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## Comparison of Vocabulary Learning Strategies

Will the use of technology based vocabulary learning strategies result in better vocabulary retention than traditional vocabulary learning strategies?

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## Abstract

The purpose of this action research project was to determine if the use of technology during vocabulary practice would improve the term retainment. Participants of this study were students who did not pass the Pennsylvania Biology Keystone Exam and therefore were placed in an intervention class intended to help students score a proficient on their second attempt of taking the Exam. There were sixteen students who participated in the study. Many of the students struggle academically due to attention disorders, there are two students with physical disabilities that affect learning, as well as students with good study skills who just did not pass the exam. The study lasted for six weeks and included two units of vocabulary terms. Students took a pretest, practiced different vocabulary learning strategies for two weeks and then concluded with a post-test. Students were placed in one of two study groups, one group used technology based learning strategies and the second group used non-technology based strategies. Students were also asked to complete anonymous surveys to get their opinions on the use of the different vocabulary strategies. Although the findings did not show a significant difference in results between technology and non-technology based strategies, the results of the surveys and observations indicate that students think daily vocabulary practices are helpful and suggests the specific strategies that are more effective in a classroom environment similar to the class in this study.

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## **Chapter 1: Introduction**

### **Background**

Standardized testing has become a normal component of students academic school year. As a result of the No Child Left Behind Laws, students in public schools start taking high stakes standardized test in third grade, and continue taking them up through high school. Under No Child Left Behind, schools were pressured to have students perform well so they would not be penalized. Even though the No Child Left Behind Law has been replaced by the “Every Student Succeeds Act,” it has left behind a culture of high stake standardized testing (Long, 2013). The pressure created around these tests has been passed down to the students, who are pushed to get a proficient score on all of these exams.

Teachers have the responsibility of not only teaching the district’s curriculum, but also ensuring that students are prepared for these state standardized exams. Teachers can accomplish both by adopting strategies that will help students improve their overall learning. One approach to increasing comprehension of material, is to ensure students have a strong literacy background, especially in the area of vocabulary (Cohen, 2012). Studies have found that there are a number of successful strategies for learning vocabulary more effectively. One of the most important strategies is making vocabulary practice part of the daily routine (Fawcett, 2009). There have also been a number of studies on the use of technology for learning vocabulary, and how it increases students vocabulary term retainment. Having access to both proven vocabulary strategies and technology, teachers have the tools to help students improve their content knowledge and help them be prepared for future standardized tests.

At the conclusion of this action research I found that including vocabulary learning strategies is beneficial to students. However, it appeared that the use of technology did not play a role in improving their learning. Individual students had different preferences, and I think their success depended on their ability to use strategies they preferred. This leads me to believe that choice of learning strategy plays a bigger role in students success at learning. I shared my findings with the instructional coach of our school who will share it with interested teachers.

### **Problem Statement**

With so many high stake standardized tests that are administered to students throughout their academic career, teachers need to take into consideration the impact that failing these exams has on students, and how we can prepare them for future tests. Kearns (2011) conducted a study focusing on students who failed a standardized test in Ontario, and found a great number of disturbing effects that failure had on students. The students felt “shame, degraded, humiliated, stressed, less smart, and like a loser” (p.119). In the Downingtown Area School District, when students do not pass the Pennsylvania Keystone exam, they are placed into a full year remediation course. So not only is there concern that these students may be feeling the same effects as the students who participated in Kearns’s study felt, but their academic course of study is effected. They are not able to move on to the next science course, and therefor may not have the opportunity to ever take a science elective in high school.

The next concern related to the presence of high-stake standardized tests, such as the Keystone Exam, is how to appropriately prepare students. One train of thought is to teach students test taking strategies. Studies conducted by Moon et al. found that there tends to be

"skill and drill" instruction in impoverished schools. This type of instruction consists of spending more time on activities that involve multiple choice and constructed responses that are similar to what would be found on standardized test (Moon et al. 2007). But this is not always the best option, test taking strategies tend to be short cuts that just teach them how to take tests (Paris et al. 1991). As Moon et al. (2007) points out, focusing on test-taking strategies eliminates the opportunity for performance base and enrichment activities. With this in mind, educators should be focused on ways to help students improve content knowledge so that they will have a better chance at passing the exam based on what they have learned.

Focusing on vocabulary is one way teachers can help students increase their content knowledge. As Cohen (2012) points out in his research, in order to comprehend material, students need to have a strong literacy background, especially in the area of vocabulary. Researchers agree that the best strategies for learning vocabulary are strategies that allow students to be creative and make vocabulary terms personalized (Marzano, 2009). With the increased availability of technology in the classroom, there is also an increase in the options to be creative. Research conducted by Dubois and Vial (2000) found that the use of hyperlinking multimedia (images, sound, video, and text) to terms, significantly helped students when learning vocabulary. When making decisions on the best practices for teaching content, teachers now have to consider if the use of technology will enhance learning or if it will just substitute traditional methods. It was difficult to find research that compared the use of technology based methods to the traditional paper based methods. In order to ensure that students are using the best strategy available, more research in that area needs to be done.

## **Significance**

In Pennsylvania, many high schools require students to take the Pennsylvania Keystone exam as a graduation requirement. When students do not score Proficient or Advanced on the exam, they are required to retake the test until they do reach proficiency. Many high schools offer remediation classes for students who have failed subject tests. In the school district where I work, students who have failed the Biology standardized test are placed in a year long remediation class. Biology is a subject that has a disproportionately large number of vocabulary terms. To truly understand the content in Biology, students need to learn and remember all of these new terms. A number of studies have found that the strategy that most teachers rely on, giving students a list of words to define, is not effective (Bintz, 2011). In order to effectively teach students the large number of terms, it is important to find the most effective strategies that are available.

Schools across the country are integrating technology into everyday learning. Schools have been focused on making technology available for all students, thanks in part to the 2013 ConnectEd initiative, which requires 99% of schools to have high speed internet by the year 2018. According to The National Science Board, as of 2017, 88% of schools had high speed broadband (Science and Engineering indicators 2018). Many school districts have begun implementing 1:1 and bring your own device programs, therefore it is worthwhile to investigate the possible advantages of using technology. Research on the use of laptop and achievement conducted by Binbin Zheng (2016) has found that there has been significant improvement in student achievement in all subject areas, with the greatest increase in science when learning includes the use of laptops. The school district where I teach has recently implemented a 1:1



program, so all students are required to have a personal laptop in the classroom. Therefore, conducting a study to determine the impact of technology on improving vocabulary retention is an important question to consider.

