9-22-2016

The effect of the video game Quizlet on the acquisition of science vocabulary for children with learning disabilities

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THE EFFECT OF THE VIDEO GAME QUIZLET ON THE ACQUISITON OF SCIENCE VOCABULARY FOR CHILDREN 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
August 22, 2016

Thesis Chair: Amy Accardo, Ed. D.

Dedications

I would like to dedicate this thesis to my mother Marian Foster and my three children, Christopher, Rachel and John. I am indebted to my many colleagues who supported me.

Acknowledgments

I would like to express my thanks to Professor Amy Accardo, Ed. D for her never-ending patience, guidance and support during the research and writing of my thesis and Rachel who took the journey with me.

Abstract

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FOR CHILDREN WITH LEARNING DISABILITIES
2015 - 2016
Amy Accardo, Ed. D.
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The purpose of this study was to investigate the impact of the learning video game *Quizle*t on students with learning disabilities in the science classroom. Specifically this study investigated (a) student academic performance, (b) student on-task behavior, and (c) student satisfaction using the learning video game. Student academic performance was measured in terms of vocabulary acquisition, and student engagement was measured in relation to on-task behaviors. Seven middle school students, three female and four male participated in the study. A single subject design with ABABAB phases and maintenance data collection was utilized. Results show that all students increased their grades in science vocabulary and increased on-task behaviors. A follow-up student satisfaction survey determined that the intervention was acceptable to all students. Additional studies to assess the effects of Quizlet are recommended.

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Chapter I

Introduction

Technology is present all around us, not limited to personal computers or laptops used in home offices, or classrooms. Technology travels with us in the form of smartphones, iPods, tablets and handheld devices. Students use technology to communicate, gather information, and learn (Marino 2010). Innovations in assistive technology allow students with learning disabilities to communicate, and keep up with their non-disabled peers in and out of the classroom (Wilkins & Ratajczak 2009, Hasselbring & Glaser 2000). Students who are non-verbal may use assistive communication devices to communicate with their peers and adults (Hasselbring & Glaser 2000). Other students with learning disabilities, like dyslexia or struggling readers, may use e-texts and computers instead of paper and pencil to complete the same assignments as non-disabled peers (Hasselbring & Glaser 2000).

Statement of the Problem

According to the Learning Disabilities Association of America (2014), learning disabilities (LD) are neurologically based processing problems that can interfere with an individual's ability to learn basic skills, organizational procedures and abstract reasoning. LD can manifest as difficulties in the area of listening, thinking, speaking, reading, writing, spelling, or doing mathematical calculations. Difficulties with reading and language skills are the most common learning disabilities. As reported by the Learning Disabilities Association of America (LDA), approximately 80% of individuals with LD have trouble in reading (2014). Dyslexia is a common form of LD, which presents as difficulty reading (LDA, 2014). Mathematical difficulty or dyscalculia is trouble solving arithmetic problems and understanding mathematical concepts (LDA, 2014). Individuals with LD may be non-verbal, have difficulty in writing or forming letters, or have sensory disabilities including visual and auditory (LDA, 2014, National Joint Committee on Learning Disabilities 2011). Kuder (2013) suggests that along with cognitive issues, individuals with LD take longer to retrieve words from memory than typically developing peers. LD is permanent and while there is no cure, with proper interventions and supports, individuals can succeed in school and beyond (National Joint Committee on Learning Disabilities, 2011).

According to the Learning Disabilities Association of America (2014), LD is the largest category of students receiving special education services. The organization reports that over 2.4 million public school children are identified with LD under the Individuals with Disabilities Education Act (IDEA 2004). As a requirement of the No Child Left Behind Act (2002), all students with LD must meet minimum academic standards including passing state standardized tests in content areas such as science. According to Mastropieri and Scruggs, science education creates opportunities to think about the world (1992). Science consists of unfamiliar, copious terminology (Mastropieri, Scruggs, & Magnusen 1999). It is important for students in the science classroom to make connections between science vocabulary and their assignments to create successful experiments (Scruggs, Mastropieri, & Okolo 2008). Marino (2010) reports that intervention programs providing intensive remedial instruction to elementary students with LD take place in subjects other than reading, writing, and mathematics. The researcher suggests that these interventions prevent students with LD from learning fundamental science vocabulary and concepts (2010). Furthermore, students with LD struggle in science because there is often a discrepancy between their reading abilities and requirements of science curriculum (Seifert & Espin 2012).

There are many components to learning. Vaidya (1999) suggests that inadequate background knowledge, poor study skills, cultural or language differences and the inability to pay attention are some factors that affect learning. Vaidya proposes that children with LD lack the metacognitive skills and learning strategies to overcome these difficulties, which makes their learning experiences difficult or painful (1999). Each unit in science involves vocabulary, often expanding on previous terminology while introducing new, important information. Some students with LD have language-processing deficits that impede their language growth in content-specific areas like science (Dieker, Finnegan, Grillo, & Garland, 2013). Furthermore, students can become overwhelmed and frustrated in learning tasks that include written work, like vocabulary definitions and terminology (Vaidya 1999). In the inquiry-based science classroom, vocabulary understanding, student engagement and attention are especially important to avoid injury from flames, misuse of chemicals or incorrect procedures. Park and colleagues (2012), suggest student engagement is fundamental to academic achievement. Therefore, it is important to keep students on-task by engaging them in the learning process. According to Mastropieri, Scruggs, and Magnusen (1999) science education promotes thinking and problem solving. In an inquiry-based science environment, students are expected to seek their own answers through problem solving and critical thinking.

According to a recent longitudinal study, 94% of students with disabilities spend part of their school day in general education classrooms like science (Wagner, Marder, &

Chorost, 2014). The readability level of science textbooks is usually one grade level above the intended reader, and students with LD often have instructional reading levels below their grade placement (Koury, 1996). Therefore, science vocabulary may be difficult for the student with LD to understand. While students with LD struggle with text-based learning and independent study, they enjoy science activities and benefit from hands-on approaches, exhibiting high on-task behaviors (Scruggs, Mastropieri & Okolo, 2008). Research in on-task behaviors (Archambault et al., 2009; Green et al., 2008; Hirschfield & Gasper, 2011) suggests that student academic disengagement presents behaviorally and cognitively, leading to poor academic outcomes. Students must develop metacognitive strategies like planning, monitoring, awareness of their behaviors and the eventual effects of those behaviors, in order to achieve academic success (Vaidya, 1999). When developed independently, these skills lead to positive life outcomes and productive adulthood. Models are not available for every life situation and children must be prepared to fly free of the nest. When students reach self-efficacy, they approach tasks and challenges positively (Schunk, 1985).

According to the Individuals with Disabilities Education Act (IDEA) of 2004 students with disabilities must be taught in the least restrictive environment (LRE). This means that students with disabilities have the opportunity to be educated alongside their non-disabled peers, to the greatest extent possible. This provides students with disabilities access to general education programs and other programs available to their non-disabled peers. LRE has given students with disabilities the opportunity to learn in inclusive science classrooms with their non-disabled peers. This opens doors for students with disabilities and allows them opportunities to prepare for careers in science and related fields (Mastropieri, et al. 1999). However, changes in the classroom may mean challenges for teachers (Dieker, Finnegan, & Garland 2013). Science teachers must approach teaching and learning from a new perspective. Dieker, Finnegan, and Garland suggest that as classrooms become inclusive, teachers must create multisensory instruction to meet the needs of a diverse student population (2013). Vocabulary instruction is important for students' comprehension as it expands their basic knowledge and encourages the construction of new meanings (Koury, 1996). Maria Montessori believed that learning occurs when teachers stop trying to use a one size fits all approach and, instead, determine how to tap the child's natural instincts for curiosity, play, and discovery (Brendtro, 1999). Finding a balance is crucial for the students with LD to reach their potential.

The academic disciplines science, technology, engineering and mathematics (STEM), are critical for student academic success and the future of competiveness and economic prosperity in the United States. According to Cover, Jones, and Watson (2011) high paying STEM occupations accounted for approximately 8 million U.S. jobs in 2009. These jobs include machine operators, product development, computer systems design and related services, research and development, and physicists. Therefore, the content area science is the foundation for employment in many industries.

Significance of the Study

This study may to add to existing literature as it aims to address the established instructional needs of students with LD through the use of video game technology. Focusing on video games along with the specific content area of science appears to fill a gap in determining the effectiveness of video learning games on students with LD.

Currently there is limited research exploring the video game impact on specific content, such as science vocabulary, and student engagement in science activities.

Statement of Purposes

The purpose of this study was to investigate the impact of the learning video game *Quizlet* on students with LD in the science classroom. Specifically this study utilized a single subject ABABAB research design to investigate (a) student academic performance, (b) student on-task behavior, and (c) student satisfaction using the learning video game. Student academic performance was measured in terms of vocabulary acquisition, and student engagement was measured in relation to on-task behaviors.

Research Questions

1) Will the use of the video game *Quizlet* increase the acquisition of science vocabulary for students with learning disabilities in the science classroom (vocabulary grades)?

2) Will the use of the video game *Quizlet* increase student engagement /time on task for students with learning disabilities in the science classroom (on-task checklist)?

3) Are students satisfied with the use of the video learning game *Quizlet*?

Chapter 2

Review of the Literature

Each time we open a book, read instructions, signs, or product labels, there is a chance we will encounter a word we have never seen before, but need to know the meaning of to understand the text. Vocabulary, or the words employed by a language or in a field of knowledge (Cohen, 2012), are an important part of literacy and essential to understanding new concepts. Vocabulary is especially important in the content area of science, which involves a great deal of academic terminology (Cohen, 2012). According to Jitendra, Edwards and Sacks, students with LD often have limited vocabulary knowledge and have difficulty learning academic vocabulary as a language-based activity (2004). Cohen (2012) suggests that students with LD may need vocabulary instruction that is explicit and direct to guide their understanding. Moreover, explicit vocabulary instruction should include words that are important for understanding, as well as frequently used functional words (Jitendra, Edwards, & Sacks, 2004).

Teaching Vocabulary to Students with Learning Disabilities

In order for any student to be successful, the teacher must understand how the student learns, then adapt instruction to meet their diverse learning needs (Cook & Klipfel, 2015). Bryant, Goodwin, and Bryant (2003) reported that students with LD require explicit instruction because they may have trouble with word learning strategies. Instruction for students with LD should concentrate on the individual child, and teach them to process and understand new words and their meanings (Bryant et al., 2003). According to Mayer (1992), instruction should focus on helping the student develop learning and thinking strategies.

Nagy (1988) reported that instruction in developing deep word-knowledge must support students in linking the meaning of new words to previous learning. Furthermore, the researcher suggests that multiple repetitions and student engagement are important to student vocabulary acquisition and understanding of text (1988). Active engagement is essential to learning vocabulary for students with LD. When students engage in the learning process, they are attentive, focused on the educational experience, and are motivated to achieve. Student engagement begins with instruction that incorporates curriculum standards, with real life and student's interests (Tapley, 2016).

Moreover, Bryant et al. (2003) reported that students with LD require opportunities to practice vocabulary. The more students are engaged with material, the more likely they will recall and use the information, (Cook & Klipfel, 2015). Similar to Nagy (1988), Cook and Klipfel also propose that practice and engagement are keys to vocabulary acquisition (2015). Students with LD may have limited background knowledge of the subject or vocabulary in the text. When students lack understanding of science vocabulary, they may have trouble following procedures, or lose interest in the material (Young, 2005). Engaging students using vocabulary strategies may bridge the gap between science vocabulary and background knowledge (Young, 2005).

