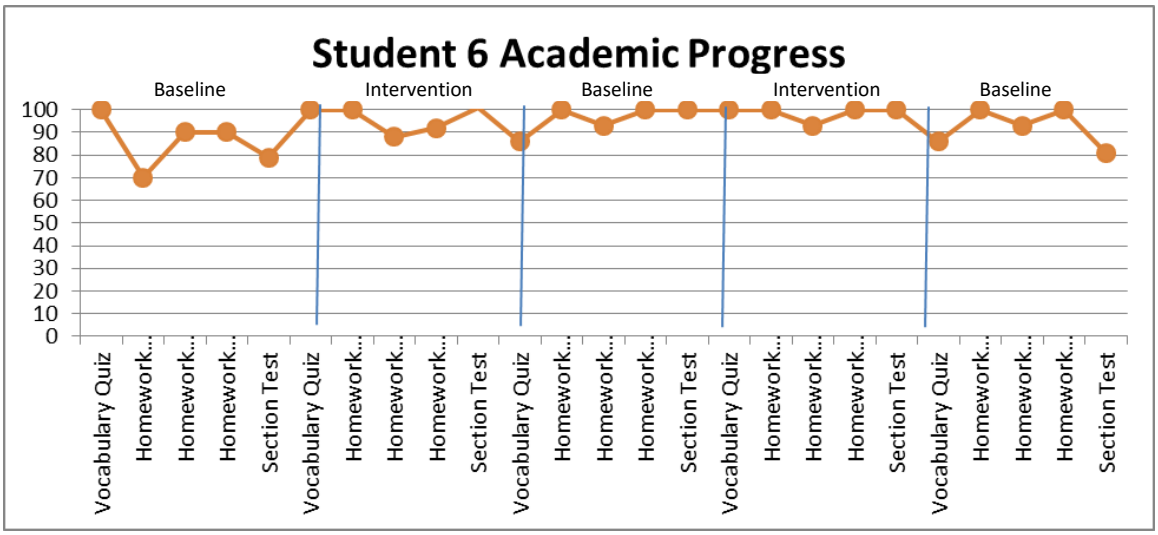

Figure 6. Student 6. Academic Performance

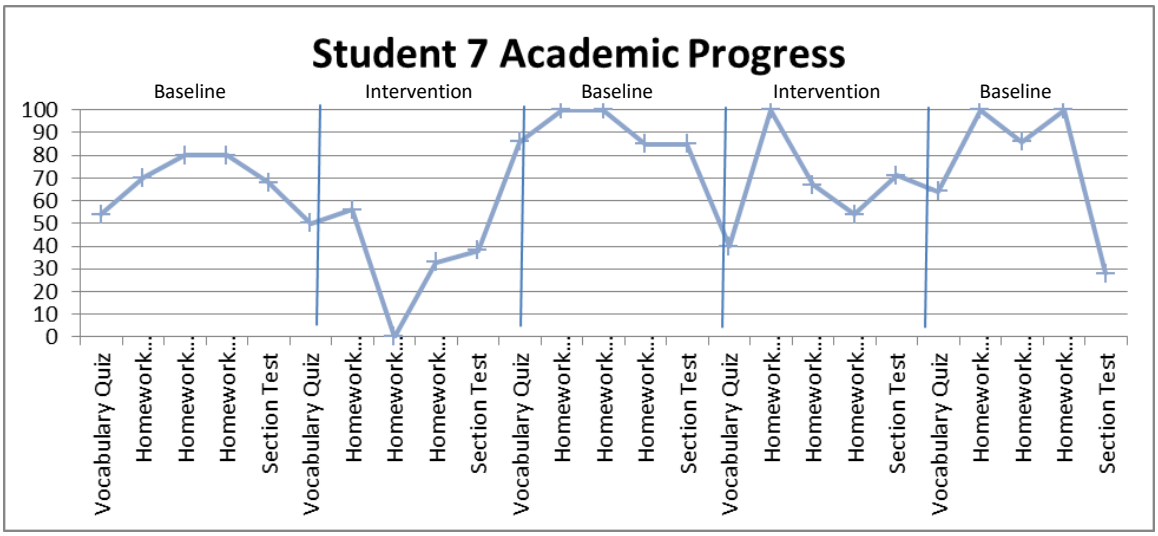

Figure 7. Student 7. Academic Performance

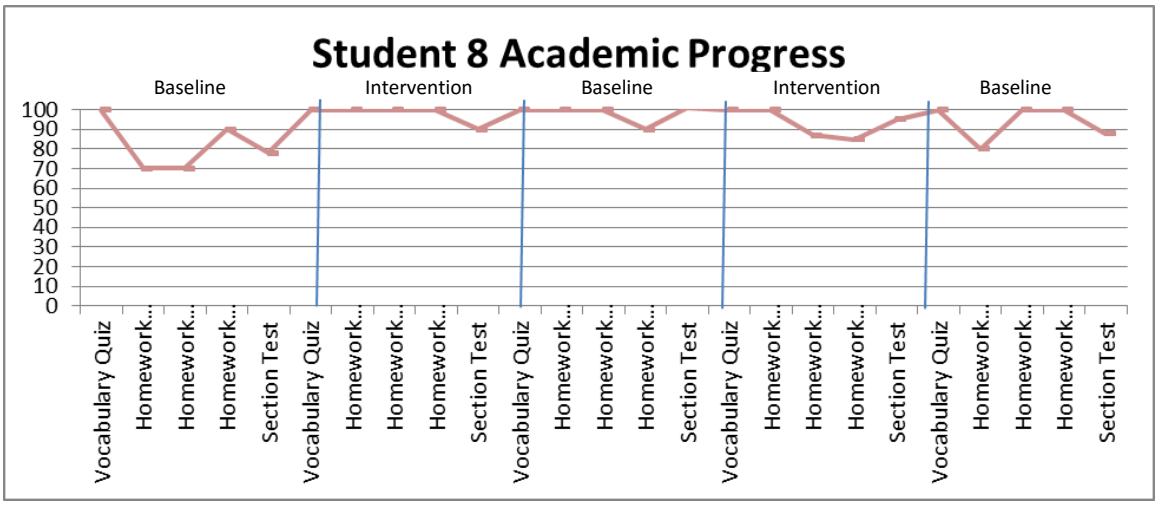

Figure 8. Student 8. Academic Performance

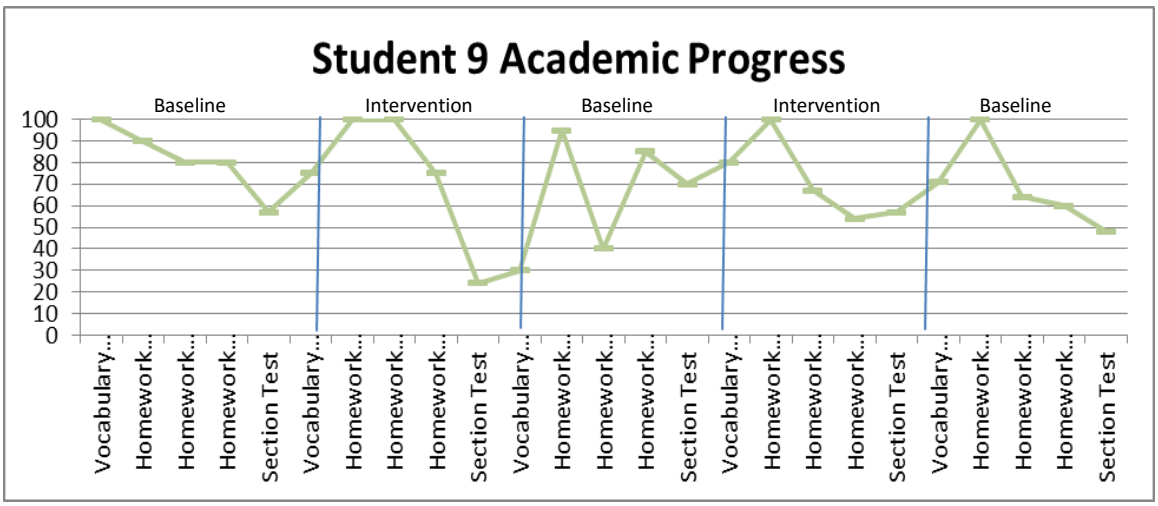

Figure 9. Student 9. Academic Performance

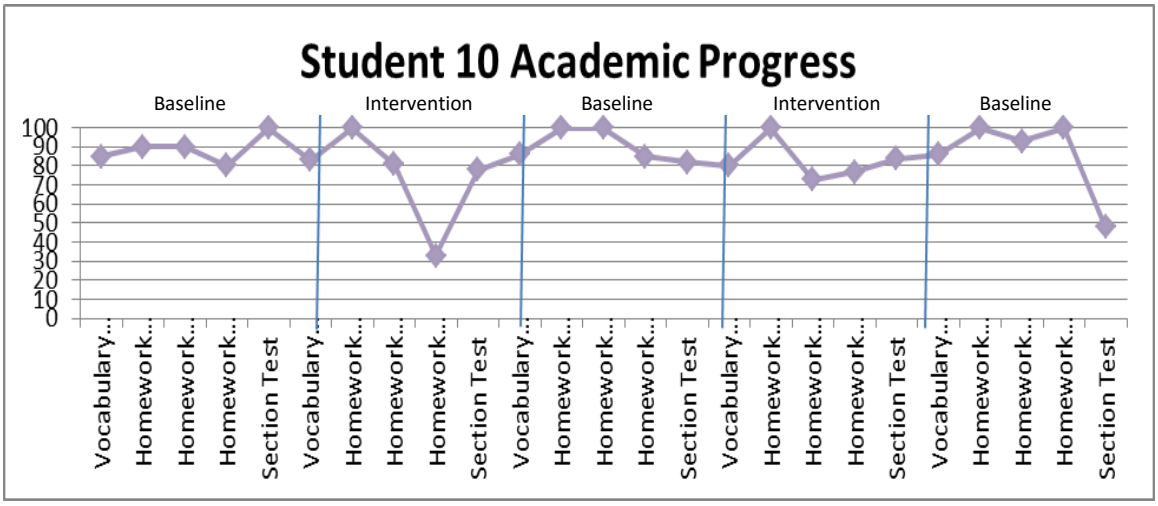

Figure 10. Student 10. Academic Performance

Vocabulary quizzes. A visual review of individual student vocabulary quiz data reveals a trend in which students had a higher score for the first two baseline's than the intervention's. The third baseline results do not correlate with the results of the first two baselines nor the interventions.