### **Research Question**

There are two questions that this action research project investigates. The first question is a quantitative question, using data acquired through analysis of pretest and post tests of two different vocabulary units of study. The second question will be a mixed-method approach, using information acquired through anonymous surveys and observations of class engagement.

**Question 1:** Is there a difference in vocabulary retention between students using technology-based vocabulary strategies and those using traditional vocabulary learning strategies?

**Question 2:** Do students prefer one method over the other?

### **Definition of Terms**

The following terms are used throughout this research and may need adequate defining for clearer understanding:

1. IBC - Introduction to Biochemistry, a second year biology course designed to help students who did not pass the Biology Keystone Exam during their freshman year of high school.
2. 1:1 - One-to-one computing; schools allow students to use electronic devices in the classroom to access the internet and digital materials
3. Keystone Exam - End of course assessment designed to assess proficiency in the areas of Algebra, English, and Biology

4. IEP- Individualized Education Program; a document that is developed for each public school child who needs special education
5. Action Research - Refers to a wide variety of evaluative, investigative, and research methods designed to diagnose weaknesses and help educators develop practical solutions to address them.

## **Chapter 2: Literature Review**

The Literature review begins by looking at how students that fail standardized tests are affected academically, socially, and emotionally. I start here to emphasize the importance of finding strategies that will assist the students in my IBC course. Even though the research spanned a timeframe between 1991 and 2011, I believe students feelings about standardized testing are relevant to students feelings today. The review then focuses on effective use of vocabulary strategies as a mean to increase content understanding. This section of the review should demonstrate that vocabulary is crucial to understanding content, and how effective vocabulary strategies lead to improved tests grades. Vocabulary strategies have been researched for close to one hundred years, however for the purpose of this study, most of the papers I used were from 2003 to 2013. Originally, my research was focused on the use of flashcards as an educational tool for learning vocabulary. However, a number of articles reported that flashcards are not an efficient method for learning, they only provide a “superficial level of word knowledge” (Harmon and Wood,2005, p.2 ). Therefore, I focused finding papers about successful learning strategies for teaching vocabulary to older students and also vocabulary in the science classroom. The final section of my review summarizes research on the use of technology when learning vocabulary. While I tried to use articles from the last five years for this section, I did include articles from 2000 and 2003, since they were based on strategies that are still integrated with technology today. The research supports the reasoning for the purpose of my action research, which ultimately is to find the best practice for increasing vocabulary learning.

## **Standardized Testing in Secondary Schools and the impact on students**

State standardized tests have become commonplace in today's school setting. Standardized tests are used to measure students achievements and needs. Schools rely on the results of standardized tests as a measure of schools performance, and how they rank in comparison to other schools within their state. According to the Pennsylvania Department of Education, standardized tests scores comprise 40% of the school performance score, with the Keystone Exams making up 30% of the category (Pennsylvania Department of Education, 2019). There is a lot of focus on how these tests are important for schools, but not alot of research on the impact they have on the students taking them. Pennsylvania has a graduation requirement that students must either pass the Exams or complete an alternative assignment (Pennsylvania Department of Education, 2019). Many schools require students take the Exam until they pass. According the Downingtown Area School District where I teach, all students must score Proficiency or Above beginning with the Class of 2019 (Downingtown Area School District, 2018). The push for all students to pass certain standardized tests comes at a high cost to the students that struggle to pass.

Studies of how these tests affect the students who take them found a number of troubling concerns. In a study conducted by Moon, et al. (2009) in which they surveyed 1,400,000 teachers they found that students felt a great deal of pressure and stress leading up to the tests. What is of greater concern is that, as one of the students pointed out, the tests cause even more stress to the students that are already struggling academically. Standardized testing has been a part of most students academic career, starting in early elementary school. By the time many students get to high school their views of standardized testing typically becomes negative. Paris,

Lawton, Turner, and Roth (1991) surveyed high school students and found that by the time they are in high school they have increased feelings of resentment, anxiety, cynicism, and mistrust of standardized achievement tests. They also found that many students were afraid that other people would consider them stupid if they got a low score on the test. Along with all the negative attitudes and feelings that students have leading up to these tests, it is important to take into consideration the impact failing these standardized tests will have on students both short and long-term.

Kearns (2011) conducted a study focusing on students who failed a standardized test in Ontario, and found a great number of disturbing effects that failure had on students. The students felt “shame, degraded, humiliated, stressed, less smart, and like a loser” (p.119). Many students also expressed self-doubt as a direct result of their failure, and they were more stressed out about having to take the exam for a second time. Moon, Brighton, Jarvis, and Hall’s (2007) findings were in agreement with Kearns. They found that the students who failed the test felt embarrassed, isolated, and stigmatized. In many schools students are required to repeat taking the test until they pass. Some schools place students in enrichment classes in hopes of helping them do better on the test the second time around. But these studies found that students felt even more embarrassed by being placed in these classes. The students did not find these classes helpful, since it was just repeating what they had already learned in their original class (Kearns, 2011).

There were a couple of implications of how failure on standardized tests could have a profound impact on students academic future. Moon, Brighton, Jarvis, and Hall (2007) found that for some students, the pressure associated with state tests appeared to lead to withdrawal from school. Which confirms Diener and Dweck's findings from 1978 and mentioned by Paris,

Lawton, Turner and Roth (1991), that when students feel that test scores control their future, they show less interest in academic work, are more inclined to take shortcuts or adopt maladaptive strategies.

Since there does not seem to be a time in the near future that standardized tests will be eliminated, we must consider ways to help these students that fail or have become stressed about taking the tests in the first place. One way to help ease stress could be by helping students feel more prepared for the test. Paris, Lawton, Turner and Roth (1991) were surprised to find in their study that high school students admitted that they did not feel prepared for the standardized test. They also found that many of the failing scores could be a result of inappropriate learning strategies. There are many teachers that spend time preparing students for taking standardized tests and teaching test taking strategies. But Paris, Lawton, and Turner found that many of the strategies that are taught are just short cuts that students do not transfer with them to other classroom activities. If we want students to feel confident both before and after taking the tests, we should look for teaching strategies that will stick with them, even after the test.