Vocabulary acquisition is a necessity for student learning in all subject areas, but especially in an inquiry-based science environment. According to Carlisle (1999), some students with LD may be unable to retell important or main ideas. This may make vocabulary acquisition difficult. Cook and Klipfel suggest that students who are cognitively engaged in their learning show an increase in retention of information, because individuals tend to remember things that gain their attention (2015).

Cohen suggests that in order for students to comprehend science material, they must be able to understand new terms and concepts, and be capable of linking the vocabulary to real-life (2012). According to Wilkins and Ratajczak, students acquire vocabulary skills when the words have personal meaning to their lives, social interactions and learning models (2009). Mastery in vocabulary acquisition may occur, when as Bryant, Goodwin, and Bryant (2003) suggest, the learner makes his or her own contribution to learning. According to the National Research Center (Subramaniam, 2012), the four key principles of learning in the science classroom, include establishing instruction that is leaner-centered, knowledge-centered, assessment-centered and community-centered. One teaching method that incorporates these principles is inquiry-based science. This approach encourages students to problem-solve, explore, create, experiment and use reflective thinking to construct his or her own meaning (Garrett, 2008). At the same time, the teacher can assess students as they work independently and cooperatively.

In order to support students with LD, teachers should use vocabulary definitions that are short and easy to remember, and then engage the students in activities that consolidate their knowledge of the words (Beach, Sanchez, Flynn, & O'Connor, 2015). Additionally, teachers should help students discover that science vocabulary words relate to each other and to words, they already know (Young, 2005). One activity that can assist students with LD in vocabulary acquisition is the use of imagery. Imagery plays a significant role in learning. Imagery allows the student to connect words and their meaning, which leads to greater retention (Cohen, 2012). Similarly, Spires (2015) suggests that imagery used in video games may enhance comprehension for struggling readers. The video learning game *Quizlet* permits students to add pictures to vocabulary definitions, allowing them to make a connection with the terminology. Furthermore, Cohen suggests that when multiple opportunities or activities for a student to use a word exist, the greater their chance of committing it to memory and learning the word (2012).

Video Game Technology in Education

While teachers may use technology in their daily routine, many do not incorporate it into classroom instruction (Musti-Rao, Cartledge, Bennett, & Council, 2015). Marino and Beecher (2010) suggest that students with disabilities can be successful in the science classroom when the instruction fits their exceptional learning styles and capabilities. Teachers can meet the diverse learning needs of all students, by thinking outside the box and looking for new or innovative ideas that will allow all students to succeed. One way to increase students' understanding of academic science vocabulary and increase engagement in the classroom may be through the use of technology. Marino and Beecher (2010) suggest that technology is our present and future and its presence in the classroom will continue to increase. Furthermore, research supports that a technology-enhanced science environment is beneficial to students with LD (Marino & Beecher, 2010).

Incorporating technology into classroom instruction brings a multisensory approach to learning. Visual images can add another layer to learning, as well as provide textual clues that enable students who are at-risk, or low achieving to find an enjoyable path to learning and comprehending vocabulary (Xin & Reith, 2001). A recent study conducted by Fengfeng and Abras (2013) shows that video games may promote learning and engagement in students with LD. This investigation focused on the effects of three pre-algebra games on the mathematical understanding of middle school students with LD or language differences. The findings suggest that video games may promote learning and engagement for students with LD. Furthermore, Fengfeng and Abras recommend that video games meet the diverse learning needs of the student participants, and should be challenging, with embedded scaffolding to allow success and an increase in higher order thinking skills (2013).

According to Annetta (2008), video games require the use of a variety of skills, like logic, self-questioning, memory, problem solving, visualization, critical thinking, and the use of discovery techniques. They are not purely for entertainment or the mindless use of time and energy. The study on technology and literacy suggests that the use of video game technology will better prepare our students for life after school where workers may need science and mathematical skills to compete in the marketplace (Annetta, 2008). Annetta sees video games as supplements to teaching that engage students, and allow them to learn in an environment they are familiar with or are comfortable using (2008). Video games may be a resource for inquiry-based science classrooms as students can use game technology to practice prior to conducting experiments. Marino and colleagues reported that video games might provide a safe learning environment where students can interact with contagious bacteria or viruses (2011). Additionally, games can build background knowledge in content areas like social studies. Students can explore games such as the *Battle of Hastings 1066* that helps students understand the history of Medieval Times through active engagement and investigation (Carter, 1994). There is limited published research, however, investigating the future of video games in education (Granic, Lobel, & Engels, 2014).

Video games may enrich student learning outcomes (Marino & Beecher 2010). Furthermore, the researchers suggest that video games allow students to work at their own pace, as well as to choose the activities that suit their skills and abilities, (Marino & Beecher 2010, Fengfeng & Abras 2013). According to Hasselbring and Glaser (2000), technology may level the playing field for students with disabilities by creating opportunities to obtain academic success alongside their non-disabled peers. Video games used as learning tools should meet the diverse learning needs of students, and should be challenging (Fengfeng & Abras 2013). According to Mifsud, Vella and Camilleri (2013), video games used for learning may enhance student autonomy as the games may encourage them to focus on learning. Robertson and Howells suggest that for the learning process to be successful, the learner must be engaged, understand the importance of their role in the process, and have an understanding that their part in the process will be rewarded when they accomplish their goals (2008). The motivational feature found in video games include immediate feedback, which prompts the player (student) to continue to the next level or keep trying at the current level, until they reach their highest level of performance. Chuang and Chen (2009) investigated third grade students' achievement in two areas: computer-assisted instruction and computer-based video games. The results indicate that computer-based video games were more effective. Participants showed significant improvement in their recall of important facts using computer-based video games. These results suggest that playing computer-based video games may improve students' critical thinking and increase higher-level cognition (Chuang & Chen, 2009).

According to the U.S. Department of Education (2010), educational video games may have the ability to change the way that students learn in the 21st century. Students with LD can benefit from using technology that allows them to perform the same tasks as their non-disabled peers without creating cognitive overloads (Marino & Beecher, 2010). Furthermore, the National Science Foundation (2002) and the American Association for the Advancement of Science (AAAS, 2008), have emphasized the importance of increasing the use of technology in the classroom. Flick and Bell (2000) suggest that technological activities in the classroom should promote student-centered, inquiry based learning and support student processing skills. While video games are not intended to replace teacher instruction, they represent a means of enhancing student-learning outcomes (Marino & Beecher, 2010). Furthermore, they are a medium for student to learn on the go, through the use of smartphones and tablets. This allows students to continue learning beyond the science classroom doors, through independent practice that meets their unique needs (Marino & Beecher, 2010).

Video Games as Assessments

Kaya (2010) investigated a way to help students avoid test anxiety through the use of virtual reality tasks. The teachers were able to assess student learning and higher order thinking skills without traditional paper and pen tests. Teachers observed students as they worked in "stealth assessments." These observations provided the teachers opportunities for self-reflection, showed areas of student learning deficits, and strengths. The researcher concluded that since many students enjoy video games, they may become useful learning tools in the classroom. Gee (2003) suggests that video games may be an asset to science instruction and an enhancement to student academic performance.

Furthermore, Marino, Basham, and Beecher found video games to be a useful assessment tools that allows teachers to evaluate student learning as it is happening (2011). The researchers observed students and monitored their progress while playing video games. Findings suggest video games allowed teachers to gage students' strengths and needs. Video games present a means of authentic assessments through observations in the student's natural environment (Dykeman 2006). Given a choice, students may prefer to play a game that determines their knowledge rather than take a traditional test or quiz, and teachers may discover what and how their students learn through these observations (Siegle, 2015). Additionally, some video games, like *Quizlet*, offer students the opportunity to be the "teacher" and create their own tests or quizzes for personal assessment or to share with peers.

The Benefits of Video Games

Video games have been shown to motivate students, improve cognitive abilities, and inspire social skills through interactions with individuals of different ages, genders and cultural backgrounds (Granic et al., 2014). Granic and colleagues reviewed the literature on the benefits of playing video games, focusing on four main domains: cognitive, motivational, emotional, and social. The authors concluded that video games are socially interactive, and cross cultures, gender, age, socio-economic boundaries and language barriers. The authors suggest that because video games are interactive, they maintain active engagement, and aid in developing problem-solving skills. Additionally, there are cognitive and social benefits to playing video games.

Improved cognitive skills may lead students to increase recall of important information, experience growth in problem solving abilities and learn to recognize that there are many solutions to a problem (Chuang & Chen, 2009). These are necessary skills in reading comprehension, mathematics, social studies and in an inquiry-based science setting. In addition, video games may help students think logically as they move to the next level of success. Granic et al. report that video games might increase social skills by inspiring players to engage in civic activities and social causes within their communities (2014).

According to Marino and Beecher (2010), video games can support the diverse learning needs of all students, and can function as an intervention resource for those not achieving academically. In order to cultivate a learning environment where all students can experience success, sometimes an educator must think outside the box and find ways to challenge students on their own turf. Individuals of all ages, races and genders play video games. Video games can be fun, and challenging. Some students with LD may have difficulty with language or speaking, and video games may allow them to answer questions without revealing their difficulties to the class. According to Siegle, video games provide students with immediate feedback that applauds their efforts in learning (2015). Making education fun is a stealthy way of guiding student learning. The best way to learn is by doing; the authors of the IKEA Effect suggest the act of doing a task creates value especially when the undertaking leads to success (2012). By using video games as a learning tool in science vocabulary, students may experience the thrill of competition, pride in their achievement, and the acquisition of science terminology.

There are limitations to the current research regarding the benefit of video games. Granic et al. note that few studies evaluate both the positive and negative effects of using video games in the classroom. Limited longitudinal data exists on the benefits or harmful effects (e.g. stress) of video games (Granic et al., 2014).

Video Games as an Intervention

As we move further into the twenty first century, technology continues to grow and shape our lives. In addition to cognitive and social benefits, video games may be used as a means of intervention for students who are struggling. Marino and Beecher (2010) identified potential in using video games along with response to intervention (RTI) in the science classroom. Their findings suggest that video games can be used as a support to students with diverse learning needs, because they provide independent practice and instructional support. Marino et al. studied fifty-seven students using Universal Design for Learning (UDL), and found that video games and supplemental texts are effective in creating student-centered learning environments (2014).

Summary

This review of literature summarizes various ways that video games may be used to engage students, enhance cognitive and problem-solving skills, and improve learning outcomes. Teaching vocabulary to students with LD in the science classroom requires innovate ideas and a mixed bag of tools. It is important to build background knowledge, and teach terminology by using brief definitions. Providing opportunities for the student to link terminology to real life and practice may lead to increased student recall, and to increased meaning between the task and student. Using video games in the classroom may make students marketable through enhanced technology skills, and may increase student confidence through opportunities for independent practice. Additionally, video games may be used as a means of assessment. Teachers are able to monitor student work and time on task, evaluate students' strengths and weaknesses, and improve their teaching styles and techniques to better serve their students through video games.

Furthermore, video games may motivate students to learn. Students with LD want to be successful. In cooperative or individual environments, they may be able to work alongside their peers doing the same activities, but at their individual level and pace. In the area of intervention, video games may provide students with additional instruction, and practice without them feeling singled out by having to work with the teacher or assistant.

This study aims to follow Cohen's lead (2012) and incorporate imagery into vocabulary instruction in an inquiry-based science classroom through the use of the technology vocabulary learning games *Quizlet*. Additionally, the study will follow the recommendation of Fengfeng and Abras (2013) with video games selected to increase student engagement and meet student diverse learning needs. The video learning games used will offer individual learning choices, so students can work at their own pace and level. The present study will investigate the use of video games on student engagement (time on-task), and science vocabulary acquisition.