Homework assignments. A visual review of individual student homework assignment data reveals a trend in which homework scores were often higher on the baseline than that of the intervention.

Section tests. A visual review of indivual student test scores reveals a trend in which test scores were higher on the first two baselines than that of the interventions. There was a decline in the scores from the third baseline, as with the vocabulary quizzes.

Student Engagement

Student Engagement was evaluated in five minute intervals each day that the students were working on the material learned and then added for a total for the day. The maximum number of minutes a student could work was 40. Means of each student's

engagement were calculated and are presented in Table 3. Figures 11-20 represent the student's engagement in graphical format.

Table 3

Means and Standard Deviation (SD) of Student Engagement

	Baseline 1		**Intervention 1**		**Baseline 2**		**Intervention 2**		**Baseline 3**	
St.	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
1	36.5	4.73	35.0	4.08	25.67	9.45	33.0	2.0	33.2	9.04
2	19.8	14.36	24.0	3.92	13.75	8.54	6.0	2.83	13.0	2.74
3	30.6	5.03	32.0	4.42	24.6	9.91	31.0	2.58	29.6	11.33
4	31.8	7.66	35.5	4.43	32.5	11.90	34.0	2.45	30.8	8.44
5	36.8	4.44	37.0	4.47	33.2	10.33	37.0	3.08	35.6	6.99
6	35.2	4.55	36.6	3.44	29.0	8.00	35.2	5.02	36.6	4.67
7	34.0	5.61	33.4	6.15	29.4	8.50	34.4	6.43	26.0	13.13
8	37.8	3.90	36.8	4.60	28.6	8.20	37.4	5.81	39.0	1.41
9	32.8	9.47	35.4	5.32	30.4	8.73	35.8	4.60	35.8	7.36
10	30.6	7.64	34.6	6.95	29.8	8.81	34.6	5.90	27.2	12.83

In the area of student engagement, measured by number of minutes on task out of a 40 minute class period, the group mean of baseline 1 was 30.68 minutes out of 40, or 76.7% of time engaged in the lessons. The group mean at intervention 1 was 32.59 minutes or 81.48% engagement. At baseline 2, the group mean was 34.03 minutes or

85.08% engagement. Intervention 2 had a group mean of 27.69 minutes or 69.23%. The third baseline measurement had a group mean of 31.84 minutes or 79.6% engagement.