***Focusing on learning vocabulary:***

I believe that one strategy that can help these students achieve success during the test and in the classroom is to spend more time focusing on vocabulary. Dewitz and Graves (2014) discuss in their research review, that one of the needs in college, at work, or as an engaged citizen is the ability to infer meanings of new words. Teaching a class that is intended to help students that have already failed the Biology Keystone Standardized tests, it is important to find strategies to help them learn the content better so that they can do better on their second attempt at the test. I predict that spending more instruction time on vocabulary will help students

improve their overall comprehension. Cohen (2012) discusses in his research that in order to comprehend material, students need to have a strong literacy background, especially in the area of vocabulary knowledge. Each year of schooling requires students to learn increasingly abundant and challenging concepts in each discipline. In his book, Zwier discusses how in disciplines such as science, math, and history, there is a need for particular focus on the complex language used (2014). The importance of focusing on learning vocabulary is further confirmed by William Bintz's (2007) review of research on vocabulary in which he concludes that there is agreement among researchers that vocabulary has always been and will continue to be an important goal in learning.

Although learning vocabulary is key to learning in all disciplines, it is especially important to make it a primary goal in science. Cohen (2014) pointed out in his review of research, the importance for all students to be able to understand new words, but it is especially important in content areas such as science. Cohen continues to discuss how science relies heavily on a student's ability to understand new terms and concepts, so students need to have a strong base of vocabulary knowledge. Yager (1983) looked at twenty-five of the most commonly used science textbooks and analyzed them for the occurrence of special/technical words. His research found that in one year of a science course students are introduced to 2500 new and unfamiliar words. This overwhelming number of new terms was found to be significantly greater than the amount of words students learn in a year of foreign language. So, in some manner, science is like learning a foreign language. As Cohen (2012) pointed out in his research, "Science has its own language, one in which students are introduced to either completely new words or novel uses of familiar words" (page 74). It is necessary to help

students master this new language so they have the tools to help them understand the content. In a study on science literacy done by Fisher, Grant and Frey (2009), they concluded that one of the most important ways to improve scientific understanding and achievement is by realizing what an important role vocabulary plays in the curriculum. The stronger a student's literacy skills, the better is his or her grasp of science material (Cohen, 2014). With so much agreement on what an important role that vocabulary has at helping students understand science content, it is easy to argue the need to make vocabulary instruction a key component of learning in the classroom. As pointed out by Zwiers (2014) in his study on meeting common core standards, language and literacy must be a part of all content classes. He specifically points out the need of science, math, and history teachers to make extra efforts at teaching different tools and skills that relate to the language of the course.

### ***Effective Strategies for Teaching Vocabulary***

Looking at the different studies I did not find agreement among the researchers about the best way students should learn vocabulary. However there was agreement among all researchers that it was important to have some type of vocabulary instruction within a course. In Blachowicz, Fisher, Ogle, and Watts-Taffe's (2006) review of vocabulary research throughout the decades, they mention Dewey's (1910) conclusion that any type of vocabulary instruction is more beneficial than none. They also discussed that their research led them to conclude that one characteristic of good vocabulary instruction includes intentional teaching of specific words with opportunities of repeated exposure, use and practice. At the conclusion of Aphorpe's (2006) study that looked at the effectiveness of vocabulary intervention in 15 third grade classes, she



agrees with Blachowicz's sentiment, arguing that vocabulary instruction should include frequent encounters with vocabulary terms along with active processing of those terms. Review of research by Bryant et al. (2003), also makes an argument for the need of multiple exposures to new words to promote understanding.

There are countless strategies that teachers can incorporate into their classroom and according to the research there is no agreed upon strategy that works for everyone. In an article in which Marzano (2009) draws on his 40 years of research and inclusion in 50 different studies, he states that there is no proven strategy that works for everyone, you have to find one that works for you and the environment you are teaching in. That being said, there are a number of general strategies that all researchers I read agreed upon.

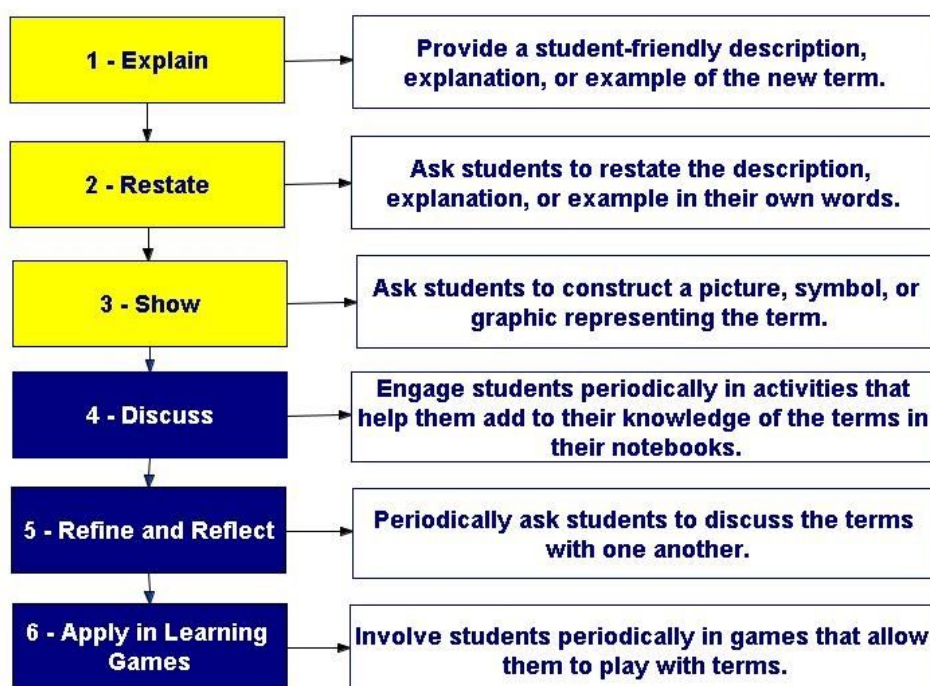
One practice that a number of researchers agreed upon was the importance of teacher modeling. Teachers must walk students through the strategies that will be used to learn and understand the meaning of new words, showing the students an example of how to use the strategy. Greenwood (2004) discussed the need for teachers to model and explicitly teach strategies to students. Fisher, Grant, and Frey (2009) agree with the importance of teacher modeling, pointing out that teachers need to show students how to determine the meaning of words by the use of context clues, and looking at the word parts; suffixes, prefixes, and roots. Fawcett (2012) also concluded in her research that it is necessary to model how to find "clues" in new vocabulary words. Many teachers believe that by the time students get to high school, they should no longer require modeling. However, a study conducted by Adams and Pegg (2012) investigated how to change this common belief among secondary content teachers. The study included 6-12th grade teachers of Science and Math from a high need district. The

purpose of the study was to conduct a study to help teachers develop literacy strategies, which included vocabulary development. One of the strategies that they focused on was how to model to the students the different strategies for learning vocabulary. As this paper pointed out, there is a need for content teachers to learn how to include vocabulary instruction in their daily teaching.