Chapter 3

Methodology

Setting

School. The study was conducted in a middle school in a southern New Jersey school district. The school district contains four schools, an elementary, an upper elementary, a middle school and a high school. There are approximately 3,926 students in the school district. The typical school day in the middle school runs for six hour and forty minutes. The school district runs on a six-day cycle.

This South Jersey middle school embraces a diverse student population. According to the New Jersey Performance Report (New Jersey Department of Education, 2014), 45% of the students in the middle school are white, 33% are black, .09% are Hispanic, .09% are of Asian descent, .03% of the students are of two or more races, and .01% are either Native American or Hawaiian Natives. English is the primary language spoken in the community, and a small percentage of residents speak Spanish.

Classroom. The study was conducted in the school's seventh grade science/social studies resource room. The classroom consists of several cabinets and drawers that house science supplies and equipment, three closets, a fire extinguisher, and a sink. There are fourteen desk/chairs combinations, five tables, two teachers' desks, and a bookcase. There is a large bulletin board at the back of the classroom with classroom rules, student projects, and student names. There are three whiteboards at the front of the room with a large projection screen in the middle. The screen connects to a computer and ELMO on the teacher's desk. Students have access to three computers and ten laptops with mice. The science and social studies special education teachers share the room. The science class in this study was held daily during sixth period, directly after lunch.

Participants

This study included seven seventh grade middle school students, three female and four male. The student participants have various documented disabilities including: specific learning disabilities (SLD), communication impaired (CI), and other health impaired (OHI). All students have an Individualized Education Plan (IEP) for their exceptional learning needs. Table 1 presents the general participant information.

Table 1

General Information of Participating Students

Student	**Age**	**Grade**	**Primary Classification**	**Baseline Vocabulary (%)**
A.	13	7	SLD	78.4
B.	13	7	OHI	50.4
C.	13	7	OHI	77.2
D.	13	7	CI	70.4
E.	13	7	SLD	54.6
F.	14	7	SLD	73.4
G.	14	7	OHI	71.8

Participant 1. Student A. is a seventh grade Asian male who is eligible for services under the category SLD. Student A. receives instruction for English language arts, mathematics, social studies and science in a resource room setting. Additionally, he

receives instruction for related arts, health and physical education in the general education setting. Even in a small group setting, Student A. has difficulty staying on task and maintaining conversational topics. His most significant struggles are in listening and reading comprehension. Student A. is compassionate, friendly and frequently assists classmates. For example, if a classmate is crying, he will attempt to comfort them prior to informing the teacher. Furthermore, he frequently offers to assist classmates when his work is finished.

Participant 2. Student B. is a seventh grade African-American male who is eligible for services under the category OHI. He has a documented reactive attachment disorder as well as ADHD. He receives instruction for English language arts, mathematics, social studies and science in a resource room setting. Additionally, Student B. receives instruction in related arts, physical education and health in the general education setting. Student B. has difficulty in listening and reading comprehension, and in recalling previously taught skills. He is frequently off-task and distracted by socializing with peers. One day he comes to class ready to work, and the next day will put his head down for the entire period.

Participant 3. Student C. is seventh grade Caucasian female who is eligible for special education services under the category OHI. She receives academic instruction for English language arts and social studies alongside her non-disabled peers in an inclusive classroom setting, and mathematics and science in a resource room setting. In addition, Student C. receives instruction in related arts, physical education and health in the general education setting. Student C. has trouble in reading comprehension and understanding directions. She often rushes through assignments and has difficulty following directions, but is capable of completing academic tasks. She is upbeat and friendly.

Participant 4. Student D. is a seventh grade Caucasian female who is eligible for special education services under the category CI. She receives instruction for mathematics, language arts, science and social students in a resource room setting. In addition, Student D. receives instruction in related arts, physical education and health in the general education setting. Student D.'s major difficulties are in reading comprehension and written expression. She has trouble maintaining attention and focusing on tasks. She is a friendly, yet quiet student.

Participant 5. Student E. is a seventh grade Hispanic male who is eligible for special education services under the category SLD. He receives instruction in English language arts, mathematics, science and social studies in the resource room setting. In addition, he receives instruction in related arts, physical education and health in the general education setting. Student E.'s major areas of weakness are vocabulary and written language. He is a charismatic and friendly student who is often distracted from academic tasks by socialization. He prioritizes socialization over academics. For example, he will engage other students in conversation instead of completing assignments. He can become non-compliant or withdrawn when he is unable to complete an assignment.

Participant 6. Student F. is a seventh grade Caucasian male who is eligible for special education services under the category SLD. He receives instruction in English language arts, mathematics and science in resource room. Additionally he receives instruction in social studies in an inclusive classroom setting, and related arts, physical education and health in the general education setting. Student F.'s major areas of weakness are in reading comprehension and vocabulary. He is friendly, and a hard-worker who likes to be challenged, but is easily distracted by socialization.

Participant 7. Student G. is a seventh grade Caucasian female who is eligible for special education services under the category OHI. She receives instruction in English language arts, mathematics, science and social studies in a resource room setting. In addition, she receives instruction in related arts, physical education and health in the general education setting. Her major areas of weakness are in reading comprehension and vocabulary. She often presents emotional problems such as anxiety and nervousness. Socialization distracts her from academic tasks.

Teacher. A special education science teacher instructed the class the entire duration of the study. This teacher has more than fifteen years as a special education teacher and has been in the district for thirteen years. The teacher is responsible for creating motivating lessons based on the Next Generation Science curriculum and the student population. Additionally, she is responsible for writing student IEPs and attending related meetings. She is a co-teacher in two inclusive science and social studies classrooms.

Materials

Seven laptops, seven computer mice, three computers, an iPhone timer, and the application *Quizlet* were used for the intervention. Students were guided to sign into *Quizlet* through Google Classroom using the provided link. Students were directed to create a study set for each new vocabulary group. They selected matching pictures for vocabulary terminology in the *Quizlet* application. After students completed entering vocabulary, they chose their study preference from the Dashboard. Figure 1 displays the *Quizlet* Dashboard choices available to students.

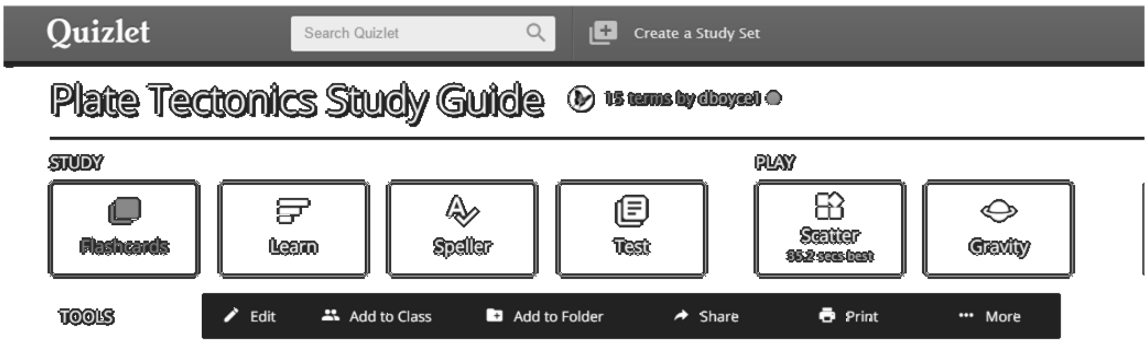

Figure 1. Quizlet Dashboard

Measurement Materials

Observation checklist. An observation checklist was developed to monitor student engagement in relation to work on current task.   A checkmark indicated when the desired on-task behavior was displayed.   A dash was used to note off-task behavior. The researcher scored students as on or off- task using an interval recording of every ten minutes. Table 2 represents the on-task checklist used in the study.

Table 2

Student On-Task Checklist

Student	On-Task	Off-Task
A.		
B.		
C.		
D.		
E.		
F.		
G.		

Assignment. The students worked on *Quizlet* vocabulary games during the first ten minutes of class throughout the intervention period. The lesson included lecture, partner or independent activity or practice, demonstration and class discussion or note taking. The inquiry-based science curriculum allowed for independent investigation and peer collaboration.

Survey. At the end of the intervention, the participating students completed a survey using a Likert Scale of 1-5 regarding their satisfaction with *Quizlet* learning video games: 1 representing strongly disagree, 2 representing disagree, 3 representing undecided, 4 representing agree and 5 representing strongly agree. The questions inquired about ease of application use, how well it helped students stay on task or prepare for tests or quizzes, the acceptance of technology in the classroom, and if the application would be perceived as useful in other classes (see Table 3.)

Table 3

Student Satisfaction Survey

Statements	**Strongly Agree 5**	**Agree 4**	**Undecided 3**	**Disagree 2**	**Strongly Disagree 1**
1. I found Quizlet easy to use.					
2. The Quizlet application kept me on task.					
3. I would rather use technology to stay on task.					
4. The Quizlet application was a distraction.					
5. I would use the Quizlet application in other classes or settings to help me study.					
6. I enjoyed using the application in class.					
7. I am prepared for tests and quizzes after using Quizlet.					
8. I would like to share this technology with friends and other students.					

Research Design

A single subject design with ABABAB phases was used and maintenance data was collected. During phase A, baseline data was collected for two weeks by the researcher using the observation checklist and teacher grade book. During phase B, intervention, students were provided vocabulary terminology and definitions for the unit. They were given the choice of laptop or computer to type the vocabulary in *Quizlet*. The students were observed for one week, and then quizzed on vocabulary. The laptops, computers and *Quizlet* were removed for one week and the same observation process was used for the second phase A using new vocabulary. During the second phase B, students were again given the laptops, computers and *Quizlet* application for one week and followed the same process for phase B. The laptops, computers, and *Quizlet* application were removed for one week and the same observation process for phase A was followed. During the third phase B, students were again given the laptops, computers and *Quizlet* application for one week with the same process followed as previous B phases.

Procedures

Prior to the intervention, students were taught how to use the *Quizlet* application and dashboard. They were taught how to sign in to the application, create new study sets, add imagery and play various games offered on the dashboard. Any additional time during the period was given to students to play the learning video games.

Instructional design. The researcher observed and recorded the behaviors every ten minutes during class time. A vibrating alarm was used to prompt the researcher to mark on-task behavior on a sheet. Additionally, the researcher logged into *Quizlet* to review student completion of work and accuracy.

Measurement Procedures

Observations. During observations, the researcher watched the students from the back of the classroom. Every ten minutes, a vibrating alarm from a timer application on an iPhone prompted the researcher to place a written response on the behavior checklist. During each interval, a checkmark was used for on-task behaviors, and a dash for off-task behaviors.

Academic grades. The number of completed assignments and grades were recorded during this study. The teacher stored and accessed this information using the district's PowerSchool software program.

Maintenance data. Two weeks following the intervention, maintenance data was collected for a two-week period. Students were given a choice of paper and pen study guides or the learning game *Quizlet* and laptop or computer. All students chose the video learning game, *Quizlet.* Students were assessed on two tests and one quiz and grades were recorded in PowerSchool. Additionally, during the maintenance phase, students' engagement was observed and recorded using the on-task checklist.

Data Analysis

Data analysis for this study involved visual assessments and measures. The percentage of correct answers on baseline and assessments were graphed for each student. The data points were used to identify changes in mean performance between conditions. Specific behaviors were also graphed to identify changes in behaviors between conditions. Survey results regarding students' attitudes about the intervention were recorded as percentages and mean scores. Means and standard deviations for results are provided in tables (see Chapter 4). A comparison of scores between phases helped to determine if video games enhanced the acquisition of science vocabulary for students with LD.