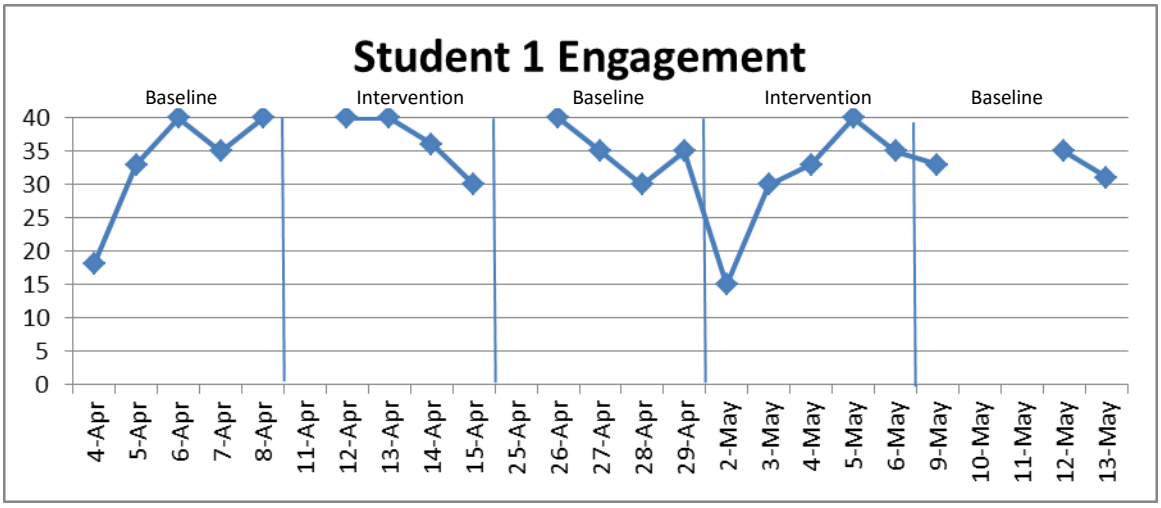

Figure 11. Student 1. Student Engagement

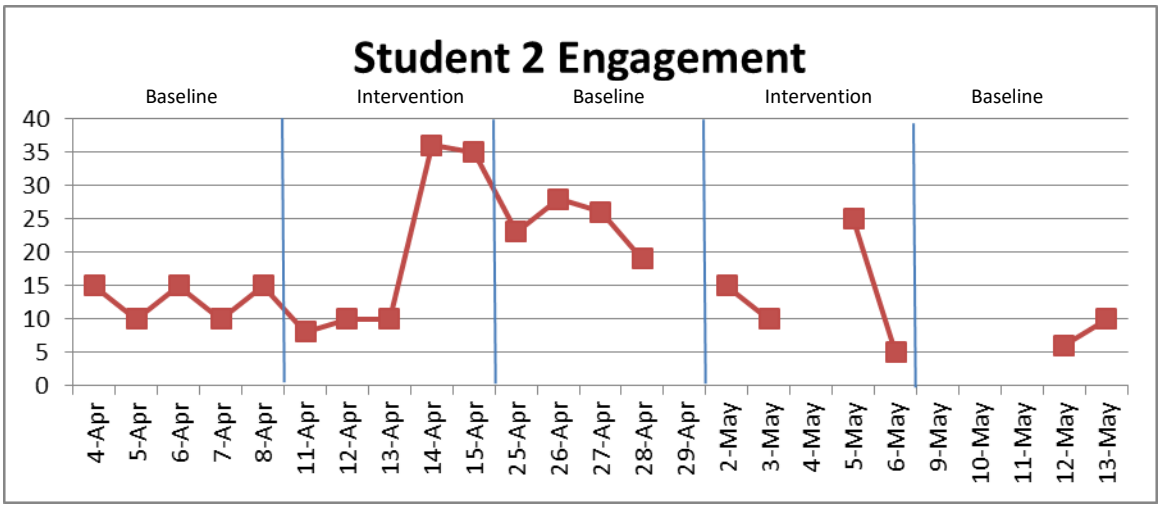

Figure 12. Student 2. Student Engagement

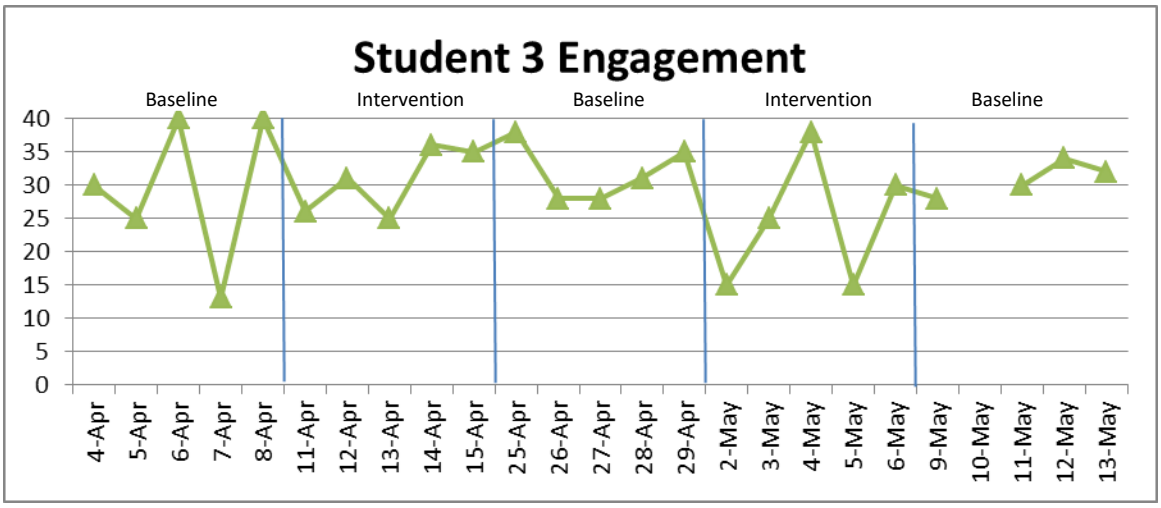

Figure 13. Student 3. Student Engagement

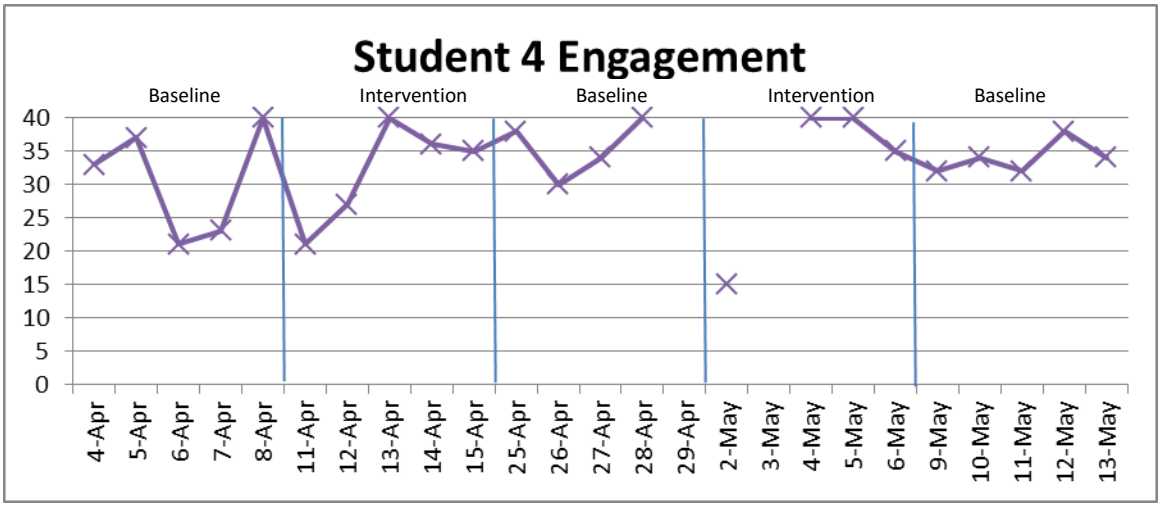

Figure 14. Student 4. Student Engagement

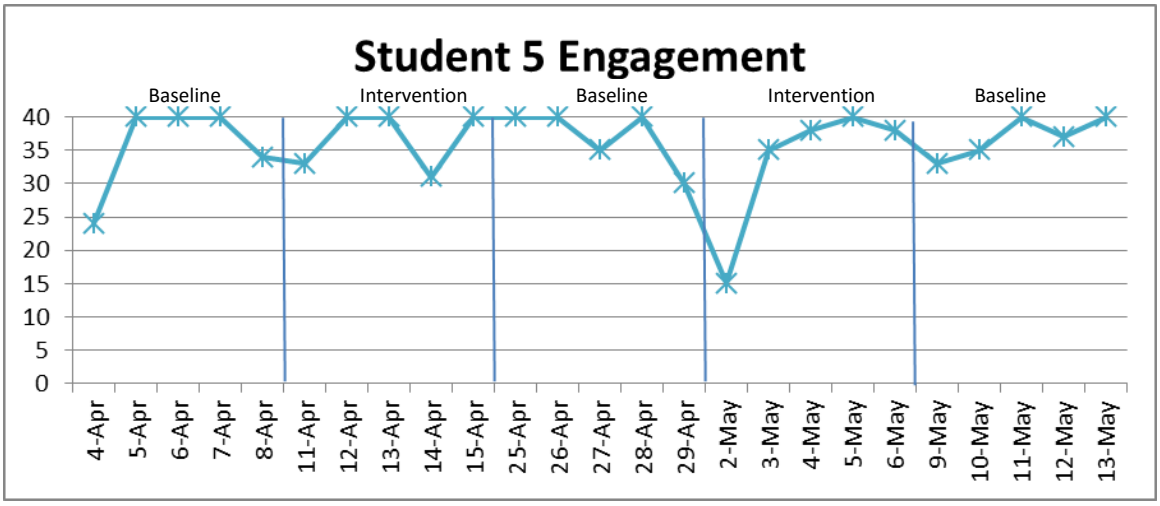

Figure 15. Student 5. Student Engagement

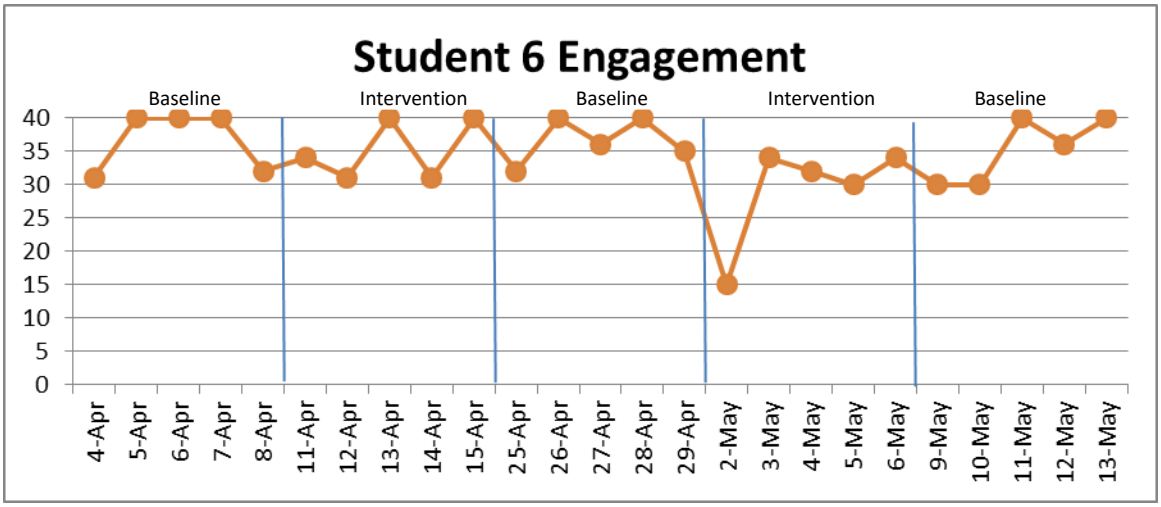

Figure 16. Student 6. Student Engagement

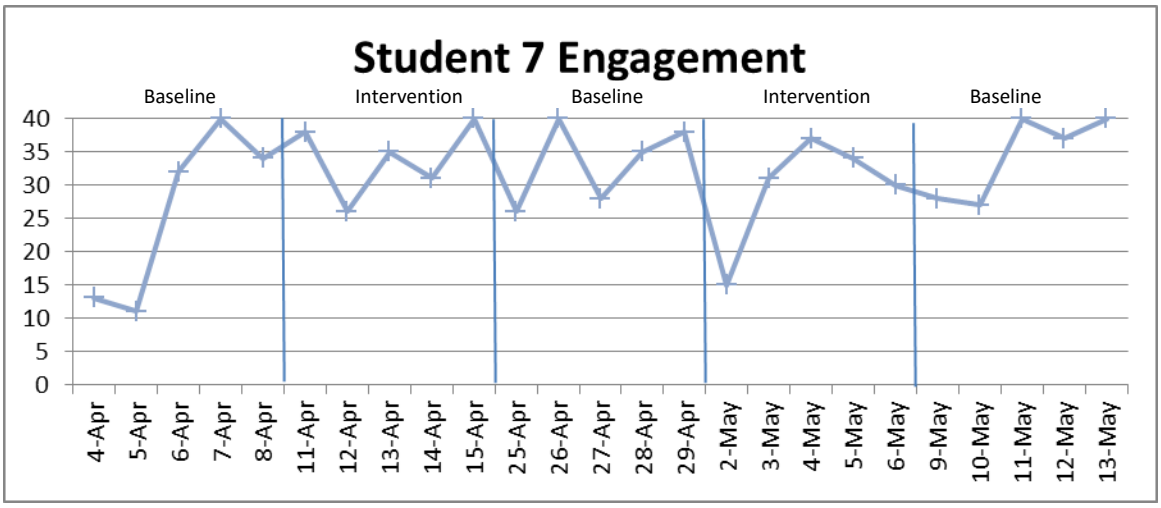

Figure 17. Student 7. Student Engagement

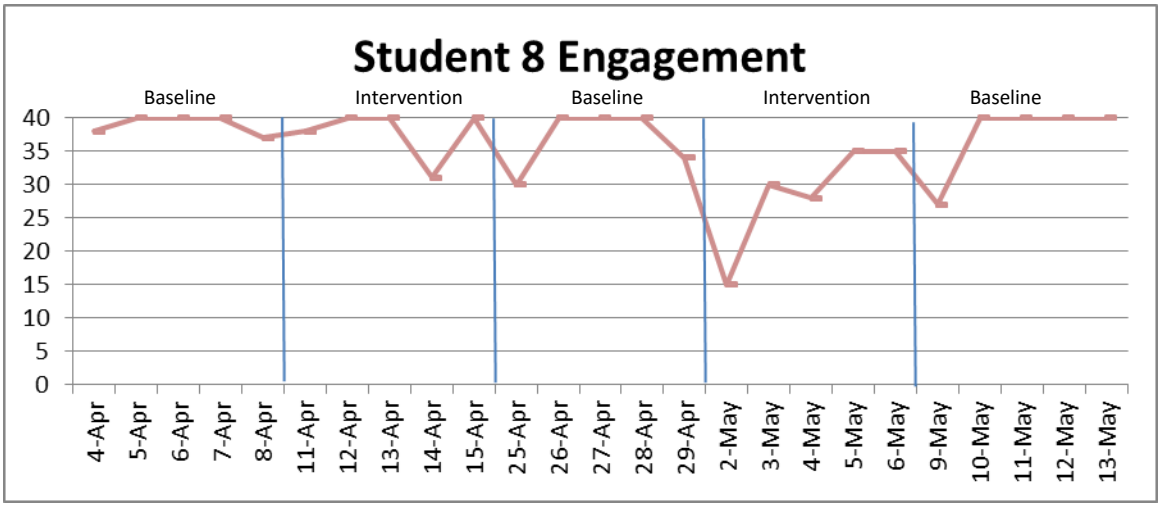

Figure 18. Student 8. Student Engagement

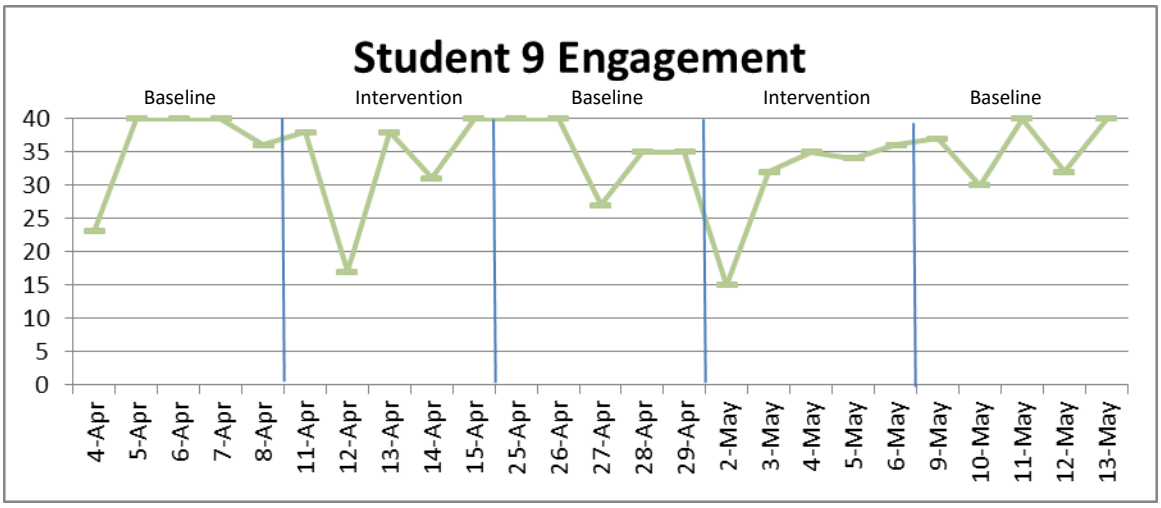

Figure 19. Student 9. Student Engagement

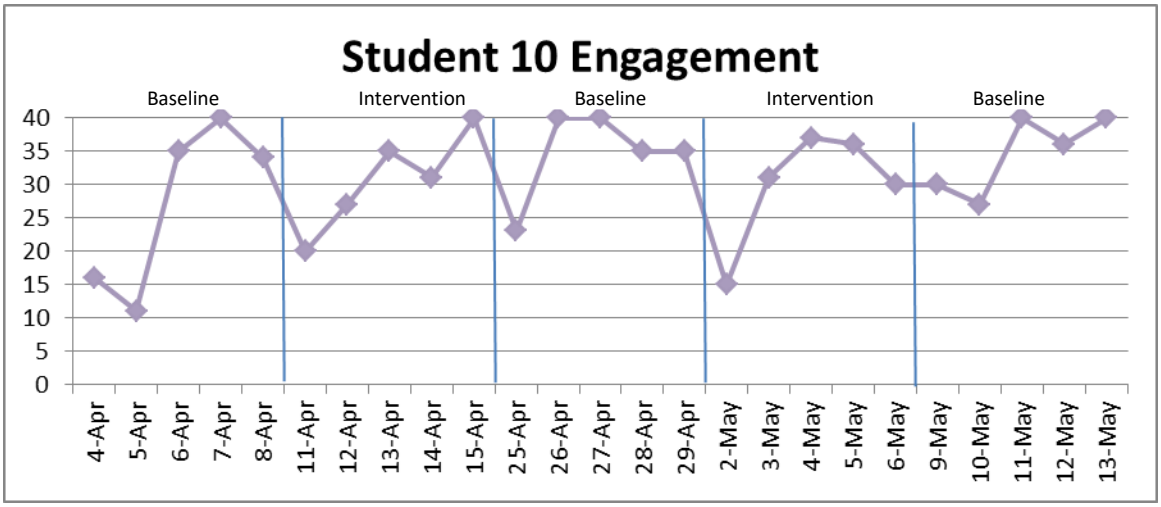

Figure 20. Student 10. Student Engagement

Engagement. Each baseline engagement mean is greater than the intervention mean. Standard deviation of each individual's engagement increased in range during the intervention, from a standard deviation of 7.99 in interventions compared to 5.55 in

baseline phases. A visual review of individual student engagement data reveals a trend of reduced engagement at intervention 1 and 2 with student 9.

Student Interest Survey

Student interest was measured using a survey (see Appendix B) after the students completed all of the lesson material. The students were given a 20 minute time frame to complete the survey with no guidance or suggestions from the teacher. No names were written on the survey to maintain student confidentiality. Percentages of student responses are presented in Table 4.