Researchers Fisher, Grant, and Frey (2009), Fawcett (2012) and Savino (2011) all agree on the need to make vocabulary teaching a priority, emphasizing the importance for repeated exposure to new vocabulary terms. Savino points out in her research that it takes 10-40 encounters with a given term before a student reaches the highest level of understanding of that term. There are many different ways to provide daily exposure to vocabulary terms each day. One of the most common ways discussed in the research was through reading. Fawcett (2012) points out in her review of research, that most vocabulary is learned through reading and listening to others read. Another common practice for increasing exposure to vocabulary is by using games, according to Marzano (2009). And a third practice to increase exposure to vocabulary is having discussions about vocabulary terms. Fisher, Fawcett, Savino, and Marzano all mentioned peer discussion as a successful strategy for reinforcing vocabulary learning. If you make vocabulary a daily part of your teaching routine, students will benefit. Students need and want routine, and routines help students develop independence (Fawcett, 2009).

A third practice that most researchers agreed upon was the need to make the vocabulary terms personal. There were a number of different methods mentioned that result in students having a personal connection to the word. One important component that researchers agreed upon was having students defining terms in their own words. Table 1 illustrates a teaching strategy developed by Marzano to help make vocabulary more personal for students.

### Marzano Six-Step Process for Teaching Vocabulary



*Table 1. Six-step process for teaching vocabulary, Marzano (2009)*

During his research, Marzano (2009) found that having students write the definitions in their own words was crucial to helping them learn. Compared to students who copied the teachers definitions, the students who wrote their own definitions were better at recalling the new vocabulary terms. Kennedy, Rodgers, Romig, Matthews and Peeples (2018) discussed in their paper that when students create a relational definition to a term, they make it their own. In their research they trained 200 preservice teachers how to use a combination of multimedia instruction

and performance feedback for effective vocabulary instruction. Teachers in this study found that this approach was particularly important in science and mathematics.

Asking students to draw pictures with their definitions is another strategy that has been found to have great success. Marzano (2009) stressed the importance of having students draw pictures with their definitions. He found that when students incorporated pictures, pictographs, or symbols, their achievement soared. So, by giving students the opportunity to write definitions in their own words and include their own visual representations of the terms allows the students to ownership of the word, and therefore they have a better chance at remembering it.

When it comes to teaching vocabulary in specific content areas such as science, most of the research agrees with the research on all vocabulary learning. The research on content specific vocabulary by Harmon and Hendrik (2005) and Greenwood (2004) both stressed the importance of repetition, practice, and meaningful use. They both also discussed the need to teach vocabulary before students are to read the text, since science textbooks are rich in technical vocabulary terms. In Greenwood's (2004) research, he also mentioned an important aspect of teaching vocabulary strategies to students. He discussed that a part of the teachers goal for teaching strategies to students is to then give the control of learning to the students. So again, the emphasis is on the importance of teaching students strategies but also making sure they take ownership of their learning.

### **The role of technology in improving student achievement**

Focusing on vocabulary as a means to help students is just one consideration to be made when trying to increase achievement. It is also necessary to take into consideration the way teaching is occurring in the classroom. Educational tools are constantly evolving. One recent

(and ongoing) change in education has been the increase of technology in the classroom. One of the primary focuses on technology within school districts across the country has been the implementation of a 1 to 1 initiative. A National Report by IESD and STEM Market Impact conducted a study on 332 school districts across the country and found that 82% of the districts are interested in implementing or expanding a 1:1 initiative, and 20% already have one (Logan, 2018). The Federal government is also involved in the push towards having more technology in the classroom. In 2010, the National Educational Technology Plan established an action plan to provide internet access to all schools across the United States, and aim to make affordable devices available for all students. With our education heading towards a school environment in which all students have access to their own devices, educators should consider what kind of impact that will have on their education.

In an analysis of 15 years of data of how laptop initiatives boost student scores, Doran and Herold (2016) concluded that in schools that gave every student a laptop, there was an increase in achievement and a boost to their “21st century skills.” According to a review of over 100 research studies on laptop use and student achievement, Binbin Zheng (2016) found that there was significant improvement in student achievement in all subject areas when using laptops, with the greatest increase in science and the second increase in size was Language arts. Another important finding, reported by Keengwe et al. (2012) in their surveys of faculty was that 1:1 computing improved the learning experience for traditional, at risk, and high-achieving students. Zheng did point out that out of the 150 related studies she looked at, there has only been 10 that focused primarily on the effect of the 1:1 initiative and student achievement, so more research is still needed.

Although the previously mentioned research has found that there is an increase in student achievement with the use of laptops, it is important to note that an increase in achievement is not due to the computers themselves, but rather, the appropriate use of computers. In an analysis of data derived from a nationwide survey of classroom computer use, researchers Norris, Hossain, and Soloway (2013), found that when computers were used as a supplement to already developed curriculum, there was no improvement in learning. However, when computers were used as an essential part of the curriculum (ie. active learning activities that involve constructiveness and collaboration) there was a 30% improvement on standardized tests. These findings stress the importance of appropriate planning when using technology in the classroom, plans should include using technology as a means to enhance learning, not simply substituting a previous used tool.

### **Using Technology to teach Vocabulary**

The findings of the limited research on the effect of 1:1 initiatives on academic success have been positive, showing that there is an increase in achievement in all subject areas. However, I am interested in finding out if using technology to learn vocabulary would be as successful. According to the studies that I looked at, the biggest benefit that technology provides for learning vocabulary is the accessibility to a variety of different forms of media that can be used when learning a new vocabulary term. Pritchard and O'Hara (2009) found during their research that studies have shown that students who learn in multimedia environments show greater gains in vocabulary development than students in a traditional environment. Their study investigated how hypermedia projects would assist in the vocabulary of seventh grade ESL students. They also found that students felt like they learned more, many students commented

on how the process of creating the slides increased their ability to remember the meaning of the word. Research on non-computer based and computer based strategies for learning vocabulary agree on three components that are essential for beneficial vocabulary learning. These components consist of creating connections between the vocabulary term, creating visual representations, and creating personal meaning. However, with computers students have more options to be creative with the use of multimedia available on the internet.