Chapter 4

Findings

This study utilized a single subject ABABAB plus maintenance design to evaluate the effects of the video learning game *Quizlet* on the vocabulary acquisition and engagement of students with learning disabilities. The study included seven students with LD from a seventh grade science resource room. The research questions to be answered follow:

1. Will the use of the video game *Quizlet* increase the acquisition of science vocabulary for students with learning disabilities in the science classroom (vocabulary grades)?
2. Will the use of the video game *Quizlet* increase student engagement /time on-task for students with learning disabilities in the science classroom (on-task checklist)?
3. Are students satisfied with the use of the video learning game *Quizlet*?

The students' science vocabulary scores were obtained from assessments including benchmark tests of skills and concepts, three quiz scores and one test score. The student engagement data was obtained through the use of daily on/off-task checklists.

Group Results

Table 4 and Figure 2 display vocabulary results for the seven participants across phases. Figure 2 shows the five vocabulary quiz and test scores collected prior to intervention used to calculate the baseline A mean. Additionally, Figure 2 shows the vocabulary scores across all other phases of intervention, baseline and maintenance data. Table 5 shows the mean scores for each individual student. The overall group data showed a baseline mean of 68% for vocabulary. In the intervention phase B, the overall mean increased to 85.4%. The overall group mean from maintenance data showed an increase to a mean of 92.4% for vocabulary tests and quizzes. All seven participants increased their vocabulary scores. There was a mean increase in science vocabulary scores from baseline to maintenance phases of 24.4%. The two students with the largest gains have a history of difficulty with reading comprehension. During the two-week maintenance phase, students used their choice of laptops or computers and the video learning game *Quizlet*. Student engagement data was obtained through the use of daily on/off-task checklists. Science vocabulary scores for the maintenance phase were obtained from two tests and one quiz. Table 5 shows the mean scores for baseline, intervention and maintenance data across all phases. Table 6 and Figure 3 show student weekly attendance across all phases.

Table 4

Mean Vocabulary Scores across Phases

Student	**A Base-line**	**B**	**A**	**B**	**A**	**B**	**Maintenance**
A.	78.4	94	83	80	90	80	91.7
B.	50.4	94	78	90	75	73	85.3
C.	77.2	94	100	100	100	80	97.0
D.	70.4	94	83	70	82	82	96.0
E.	54.6	80	67	60	50	80	87.7
F.	73.4	85	83	100	85	100	94.3
G.	71.8	90	94	85	80	83	95.0

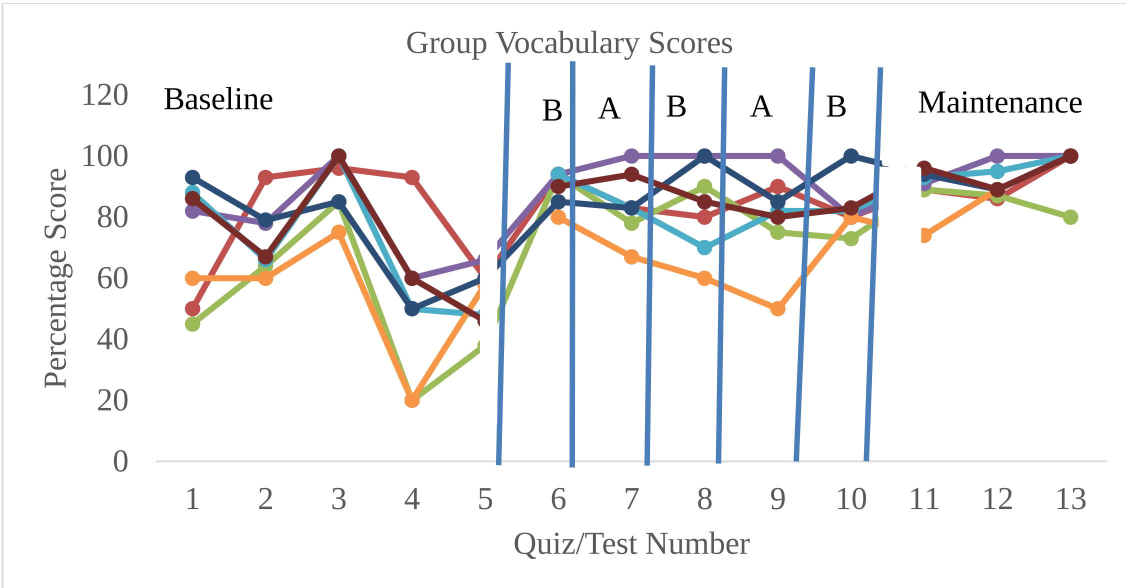

Figure 2. Group Vocabulary Scores

Table 5

Science Vocabulary Quiz/Test Means by Baseline, Intervention and Maintenance Phases

Student	Baseline Mean (%)	Intervention Mean (%)	Maintenance Mean (%)
A.	78.4	84.7	91.7
B.	51.8	85.7	85.3
C.	77.2	91.3	97.0
D.	63.2	82.0	96.0
E.	54.6	73.3	87.7
F.	73.4	95.0	94.3
G.	71.8	86.0	95.0

Table 6

Weekly Attendance

Student	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
A.	5	5	5	5	5	5	5	4	5
B.	5	5	5	5	5	5	5	5	4
C.	5	5	5	5	5	5	5	5	5
D.	5	5	5	4	5	3	5	5	5
E.	5	5	5	5	5	4	5	5	5
F.	5	5	5	5	5	5	5	3	5
G.	5	5	5	5	5	5	4	5	5

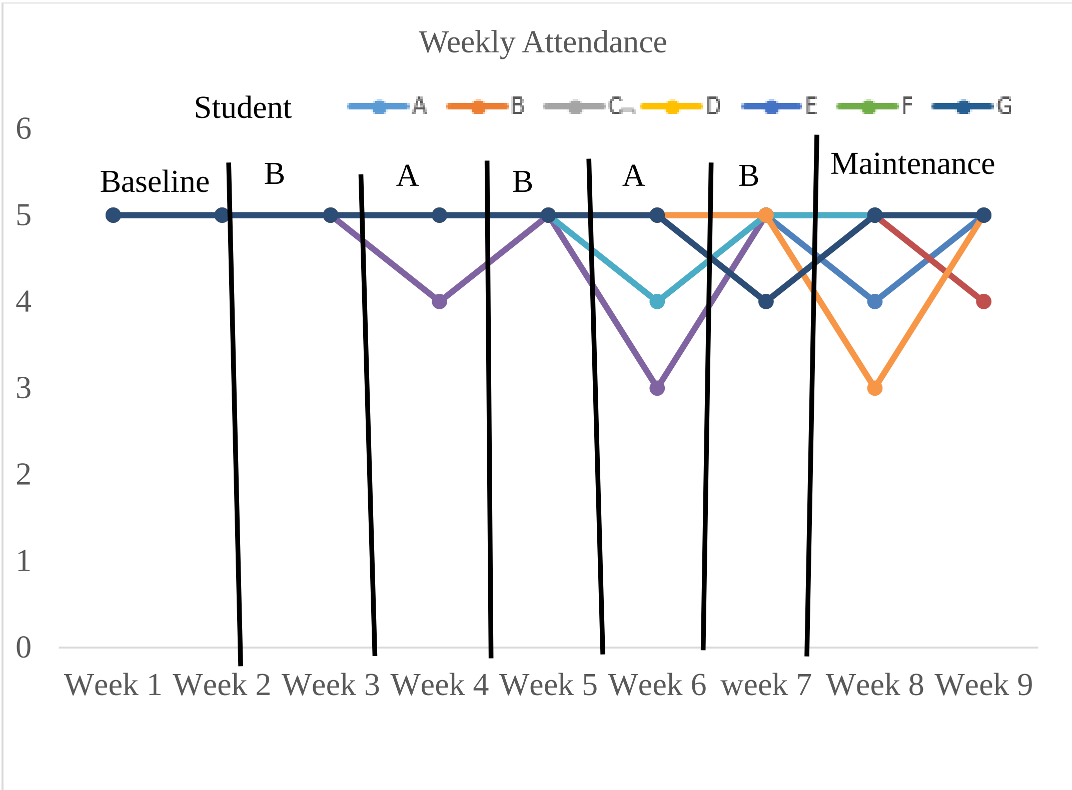

Figure 3. Weekly Attendance

Individual Results

Figure 4 illustrates the vocabulary scores for participant Student A. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, Maintenance). The pre-intervention baseline science vocabulary mean score for Student A. was 78.4%. During the first intervention, phase B, his weekly vocabulary quiz score increased to 94%. The weekly quiz score for the second baseline phase A decreased to 83%. The test score in the second intervention phase B decreased to 80%. His weekly quiz score for the third baseline phase A increased to 90%. The weekly quiz score for the third intervention phase B decreased to 80%. The mean science vocabulary score for

Student A. over the three phases of intervention was 84.7%. The post-intervention maintenance data for Student A. showed an increase to a mean score of 91.7%.

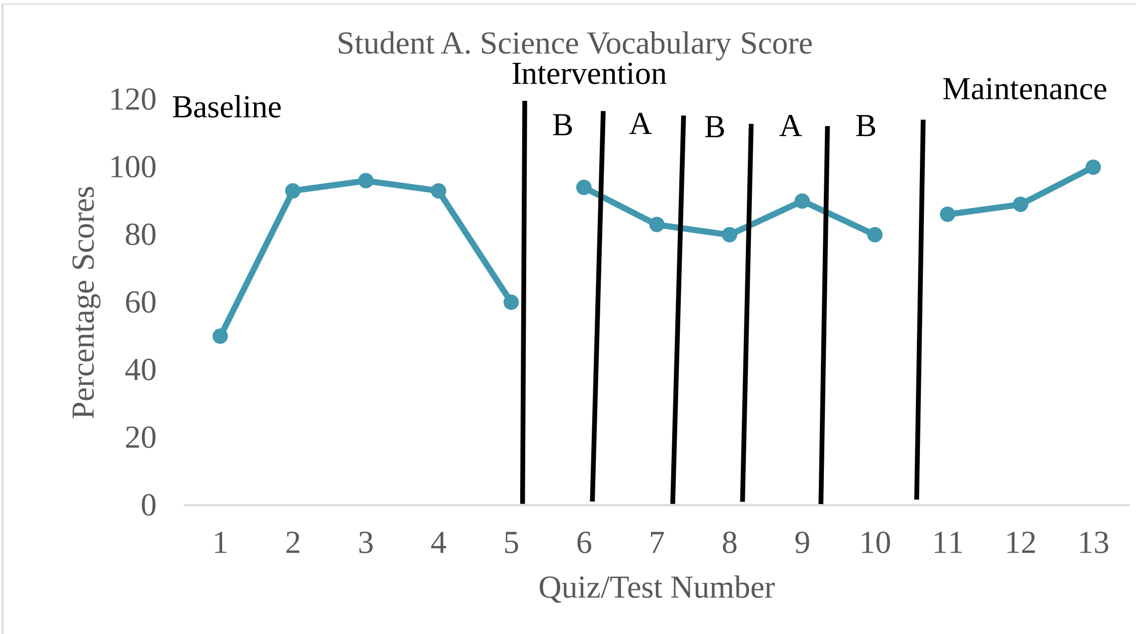

Figure 4. Student A. Science Vocabulary Scores

Figure 5 illustrates the vocabulary scores for participant Student B. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). The pre-intervention baseline science vocabulary mean score for Student B. was 51.8%. During the first intervention phase B, his weekly vocabulary quiz score increased to 94%. The quiz score for the second baseline phase A decreased to 78%. His test score in the second intervention phase B again increased to 90%. His quiz score for the third baseline phase A decreased to 75%. The third intervention phase B quiz score again decreased to 73%. The mean science vocabulary score for Student B. over the three phases of intervention was 85.7%. Similarly, the post-intervention maintenance data for Student B showed a mean score of 85.3%.