Table 4

Student Interest Survey Results in Percentages

	Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %
1. The textbook was easy to use and understand.	10	10	80		
2. The textbook was uninteresting.	10	10	20	40	20
3. The textbook was too difficult to follow.	10	40	30	20	
4. The textbook was difficult to use.	10	50	20	20	
5. I understood how to find information in the textbook.	10	10	40	20	20
6. I understood where to find the information in the textbook.		20	40	40	
7. The e-text was easy to use and understand.			50	30	20
8. The videos fit in with what I was learning.	10		40	40	10
9. The e-text was uninteresting.	20	20	40	20	
10. The e-text was too difficult to follow.	30	30	30	10	
11. The e-text was difficult to use.	30	20	20	10	20
12. I understood how to find information in the e-text.		20	20	30	30
13. I understood where to find the information in the e-text.	10	10		40	40

According to the results of the student survey, 80% of the students felt neutral about the use of the print textbook, however, 0% of students agreed that it was easy to use and understand. In contrast, 50% of students felt the e-text was easy to use and understand. In terms of e-text usage, 30% of students strongly disagreed that it was difficult to use, and 20% of students disagreed that it was difficult to use, for a total of 50% of students disagreeing that it was difficult to use.

Chapter 5

Discussion

The purposes of this study were to determine if using e-text technology in a middle school resource science classroom increases student academic performance, to determine if using e-text technology in a middle school science resource classroom increases student engagement and on-task behavior, and to evaluate student comfort and satisfaction in using an electronic textbook or print textbook.

Findings

The results of the study regarding academic performance showed that student overall academic performance was lower when using the e-text than when using the printed textbook. On average, student scores were 79.96% when using the printed textbook in comparison to the 75.88% when using the e-text. The 7th grade class had lower mean scores compared to the 8th graders whether using the printed textbook or the e-text. Despite the low scores, the 7th grade group scored higher when using the printed textbook than when using the e-text. The 8th grade class had similar results to that of the 7th graders, with lower scores occurring when using the e-text than when using the printed textbook. Student 6 and student 8 were successful, earning top scores on the material using both the printed textbook and the e-text. All students were successful with the textbook and the e-text in completing the work put forth before them with little assistance.

Furthermore, homework scores were higher for both grades when using the printed textbook. The final baseline results for quizzes and tests do not correspond with the results of the first two interventions, however. Overall, study results related to student

academic performance corroborate the findings of Drummond et al. (2011) in which no academic benefit was found for students who utilized enhanced e-texts.

In terms of student engagement, time on task varied based on the section and material that was being taught as opposed to what text format was being tested. The first intervention showed the strongest level of student engagement. This time on task declined, however, in the second intervention (mean decline of 12%.) Student 2 was not engaged in much of the lesson material being taught, especially when using the printed textbook. This may be explained by the fact that when using the e-text, more time and effort was placed on the work that was being completed. In contrast, student 9 showed a decline in mean engagement when using the e-text as opposed to the printed textbook. Furthermore, each of the students had a severe decline in active engagement on Monday, May 2nd and this can likely be explained as a result of 50 quail chicks that hatched over the weekend. These quail led to disruption that first day until the excitement wore off and students returned to their learning for the last 15 minutes of class time. Results from this study contradict earlier research from Rockinson et al., (2013) as students were not more active learners or more focused when using the e-text than when using the printed textbook.