Multimedia environments provide a rich variety of graphics, animations, pronunciations, videos and music. These resources are beginning to be used by educators and learning programs to enhance understanding of vocabulary terms. Dubois and Vial (2000) found in their study that multimedia did significantly help students learn vocabulary terms. They conducted their study on 60 French students learning Russian, some students were shown the Russian word and French meaning, other students were shown the meanings, along with pictures and audio pronunciations. Dubois and Vial (2000) found that when visual images, sound, and text definition were incorporated, both learning and memory improved. The use of hypermedia, linking audio, graphics, and video to text, in the science classroom is even more beneficial. There are many terms in science that are difficult to understand because they refer to ideas that are conceptual. A study by Jazlin Ebenezer (2001) looked at how hypermedia is especially useful when teaching scientific terms. In her study she used hypermedia to teach chemistry students about solutions. She found that hypermedia to be beneficial because she could include illustrations and animations that helped students better understand the concept.

There is even greater benefit to learning vocabulary terms when students are required to create their own hypermedia according to Dalton, Proctor, Uccelli, Mo, and Snow (2011). Their

study compared two different learning strategies developed to help students improve their vocabulary scores. The participants of their study were seventy-five monolingual English speakers and thirty-one bilingual students assigned to three different groups. They divided the groups into one that used reading comprehension strategies, a group that used vocabulary strategies and a group that used a combination of strategies. The reading comprehension strategy included a digital reading program with features such as; text to speech, highlighting, hints for understanding words, glossaries and illustrations. The vocabulary strategies included a program in which students read a text and for keywords they were asked to create concept maps, find pictures and create captions using the vocabulary word, and add hyperlinked words that related to the text. Their study found that the students who used the vocabulary strategy, performed better on the post vocabulary test than the students who used the reading strategy. They also found there wasn't much difference between outcomes of the group who used the vocabulary strategies and the group that used the combined comprehension and vocabulary strategies. Warner and Jones discuss in their study of literature, that when students create, synthesize, and apply their understanding when creating hypermedia, they are using higher order thinking skills (2011). Research by O'Hara and Pritchard (2004) back up this point with their findings that when students are allowed to design their own hypermedia they become active learners. This type of active learning promotes cognitive and metacognitive learning strategies.

The takeaway from the research that I found was that technology can improve vocabulary learning by giving students the ability to access different forms of understanding of the term from the multiple forms of media available. It also provides the opportunity for students to create their own representations of the meaning of terms. The research mentioned a number of



tools on the internet that students can use to help them create meaningful representations of vocabulary terms. Visual representations can be made with apps such as Flickr, Wonder Wheel, Image Swirl, and Big Huge Labs. Video representations can be made with Animoto, or by having students create youtube videos about vocabulary terms. And audio representations can be created with apps such as voicethread, blabberize, Audacity, or Voice Memos. With the opportunity to use technology to help students learn vocabulary, Warner and Jones (2011) points out that students are also acquiring the skills needed for the 21st century.

The research that I found about the use of technology for learning vocabulary focused on how technology can improve students acquisition of new vocabulary terms. All the research indicated that technology is beneficial for learning vocabulary. However, I did not find any research comparing use of technology-focused to traditional strategies for learning vocabulary. There were many similarities between the findings of successful vocabulary strategies between traditional and computer based learning. They both stressed the importance of students creating their own definition of the vocabulary term and including visual representations. Technology based strategies also included the use of animations and sound to assist in the learning of new vocabulary terms. This study will investigate if there is a significant difference in learning between the use of technology based vocabulary learning strategies and non-technology based learning strategies.

## **Chapter 3: Methodology**

### **Introduction**

When teaching a class intended for students who struggle academically, it is important to continually search for teaching strategies that will increase student achievement. Decisions need to be made about what strategy will help students have a better understanding of the content and what is the best way for students to participate. The aim of this action research was to determine if the use of technology during vocabulary learning, would improve learning or if it would have no effect. By conducting Action research, I hoped to find an answer to this question, while teaching my students new strategies that could help them improve their vocabulary learning and retention.

### **Conceptual Framework**

During this study I set out to determine if the use of technology based vocabulary learning strategies would result in better vocabulary retention than traditional vocabulary learning strategies. I hoped to find out if students preferred one method over the other. Action Research was the best method to answer these questions for a number of reasons. Action Research is conducted in the effort to improve and/or refine the researchers action in the classroom (Sagor, 2000). In the process of the research, students participated in practicing new or improved techniques, so action research allows researchers to see first hand if efforts actually work. Since I am always trying new methods to help the students in IBC increase their content knowledge in order to pass the Keystone, working first hand with them on new learning strategies had the potential of having potential positive results. This action research project exposed the students to new strategies that they could integrate in their own study skills. The Action research also

allowed the opportunity to observe how the strategies actually worked in my classroom, and which ones worked better than the others. Since my goal was to find strategies that were the most effective, it made sense to conduct action research in order to see first hand if I successfully found a solution to my problem.

## **Participants**

Participants of this study included 14 students, 10 males and 4 females. They were students in my 10th grade, Introductory to Biochemistry (IBC) class. This is a class that was developed to re-teach Biology to students who failed the Biology Keystone Exam after 9th grade. There were 29 students in this class total, however not all parents allowed their students to participate. Of the students who participated, 7 of them had IEP's. The majority of the IEP students needed assistance with everyday learning activities, such as following directions, staying on task, organizing work, and staying focused. One student had a hearing impairment and wore a hearing aid. It was a class that needed constant guidance and motivation. Of the participants, there were 3 racial minorities. The high school is a public school, with a population of 1,721 students, 18% of the students are racial minorities, 13% of the students are economically disadvantaged.

I chose to conduct my action research project with my IBC class, because I hoped to find successful strategies that would help these students perform better on the Keystone Exam. Since they did not retain enough content knowledge after their first year of taking Biology, I thought it would be beneficial to look at strategies that might help reinforce their understanding of the content. In a typical Unit of this course, students learn approximately 40 new or

unfamiliar vocabulary terms. It is difficult to understand the main concepts of Biology if you do not know what the majority of the words mean.

During the research I continued teaching the course content as usual. However, when the action research project started, I changed the daily routine of the class by having students spend 10-15 minutes everyday on vocabulary learning. I introduced the vocabulary strategies, and taught them how to work with them. While students were completing the vocabulary activities I made observations on the levels of engagement. During the project I also analyzed vocabulary quiz results, and analyzed results from student surveys given at the end of each vocabulary unit.

### **Procedure**

The purpose of the study was to determine which vocabulary learning strategy would result in the greatest increase of vocabulary retention. A couple of weeks before the research began I explained the study to my students. I went over the procedures, explaining what I hoped to find out, and discussed their role in the study. I explained that it was a voluntary study and that they could choose to participate or not in the study. I reassured them that there would be no negative consequences if they chose not to participate. I explained that all students, participants and nonparticipants, would engage in vocabulary learning strategies and quizzes. The students were given an assent form to look over, and a consent form to take home to their parents. An email was sent home to parents explaining the study and that it was voluntary for the students. I also emailed them a copy of the consent form.