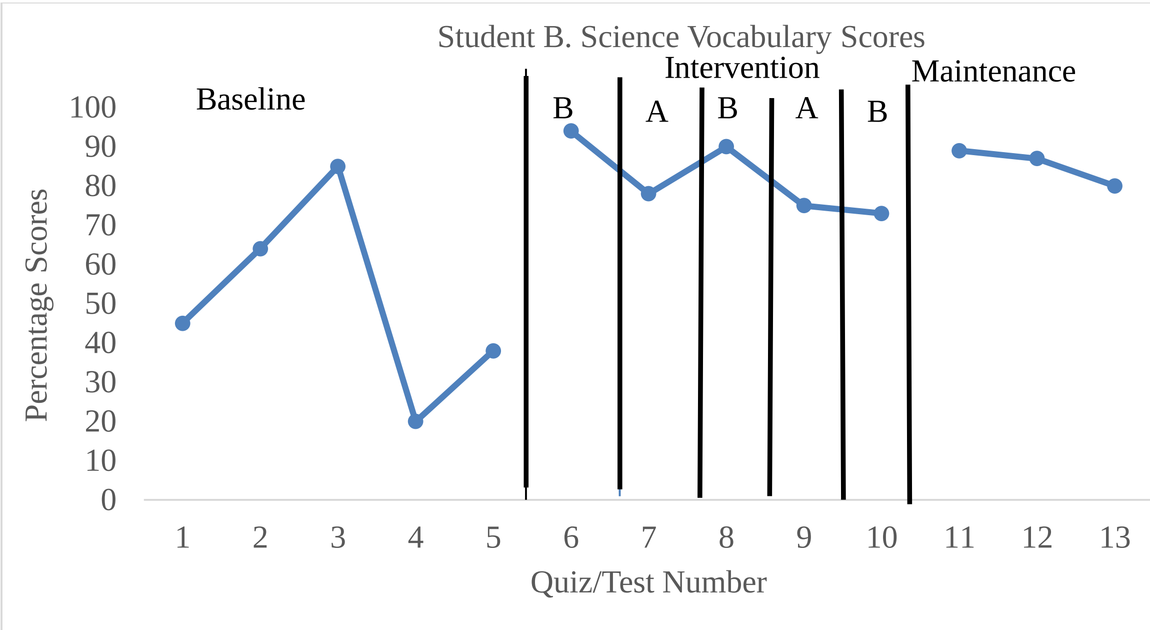

Figure 5. Student B. Science Vocabulary Scores

Figure 6 illustrates the vocabulary scores for participant Student C. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). The pre-intervention baseline science vocabulary mean score for Student C. was 77.2%. During the first intervention phase B, her weekly vocabulary quiz score increased to 94%. Her quiz score for the second baseline phase 2 increased to 100%. Similarly, her test score for the second intervention phase B, remained the same at 100%. The quiz score for the third baseline phase A again remained at 100%. The quiz score for the third intervention phase B decreased to 80%. The mean science vocabulary score for

Student C. over the three intervention phases was 91.3%. Similarly, the post-intervention maintenance data for Student C. showed a mean score increase to 97%.

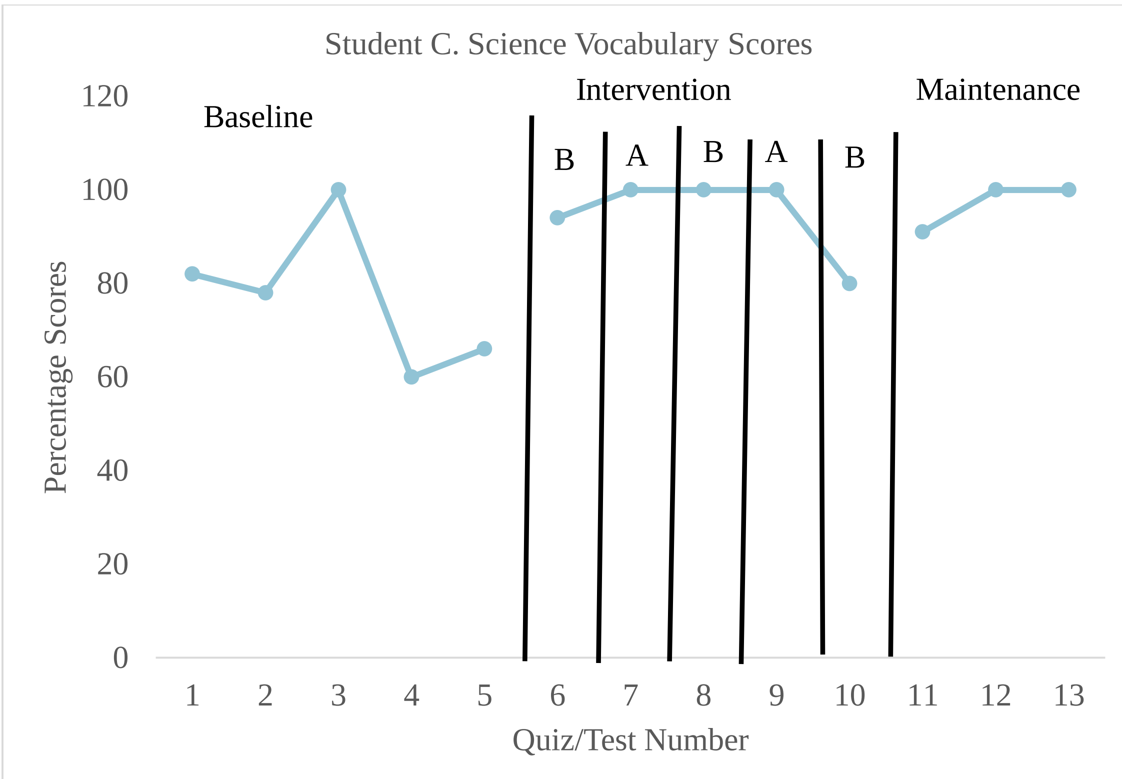

Figure 6. Student C. Science Vocabulary Scores

Figure 7 illustrates the vocabulary scores for participant Student D. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). The pre-intervention baseline science vocabulary mean score for Student D. was 63.2%. During the first intervention phase B, her weekly vocabulary quiz score increased to 94%. The quiz score for the second baseline phase B decreased to 83%. Her test score for the second intervention phase B again deccreased to 80%. Her quiz score for the third baseline phase A again decreased to 70%. Her quiz score for the third intervention phase B increased to 82%.   The mean science vocabulary score for Student D. over the three intervention phases was 82.0%.   Similarly, the post-intervention maintenance data for Student D. showed a mean score increase to 96%.

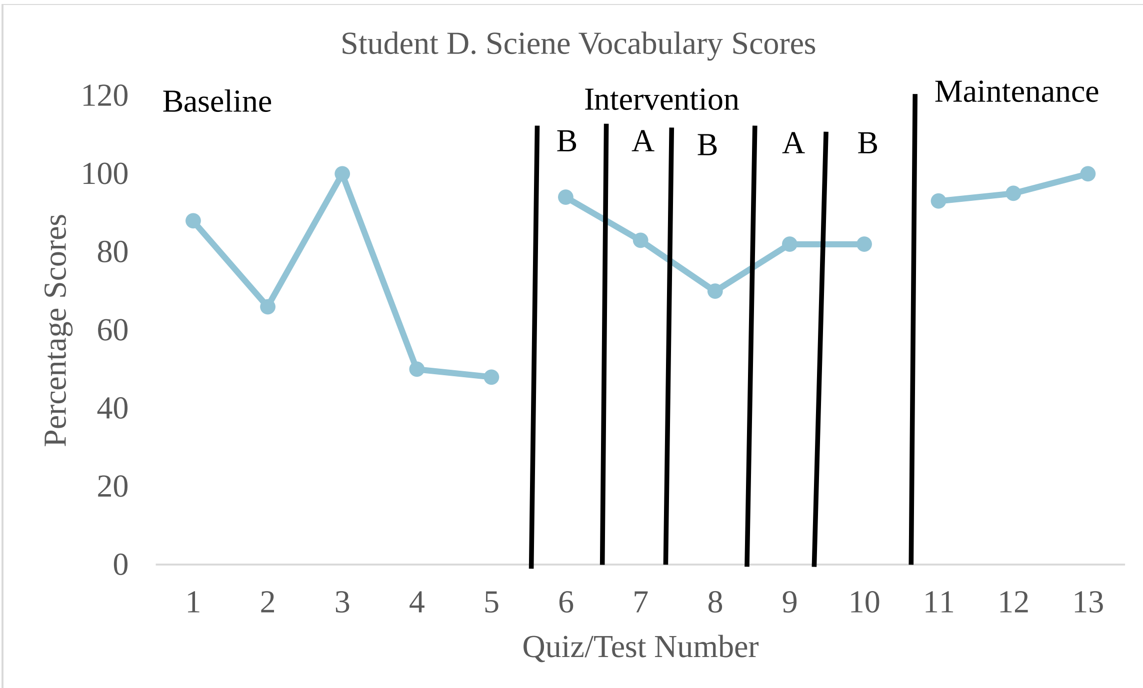

Figure 7. Student D. Science Vocabulary Scores

Figure 8 illustrates the vocabulary scores for participant Student E. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance).   The pre-intervention baseline science vocabulary mean score for Student E. was 54.6%.   During the first intervention phase B, his weekly vocabulary quiz score increased to 80%.   His quiz score for the second baseline phase A decreased to 67%. The test score for the second intervention phase B again decreased to 60%. Similarly, his quiz score for the third baseline phase A decreased to 50%. His quiz score for the third intervention phase B increased to 80%. The mean science vocabulary score for Student E. over three phases of intervention was 73.3%. Similarly, the post-intervention maintenance data for Student E. showed a mean score increase to 87.7%.

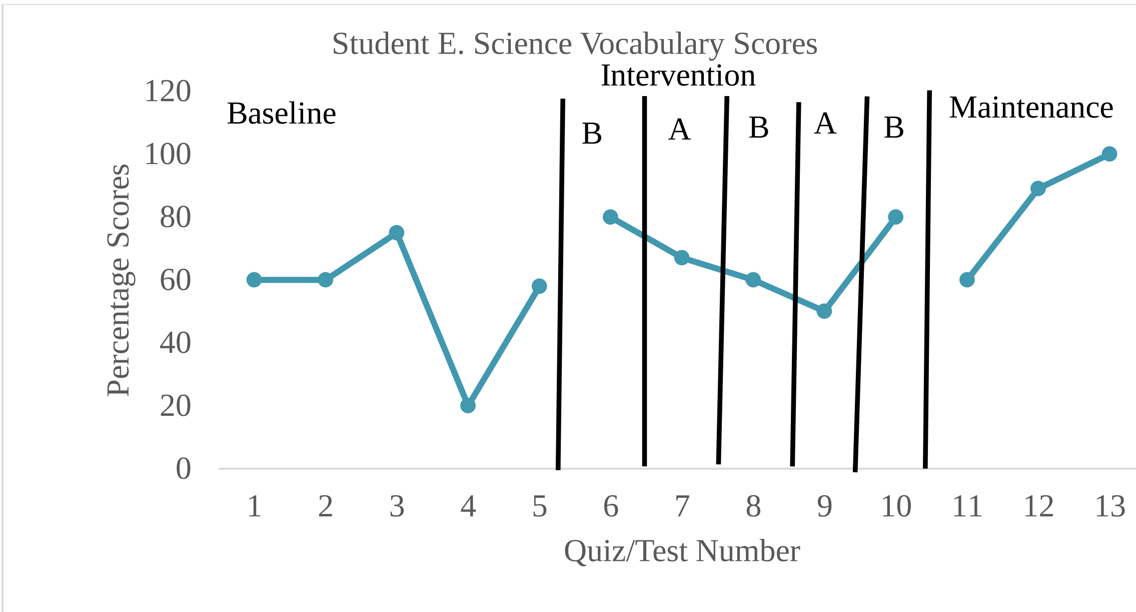

Figure 8. Student E. Science Vocabulary Scores

Figure 9 illustrates the vocabulary scores for participant Student F. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). The pre-intervention baseline science vocabulary mean score for Student F. was 73.4%. During the first intervention phase B, his weekly vocabulary quiz score increased to 85%. His quiz score for the second baseline phase A decreased to 83%. The test score for the second intervention phase B increased to 100%. His quiz score for the third baseline A decreased to 85%. The quiz score for the third intervention B increased to 100%. The mean science vocabulary score for Student F. over three phases of intervention was 95%. Similarly, the post-intervention maintenance data for Student F. showed a mean score of 94.3%.