In terms of student text preference, survey results showed that they preferred the e-text over the printed textbook. Students were more likely to agree that the e-text was easy to use and follow than the printed textbook. Forty percent of the students agreed with the statement that the textbook was uninteresting, while 20% of the students agreed that the e-text was uninteresting. For the open-ended question, "What did you think of the study? If you had a choice of either electronic textbook or printed textbook, which

would you choose? Why?" students responded that the "electronic textbook is better because info is way easier to find," or that the "techbook is better because there is less stuff to carry and it is much easier to understand. Keep the techbooks!" One student even responded that the "e-text is better because it made the learning interesting." Another response was "the electronic textbook because it's faster to search pages and we get to rewatch videos we didn't understand." Out of the ten surveys completed by the students, two students felt the "printed textbook is better because it's easier to read," and that the "textbook is easier." Eight of the ten students however, preferred the e-text, stating that it is easier to use. These results corroborate the results of Marino et al. (2014) where students stated they preferred to access and study scientific information through technology rather than through a printed textbook.

Limitations

Time was a major limitation in this study. This study was conducted during the last third of the school year, from April 4th until May 13th. The study was conducted during the end of the school year, and as a result, students were often completing work around field trips, school assemblies, and presentations from the regional high school they would be attending. The study itself had to be restricted to a five week time period to avoid the 8th grade Washington D.C. trip which lasted for three days, from May 18-20th, and the 7th grade Pocono Environmental Education Center trip which affected Students 1-4 on May 11th. Final exams and grades were also to be completed before June 5th, with science exams taking place immediately following the Washington D.C. trip.

The results of this study may have also been limited by the data from student 2. The data from student 2 skewed the final results as this student was more inclined to be

oppositional, refusing to complete work and eventually, not attending school at all. This affected the final results, lowering the mean for both engagement and participation, not just in terms of the 7th grade class but the final results as well. It may have been better to study this student during the first part of the school year, when he was still actively participating and completing work.

Another major limitation for this study was the unexpected distraction of hatching of quail in the classroom. At the beginning of April, 120 Bobwhite Quail eggs were placed in an incubator in the classroom where they developed until they hatched on Saturday, April 30th. Upon arriving in the classroom on May 2nd, the students were excited and eager to examine the quail chicks as opposed to completing the work assigned to them. Within a day, the students settled into an easy routine of visiting the chicks before class started and then working for the remaining class time, visiting again after the bell rang to signal the end of class. Student 7 would sit by the quail and complete her work next to their brooder box, which resulted in much higher academic scores during the time the quail chicks were present in the classroom. While they may have been a distraction initially, the quail were a reason for some students to work harder and improve their academic grades.

Implications and Recommendations

Though this study had its limitations, it presents the usefulness of printed textbooks in the 1:1 science classroom. Earlier studies demonstrate the usefulness of e-text for student learning at a higher age level though more studies are warranted to determine if this technology is beneficial in the middle school classroom (Moreno, et al., , 2015; McIntyre, et al., 2015; Drummond, et al., 2011; Sheppard, et al., 2008; Woody, et

al., 2010). Further studies are needed to determine the effectiveness of the e-text in the 1:1 science classroom. The majority of middle school students found the e-text to be easier and more user friendly, expecting higher scores and a better likelihood of staying on-task during the lesson. Results however determined that the printed textbook led to better scores and student engagement levels.

As a result of study findings, it appears middle school science teachers should use e-texts in conjunction with traditional textbooks to further student understanding. E-texts will motivate and engage the students while a printed textbook will further the students learning. Study findings add to the current research base on e-texts and middle school science classrooms, noting research is still vague in describing how to best meet the educational needs of student through the use of e-texts. Additional research appears warranted to determine best practices in when and how to utilize e-texts effectively in the interactive science classroom.

Conclusion

The study was successful in that it determined the usefulness of the printed textbook in the science classroom as opposed to the e-text that is becoming the norm in many classrooms. While technology continues to improve and develop, students may struggle to be more successful in the academic classroom without teacher guidance in the use of this technology. Further research is needed to determine how to educate students using best practices when the use of an e-text is required. With more time and practice, there is the possibility that students may be successful using the e-text, just as they are now with the printed textbook.

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Appendix A

Monitoring Materials

Student Academic Progress

Method: _____ Date: _____ Week #: _____

Student #	Vocabulary Quiz	Homework Assignment	Homework Assignment	Homework Assignment	Section Test
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Student Engagement Monitoring

Method: _____ Date: _____ Week #: _____

Student #	5 minutes	10 minutes	15 minutes	20 minutes	25 minutes	30 minutes	35 minutes	40 minutes
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Number 1-5 for number of minutes on task

Appendix B

Student Satisfaction Survey

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The textbook was easy to use understand.					
2. The textbook was uninteresting.					
3. The textbook was too difficult to follow.					
4. The textbook was difficult to use.					
5. I understood how to find information in the textbook.					
6. I understood where to find the information in the textbook.					
7. The e-text was easy to use and understand.					
8. The videos fit in with what I was learning.					
9. The e-text was uninteresting.					
10. The e-text was too difficult to follow.					
11. The e-text was difficult to use.					
12. I understood how to find information in the e-text.					
13. I understood where to find the information in the e-text.					

What did you think of the study? If you had a choice of either electronic textbook or printed textbook, which would you choose? Why?_____

_____

_____

Any additional comments are welcome: _____

_____

_____