This study took place over the period of 1 Unit in my Introductory to Biochemistry (IBC) class. It was a Unit on Genetics, there were 44 new vocabulary terms in that unit, so the unit was divided into 2 Vocabulary sections.

On the first day, all students took a pretest which included 20-22 words requiring students to match terms to the correct definitions (appendix E). Students were then divided into their predetermined, randomly chosen groups.

The students then spent the next 7-10 days focused on vocabulary learning strategies. For the first 5-7 days students will define the terms using the strategy predetermined for their group. Non-technology based students filled out the Frayer Model given to them (appendix F) and the technology based students completed a google slide form of the Frayer model. The technology based students were encouraged to add hypermedia (audio, video, or graphics), but all students stuck with simple images. Examples of students work can be seen in Appendix M. Students were initially asked to define five terms a day, but this ended up being too time consuming so it was reduced to three terms a day.

After all the terms were defined the original plan was to have students choose 2 - 3 terms to make creative vocabulary work. Students in the Non-technology group were asked to make a comic (appendix G, students in the Technology based group were given the option of making a fake instagram post or Word poster (Appendix H). During the actual study I only required the students to do a creative vocabulary work for one term, due to time restraints.

The next day students were assigned term sorting activities. The non-technology based students were to create mind maps with the terms, and the technology based students were to sort

words into tables using excel. Both of these tasks proved too difficult for the students so they did not successfully complete them.

The next learning activity was a review game. Students in the non-technology based group had a matching game to play with other students in their group. The technology based students were asked to use Quizlet and choose a review game of their choice (Appendix I).

On the final day all students all took the same post-test and completed the google form survey. Students were then asked to switch the group they were in and the whole process was repeated.

### **Materials**

Students received an assent and consent form before the study began, and parents received an email with an additional digital copy of the consent form, (Appendix A and C). The pretest and post test for each unit was the same (Appendix E and K). During this study, students who are in the non-technology based group got paper copies of the Frayer Method (Appendix F). They completed their comic (Appendix G) on paper and used colored pencils provided in class. The students in the technology based group used their personal laptops, all students in this class had their own personal laptop that they are required to bring to school everyday. If a students laptop is not charged, or is not working properly, they may borrow a school laptop from the library. While students participated in the daily vocabulary activities, I planned on circulating the room taking notes on engagement but found that students required too much assistance, so I took notes during my free period following this class. After the post-test students completed a short survey using Google - Form, (Appendix J and K).

### **Analytic Processes**

At the end of the study I analyzed the quantitative data collected from the pretests and posttests. I determined the mean difference between pretest and posttest for each vocabulary unit studied. I completed a t-test and determined if the change in scores were significant. I also ran a t-test to compare the mean differences of the technology based groups to the non-technology based groups to see if there was a significant difference in their change of scores. I also used a mixture of quantitative and qualitative data during my research. The students took surveys at the end of each vocabulary unit. The surveys were conducted on a Google Form. The surveys were used to analyze which strategies the students preferred, if they felt like the strategies were helpful, and if they would use any of them on their own in the future. I also made observations on levels of engagement during vocabulary activities, to see which strategies appeared to be the most engaging.

### **Ethical Considerations:**

Parents and students were given information about the nature of the study and reassured that participation was voluntary and there would be no negative consequences for not participating. The students and parents were reassured that their grade would not be affected by participation in study, and that all vocabulary quizzes were being used for research, not grades. Parent consent forms and student assent forms were collected from participants and securely locked in an office at my house. All participants were de-identified for the study, and all work collected will be securely locked. All material will be stored for 3 years and will then be disposed of by shredding documents before being placed in recycling bin. Information stored on on the my district computer will be printed out and erased from the computer. Taking these safeguards into account, I do not foresee any ethical, or moral issues that should arise during this study.

## Chapter 4 Data Analysis and Results

**Results and Analysis Question 1; Is there a difference in vocabulary retention between students using technology-based vocabulary strategies and those using traditional vocabulary learning strategies?**

### **Pretest and Post-test scores and Average Scores.**

Participants began each vocabulary unit by taking a Vocabulary Pretest, this test was given before we had any discussion or lessons that involved the terms. After approximately ten days of vocabulary practice and lessons on the content, students were given the same vocabulary test. The test grades are scored as percentages, scores for each test is shown in Data Table 1.

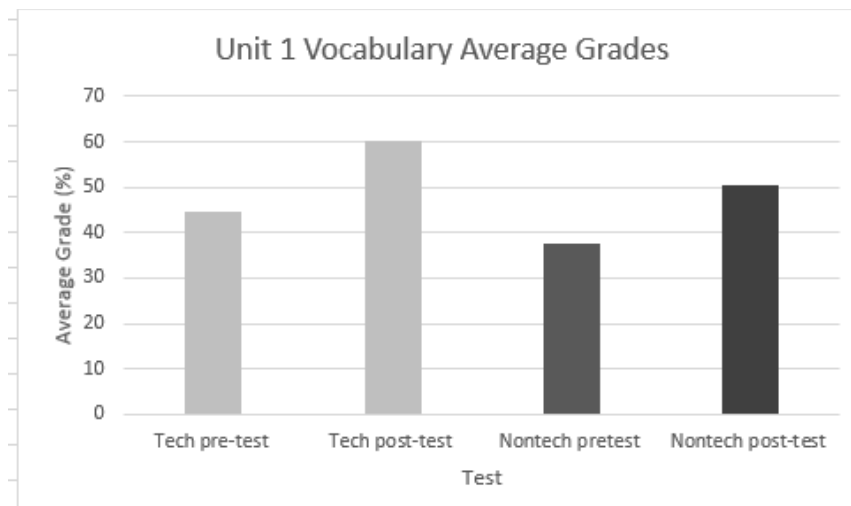
student #	pretest 1	post-test 1	pretest 2	post-test 2
45	13	17	14	32
28	35	9	14	14
13	35	74	18	41
64	48	65	18	56
12	65	100	45	73
37	48	78	45	63
82	69	78	50	68
73	22	43	18	23
91	30	65	27	41
52	74	35	18	74
95	13	57	27	50
74	17	31	23	36
18	4	35	41	32
66	69	87	41	78

**Data Table 1.** Vocabulary Test Scores for Pre and Post Tests of the two vocabulary units. Shaded areas indicate groups that were using the non-technology based strategies