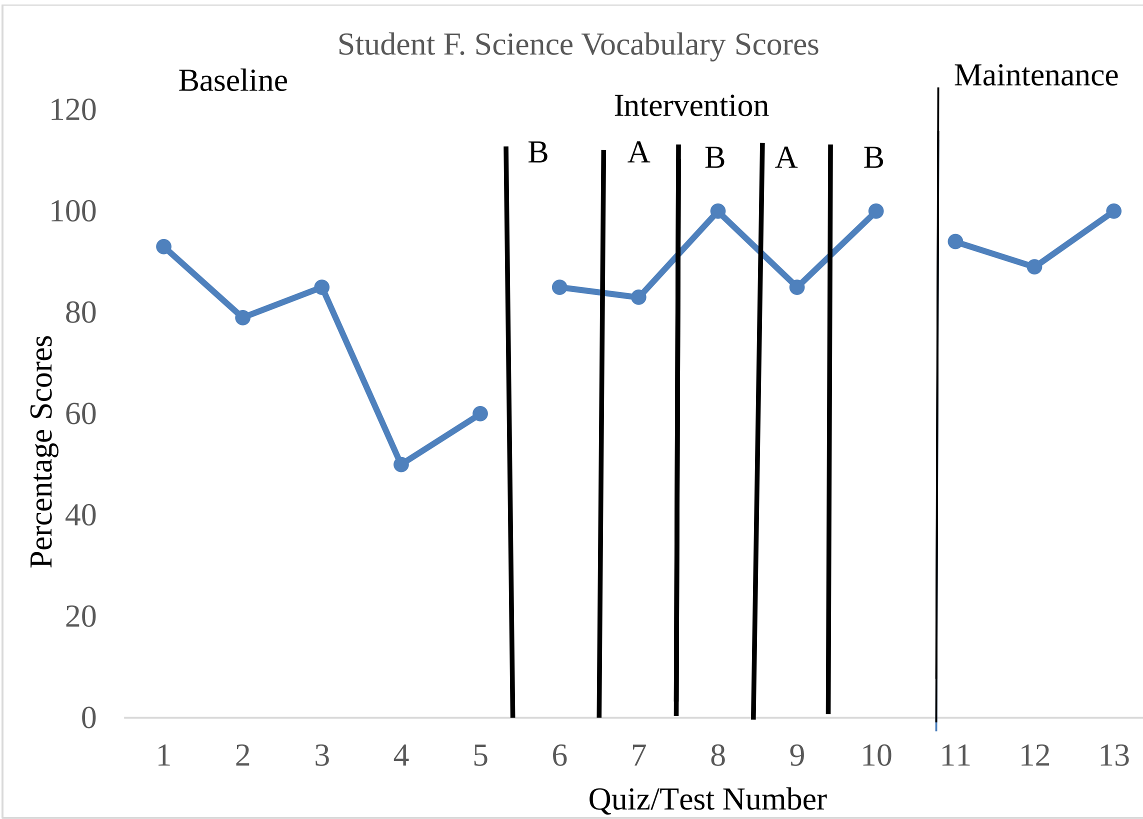

Figure 9. Student F. Science Vocabulary Scores

Figure 10 illustrates the vocabulary scores for participant Student G. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). The pre-intervention baseline science vocabulary mean score for Student G. was 71.8%. During the first intervention phase B, her weekly vocabulary quiz score increased to 90%. Her quiz score for the second baseline phase A again increased to

94%. The test score for the second intervention phase B decreased to 85%. Her quiz score for the third baseline phase A decreased to 80%. The quiz score for the third intervention phase B increased to 83%. The mean science vocabulary score for Student G. over three phases of intervention was 86%. Similarly, the post-intervention maintenance data for Student G. showed a mean score increase to 95%.

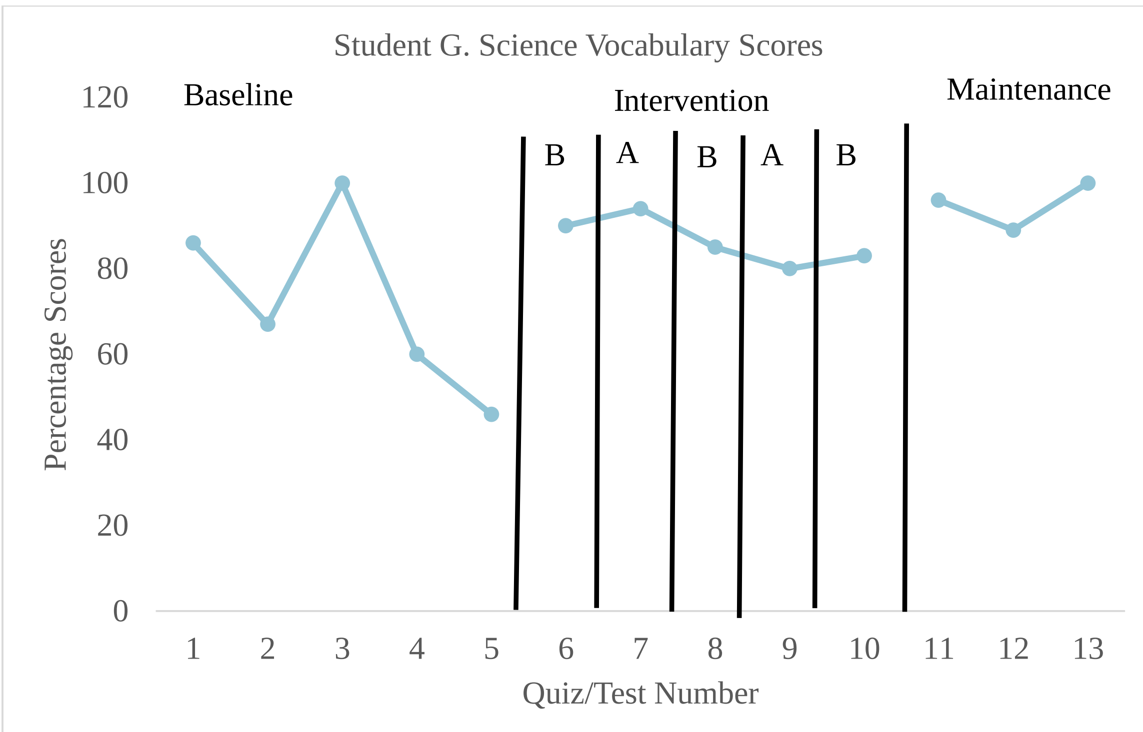

Figure 10. Student G. Science Vocabulary Scores

On-Task Behaviors

Student engagement was measured using the on-task observation checklist specific to work on current task. On or off-task behaviors were observed and recorded using the observation checklist in Table 4. Means and standard deviations engagement behavior were calculated.

Work on current task. Figure 11 illustrates student engagement (time on task) scores for Student A. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). Student A. displayed on-task behavior a mean of 4.5 times during the initial baseline, which increased to 5.4 during the first intervention. The mean score showed an additional increase to 5.6 during the second baseline, followed by an increase to 5.8 in the second intervention that remained constant over the next two phases of baseline and intervention. However, during the maintenance phase Student A.'s mean score decreased to 5.4.

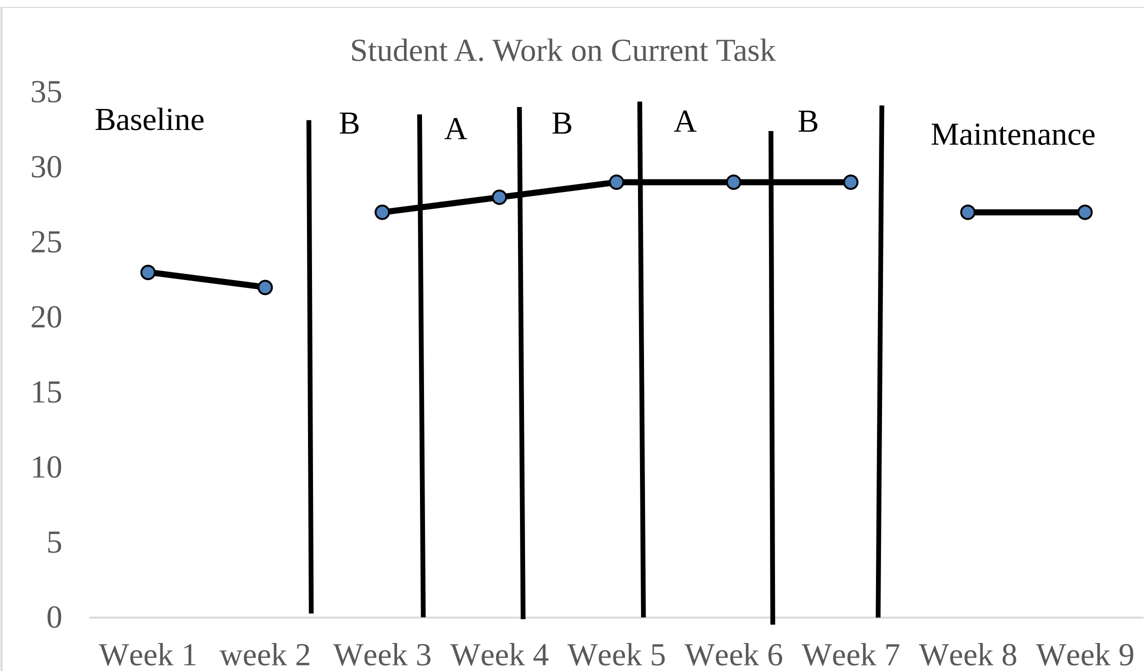

Figure 11. Student A. Work on Current Task

Figure 12 illustrates student engagement (time on task) for Student B. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). Student B. displayed on-task behavior a mean of 2.0 times during the initial baseline, which increased to 2.4 during the first intervention. His mean decreased to 2.0 during the second baseline, followed by an increase in the second intervention to 3.6. His third baseline showed a decrease to 3.2. His final intervention showed an increase to 4.0. During the maintenance, his mean score reached the highest point of 5.3.

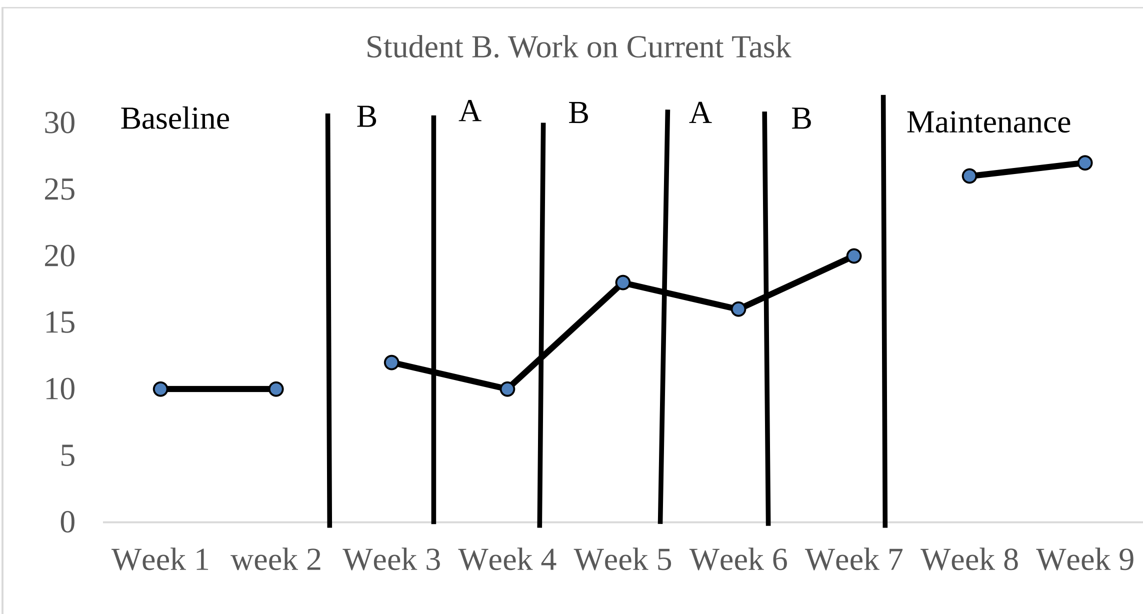

Figure 12. Student B. Work on Current Task

Figure 13 illustrates student engagement (time on task) for Student C. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, Maintenance). Student C. displayed on-task behavior a mean of 3.8 times during the initial baseline, which increased to 4.2 during the first intervention. There was no change during the second baseline. However, she showed an increase to 4.8 during the second intervention, an increase in the third baseline to 5.0 followed by an increase to 5.2 during the third intervention. During the maintenance phase, Student C.'s mean score reached the highest point of 5.6.

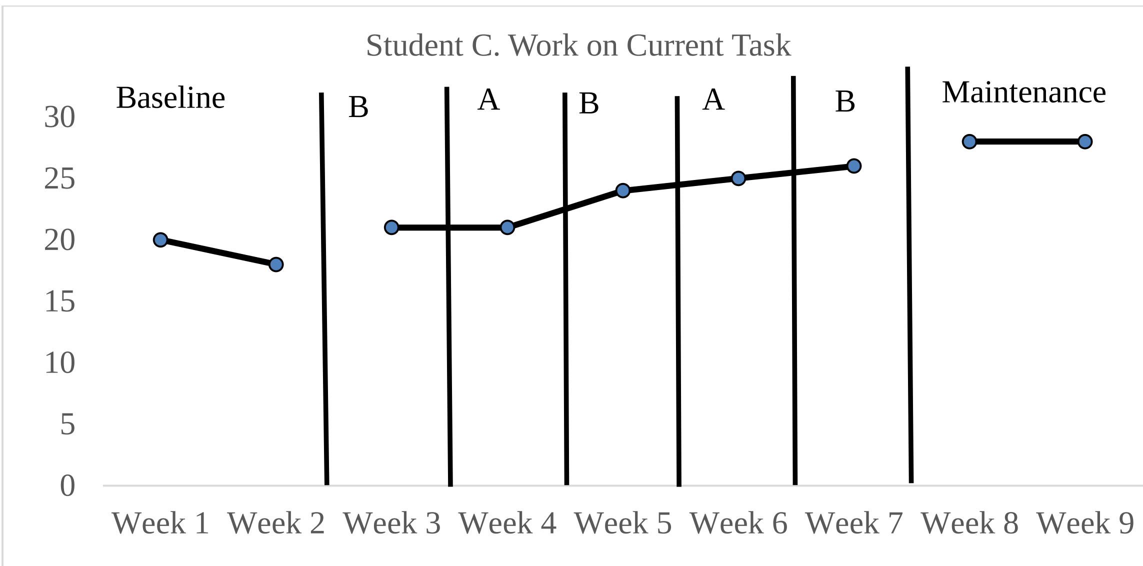

Figure 13. Student C. Work on Current Task

Figure 14 illustrates student engagement (time on task) for Student D. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). Student D. displayed on-task behavior a mean of 1.5 times during the initial baseline, which increased to 4.0 during the first intervention. The mean score during the second baseline was 2.0, but increased to 4.0 during the second intervention. However, she showed a decrease to 3.0 in the third baseline. In the third intervention, her mean score was 4.4. During the maintenance phase, Student D.'s mean score reached her highest point of 4.9.

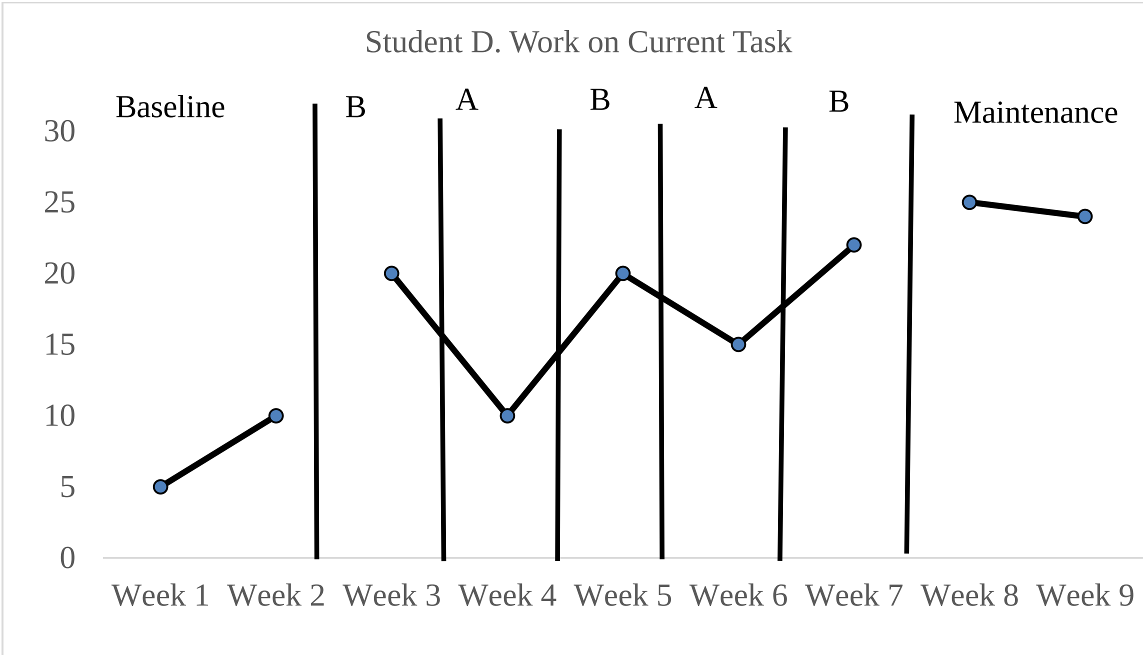

Figure 14. Student D. Work on Current Task

Figure 15 illustrates student engagement (time on task) for Student E. across ABABAB phases and maintenance data collection (Baseline A, Intervention, and Maintenance). Student E. displayed on-task behavior a mean of 2.3 times during the initial baseline, which decreased to 2.0 during the first intervention. He maintained the same score during the second baseline, but showed an increase in the second intervention to 4.0. The third baseline showed a decrease to a mean of 3.6. In the third intervention, this score increased to 5.2. During the maintenance phase, Student E. reached his highest mean score of 5.4.

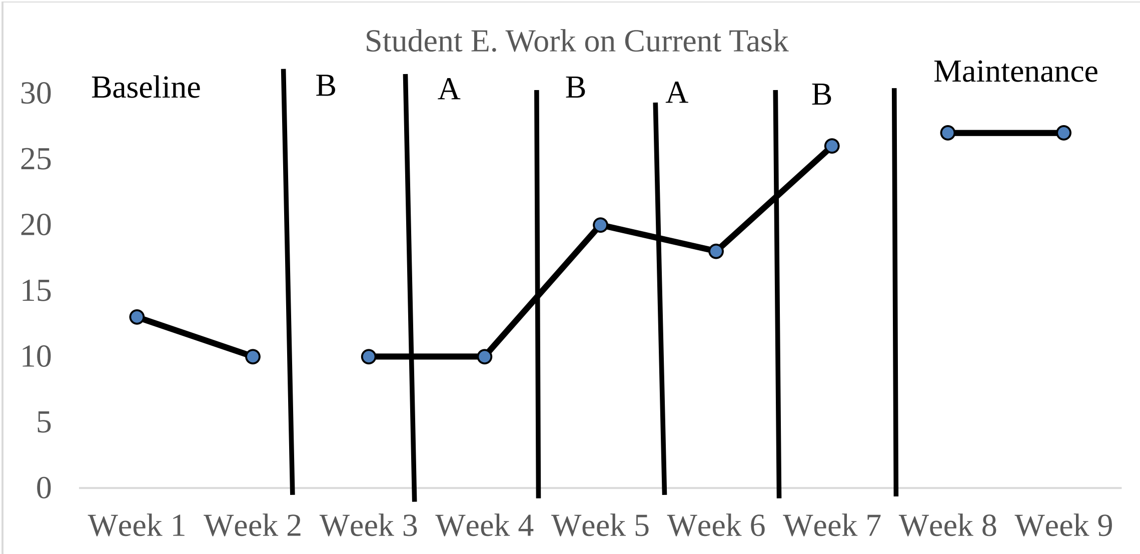

Figure 15. Student E. Work on Current Task

Figure 16 illustrates student engagement (time on task) for Student F. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). Student F. displayed on-task behavior a mean of 2.9 times during the initial baseline, which increased to 4.0 during the first intervention. The mean score during the second baseline decreased to 3.2, but increased to 4.4 during the second intervention. However, he showed a decrease to 4.0 in the third baseline. In the third intervention, his mean score reached its highest point of 5.8. During the maintenance phase, Student F.'s mean score showed a slight decrease to 5.2.