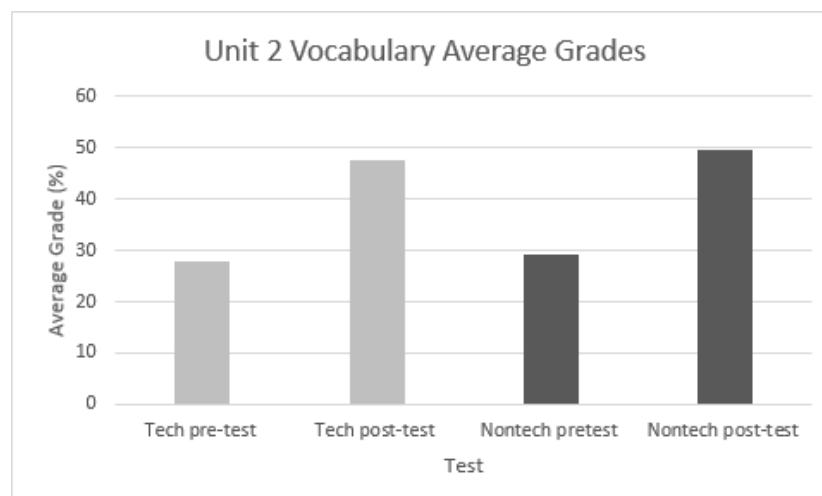
Once I had all the test scores I calculated the average scores using microsoft excel for each of the following the groups; Unit 1/Technology based pretest and post test, Unit



1/Non-technology based pre-test and post-test, Unit 2/Technology based pretest and post-test, Unit 2/Non-technology based pretest and post-test. Figures 1 and 2 show the average scores for each of the categories.



**Figure 1.** Average Test Scores for the Unit 1 Vocabulary Test. Pretest and post-test scores for both the technology based and non-technology based groups.



**Figure 2.** Average Test Scores for the Unit 2 Vocabulary Test. Pretest and post-test scores for both the technology based and non-technology based groups.

Figure 1 and Figure 2 both indicate quiz grades improved after a couple of weeks of vocabulary practice. For example, for Unit 1 the non-technology based groups average scores

increased from 38% to 50% , while the technology based groups increased from 44% to 60%, and for Unit 2 the non-technology based group average scores increased from 29% to 50%, while the technology based group average scores increased from 28% to 48%. The test scores were used as an indication of increase in vocabulary retention. The graphs indicate that the average scores were somewhat higher for the first Vocabulary Unit, with the highest average being 60% while the highest average from Unit 2 was 50%. One possible reason for the higher average could due to the difficulty of the terms in the second Unit.

### Comparing Mean Difference of Pretest and Post-test Scores

I next compared the differences between pretest and posttest scores to determine if there was a significant difference due to learning strategy. To compare the results, I looked at the mean difference between the pretest scores and post-test scores, I calculated these differences using microsoft excel, the differences in test scores are seen in data table 2.

student #	pretest 1	post-test 1	Difference	pretest 2	post-test 2	Difference2
45	13	17	4	14	32	18
28	35	9	-26	14	14	0
13	35	74	39	18	41	23
64	48	65	17	18	56	38
12	65	100	35	45	73	28
37	48	78	30	45	63	18
82	69	78	9	50	68	18
73	22	43	21	18	23	5
91	30	65	35	27	41	14
52	74	35	-39	18	74	56
95	13	57	44	27	50	23
74	17	31	14	23	36	13
18	4	35	31	41	32	-9
66	69	87	18	41	78	37

**Data Table 2.** The difference between pretest and post-test scores.

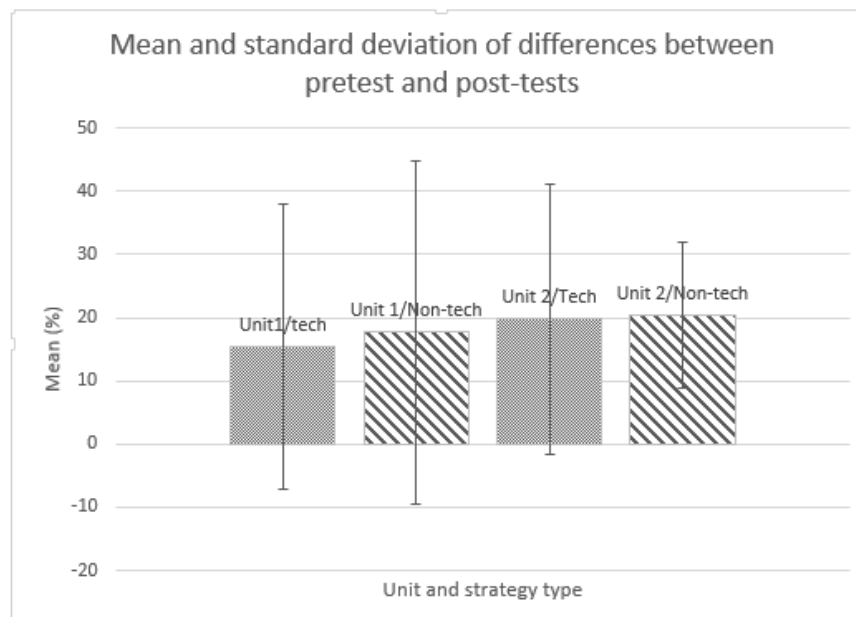
There are a couple of things to note upon examination of the data in Data Table 2. The first item of note is that the majority of the students showed improvement between the pretest and post-test. But it is also worth noting that there are some discrepancies in the data. For example, test scores for both students 28 and 52 decreased at the time of the post test. These two results may have caused inaccuracies in the data analysis.

Once the difference were calculated, I grouped the scores into the following groups; Unit 1/ Technology based, Unit 1/Non-technology based, Unit 2/ Technology based, Unit 2/ Non-technology based. Once scores were grouped into their categories I calculated the mean differences of the test scores and the standard deviation for each category. To calculate the mean and standard deviation I used microsoft excel tools. Results of these calculations are shown in data table 3 and figure 3.

Unit/Strategy	Mean	Standard. deviation
Unit 1/Technology based	15.42857	22.5156031
Unit 1/ Non-technology based	17.71429	27.10298
Unit 2/Technology based	19.85714	21.38869
Unit 2/Non-technology based	20.42857	11.60254

**Table 3.** The calculated mean of difference between pretest and post-test scores and the standard deviation of each

The results of the calculations show that the standard deviation for the means was very large, particularly for the Unit 1 Vocabulary. I do not find this large variation from the mean surprising since the variation in test takers was so large, there are a few students who were serious about learning, there were some that did not really care about trying their best on the quizzes, and there are some students who struggle with testing. So although the large variation among the means is not helpful for giving me significant results, it does show a accurate representation of the participants.