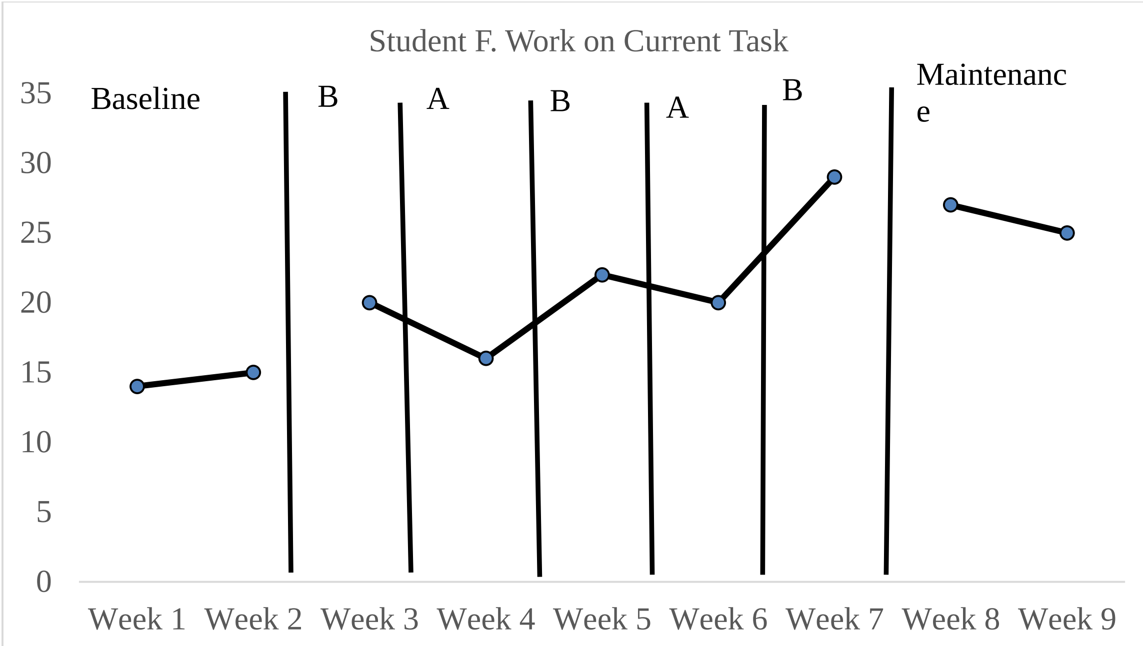

Figure 16. Student F. Work on Current Task

Figure 17 illustrates student engagement (time on task) for Student G. across ABABAB phases and maintenance data collection (Baseline A, Intervention B, and Maintenance). Student G. displayed on-task behavior a mean of 3.0 times during the initial baseline, this score increased to 4.0 during the first intervention. The mean score during the second baseline decreased to 3.2, but increased to 4.4 during the second intervention. Additionally, there were increases over the remaining phases, moving to 4.6 during the third baseline, then 5.2 in the third intervention phase. Her highest mean score of 5.4 occurred during the maintenance phase.

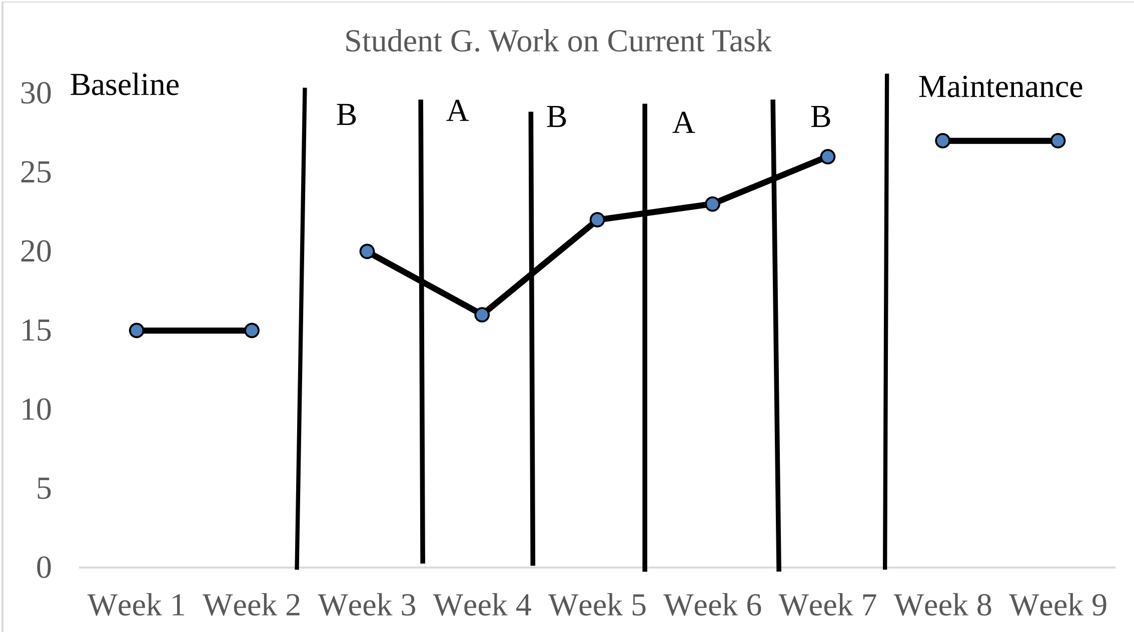

Figure 17. Student G. Work on Current Task

Survey Results

At the end of the study, the students completed an anonymous Likert scale type survey.   A choice of five pre-coded responses were offered ranging from 1 to 5, with 5 representing "strongly agree," 4 "agree," 3 "undecided," 2 "disagree" and 1 "strongly disagree." The answers were tallied and the mean group scores and standard deviation calculated for each statement (see Table 7).

Table 7

Group Mean Satisfaction Scores

Statement	**Mean**	**SD**
1. I found Quizlet easy to use.	4.43	0.49
2. The Quizlet application kept me on task.	3.57	0.73
3. I would rather use technology to stay on task.	4.71	0.70
4. The Quizlet application was a distraction.	1.71	0.45
5. I would use the Quizlet application in other classes or settings to help me study.	4.57	0.49
6. I enjoyed using the application in class.	4.57	0.49
7. I am prepared for tests and quizzes after using Quizlet.	3.71	0.45
8. I would like to share this technology with friends and other students.	4.57	0.73

All seven students participated in the survey. Scores higher than 3 represent agreement with the statement, while scores lower than 3 represent student disagreement. All students agreed with the first statement that the application *Quizlet* was easy to use. All students disagreed that the application was a distraction. Six students felt that given a choice between paper and pencil tasks, they would use technology to stay on task, while one student was undecided. Five of the students agreed that *Quizlet* kept them on task, one was undecided and one disagreed with the statement. Six students agreed they would like to share *Quizlet* technology with friends, while one was undecided.

Every student agreed that they enjoyed using *Quizlet* in class, and would use it in other classrooms or settings as a study aide. Finally, five of the students agreed that *Quizlet* helped them prepare for tests and quizzes.

Chapter 5

Discussion

The purpose of this study was to examine the effect of the video learning game *Quizlet* on the acquisition of science vocabulary and engagement for students with LD. The students' vocabulary grades before and after the intervention were compared to evaluate gains. Additionally, the study sought to evaluate if there was an increase of student engagement (time on task) when using the video learning game.

The results showed that all participants increased their science vocabulary scores between the baseline and the intervention phases as well as during post-intervention maintenance data collection. The overall mean increase between pre-intervention and maintenance data collection was 24.4%. The two students with the highest increase were student B. with an increase in his mean science vocabulary score of 34.9% and Student E. with an increase in his mean science vocabulary score of 33.1%. Six participants showed an increase in science vocabulary scores over the three phases of intervention and maintenance data collection. Student D. had a slight decrease of .4% from baseline to the second intervention. Study results corroborate the findings of Mifsud et al. (2013), Gee (2003), and Marino and Beecher (2010) in which the use of technology games increased student vocabulary grades and enhanced learning outcomes.

Furthermore, the results showed that all students increased their engagement/time on-task behaviors. Six students showed an increase in on-task behaviors during the first intervention, with only Student E. showing a decrease. However, all seven students showed an increase during the second and third interventions. Student F. reached the highest mean (M = 5.8) during the third intervention. All students maintained above average means during the maintenance data collection with four students reaching their highest mean suggesting the benefits of *Quizlet* continued post intervention. Study results corroborate the findings of Fengfeng and Abras (2013), Carter (1994), and Granic, Lobel and Engels (2014) with the use of technology games increasing student engagement.

Students were surveyed at the end of the study on their opinion about using the video learning game *Quizlet.* The scores above 3 represented an agreement, scores below 3 represented disagreement. A score of 5 represented strongly agree and 1 represented strongly disagree. All students agreed that the application was not a distraction with the lowest mean score a 1.71 out of 5. All students found the application *Quizlet* easy to use, and preferred to use the technology to stay on task, scoring that statement highest at 4.71 out of 5. Every student enjoyed using *Quizlet* and felt that it should be used in other classrooms or settings as a study aide. The majority of students believed that *Quizlet* helped them prepare for tests and quizzes and would like to share the technology with friends. This suggests that *Quizlet* is perceived as an effective study tool by middle school students with LD in the science classroom.

The introduction of laptops in addition to the three computers in the science resource room allowed the students to remain in the classroom during the intervention. Students were able to choose their individual manner of study when using the video learning game *Quizlet*. Successful use of these two important factors, available resources and choice supports the recommendation of Annetta (2008), that supplements to teaching engage students while allowing them to learn in a familiar environment with tools that they are comfortable using. Additionally, it appears *Quizlet* provided an alternative to traditional study guides, following the suggestion of Marino and Beecher (2010), and provided students with independent practice that met their unique needs.

Limitations

One limitation of this study was time. This study was a master's thesis conducted during the spring semester. There was limited time between Rowan University's IRB approval and the end of the school year. Data was collected over a ten-week period. As a result, each phase was limited to a one-week period. This limited the amount of data collected, and may have limited the effects of the intervention. The results may have been different if more time was available for the students to explore and practice using the video learning game *Quizlet.*

Additionally, the participant's ability to fully understand how to use the video learning game *Quizlet* may have been a limitation. For example, as Student E. became familiar with the application, his grades improved. Additionally, the seven participants had different levels of typing abilities. As a modification, the researcher worked with Student D. by adding definitions to the terminology she typed during the first intervention. To ensure that all students had time to practice and add imagery, during the second and third interventions, the researcher typed, then shared the vocabulary information through the *Quizlet* application. Students B., D., E. and F. used the shared data. The modifications follow the suggestions of Cook and Klipfel (2015); and Fengfeng and Abras (2013) in adapting instruction to meet the diverse learning needs of students. However, this may have limited the amount of student contact with terminology and definitions and affected their grades. All students added imagery to their definitions as a study tool and way of connecting vocabulary terminology and their meaning, (Cohen, 2012). Study outcomes corroborate the findings of Bryant, Goodwin and Bryant (2003) that mastery occurs when the learner makes his or her own contribution to learning.

A further limitation of this study was researcher responsibilities. In addition to assisting the teacher and students as well as monitoring student engagement, the researcher also examined accuracy in response to Marino, Basham and Beecher's (2011) suggestion that it is important to evaluate student learning as it is happening in order to gage strengths and weaknesses. The discrepancies between on-task behaviors and vocabulary acquisition could be attributed to the researcher monitoring students' input of terminology and definitions during class. For example, during the third intervention phase, Student G. used some of the generic definitions available on *Quizlet* and scored 83% on the quiz. Her grade may have been higher if she had used the correct definitions.

Moreover, the students were observed during a highly stressful time that coincided with required state testing. The school wide participation in state testing and schedule changes may have affected student on-task behaviors and performance. It would have been better to expose students to the intervention process during regular scheduling prior to preparation for and the experience of state testing.

Finally, a limitation of the study may have been the small sample size and specific grade level. This single subject design study was conducted with a small group of seventh grade students (N=7). Data from this study may not be generalized beyond the seven student participants.

Conclusion

The results of this study are encouraging. Participants showed increases in both science vocabulary acquisition (vocabulary grades) and engagement (time on task) behaviors. However, because of varying individual scores, it is inconclusive if the use of the video learning game *Quizlet* had any effect on the academic achievement of students with LD. Students' vocabulary scores increased along with engagement, and off-task behaviors decreased. Additionally, students made unexpected gains, e.g. by the end of the study, students became independent at using *Quizlet* and typing skills appeared to improve. This study suggests opportunities for further research with a larger sample size is justified. Furthermore, follow-up studies that increase the intervention duration, and or implement additional interventions to more accurately access the effects of *Quizlet* are recommended.

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