**Figure 3.** Graph showing the mean difference of pretest and post-test scores for the different testing categories. Standard deviation is also displayed on the graph.

When looking at the graph of the mean differences in scores, there is one noticeable trend. It appears that the mean differences were greater in Unit 2 than Unit 1. One possible reason for the increase in differences in scores could have been due to students becoming more familiar with the vocabulary practices. In the first Unit, students were not only learning vocabulary, but also learning new strategies. Having to learn new terms, and new learning strategies could have impacted how well they learned the vocabulary. During the second Unit, they only had to focus on vocabulary learning, so it might have been more effective.

### **Significance of Score Differences between Technology Based and Non-Technology based groups**

The next step was determine if there was a significant difference in means between the technology based groups and non-technology based groups. In order to determine the

significance, I calculated the two sample T-test and p-value for each Unit Test. To calculate the two sample T-test and p-value I used the following online resource, (<https://www.usablestats.com/calcs/2samplet&summary=1> ). Results of the calculations are shown in data tables 4 and 5.

Unit/Strategy	Mean of Differences	Standard deviation	
Unit 1/Technology based	15.42857	22.5156031	
Unit 1/ Non-technology based	17.71429	27.10298	
	2 Sample T-test		-0.17163
	p-value		0.8668

**Data table 4.** Calculated 2 Sample T-test and p-value for the Unit 1 Vocabulary Test.

Unit/Strategy	Mean of Difference	Standard Deviation	
Unit 2/Technology based	19.85714	21.38869	
Unit 2/Non-technology based	20.42857	11.60254	
	2 Sample T-test		-0.57143
	p-value		0.9518

**Data Table 5.** Calculated 2 Sample T-test and p-value for the Unit 2 Vocabulary Test.

Looking at the mean difference in scores for both Unit 1 and Unit 2 test, it appears that students who were in the non-technology based groups performed better than the students in the technology based groups, (See figure 3). For the Unit 1 test, the non-technology based mean difference was 2.3 % higher than the technology based, (non-technology based: 17.71, technology base; 15.43, Table 3). There was a very small difference between the two for the Unit 2 test, the non-technology was slightly higher at 20.43, while the technology based mean was 19.86, Table 3). To test the significance of the difference between the two means, I calculated the 2 Sample T-test and p-value for both the Unit 1 and Unit 2 tests, Tables 4 and 5. The results of the p-value, which were 0.8668 for Unit 1 and 0.9518 for Unit 2, indicate that I could not reject the null hypothesis. The null hypothesis for this study was that “there is no difference

between learning strategies”. Since the p-values for both Units are much greater than 0.05 (Unit 1 is 0.8668, Unit 2 was 0.9518), the null hypothesis cannot be rejected. Therefore the data shows that there is no difference between the two learning strategies.

#### **Significance of Difference in Pretest and Post -Test Scores**

Since this action research was based on the improvement of the students scores from the pretest to the post-test, I thought it was important to see if the improvements were statistically significant. I calculated the T-test and p-values using tools on microsoft excel, the results are shown in Data Table 6.

	Mean of difference	t-test	p-value
Unit 1/Non-tech	17.714	0.1745	0.4321
Unit 1/Tech	15.429	0.1831	0.4289
Unit 2/Non-tech	20.423	0.4706	0.3232
Unit 2/Tech	19.85714	0.2481	0.4041

**Table 6.** Results of T-test and p-value calculations of difference in pretest and post-test scores.

Once again, the p-values indicate that the null hypothesis could not be rejected. The null hypothesis for this analysis was that “there is no difference between Pretest and Post-test scores”. Since all of the p-values were much greater than 0.05, I could not reject the null hypothesis, therefore the data indicates that there is no difference in the scores.

#### **Significance of Differences in scores between Unit 1 and Unit 2**

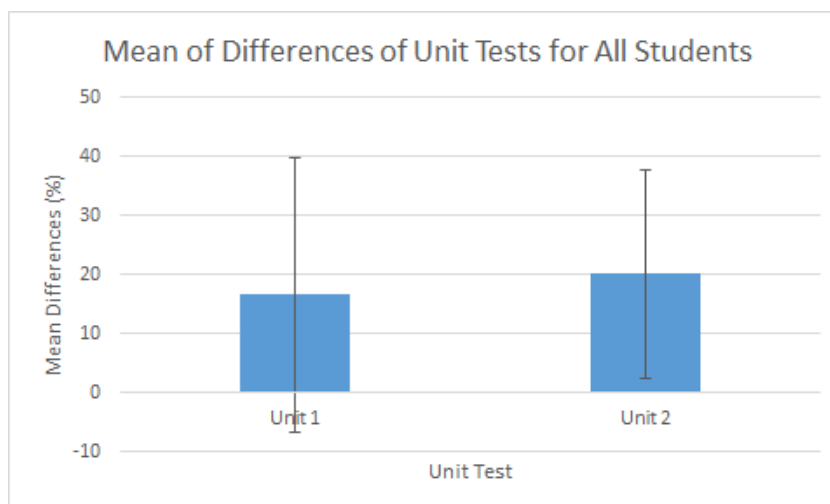
I was also interested to see if the difference in pretest and post-test scores changed as the students became more familiar with the routine of daily vocabulary practice. Therefore I compared the mean difference overall between the Unit 1 Test and the Unit 2 Test. The

calculated values are shown in data table 7 and graphed in Figure 4. I also calculated the 2 sample T-test and p-value for the means of the two categories, using the online resource, <https://www.usablestats.com/calcs/2samplet&summary=1>. This data is also shown in Data Table 7.

Test	Mean of differences	Standard deviation	
Unit 1	16.57142857	23.30855828	
Unit 2	20.14285714	17.68897962	
	2 Sample T-test		-0.4567
	p value		0.652

**Data Table 7.** The calculated mean and standard deviation of the pretest and post-test score differences for the Unit 1 and Unit 2 tests.

The calculated p-value was 0.652 which is much greater than the 0.05 p-value needed to reject the null hypothesis. For this analysis the null hypothesis was ‘that there was no difference between the mean of differences in scores between Unit 1 Tests and Unit 2 Tests’. So the data analysis indicates that there is not a difference between the Unit 1 and Unit 2 means.



**Figure 4.** Graph displaying the calculated mean and standard deviation of the difference between pretest and post-test scores for the Unit 1 and Unit 2 Test.

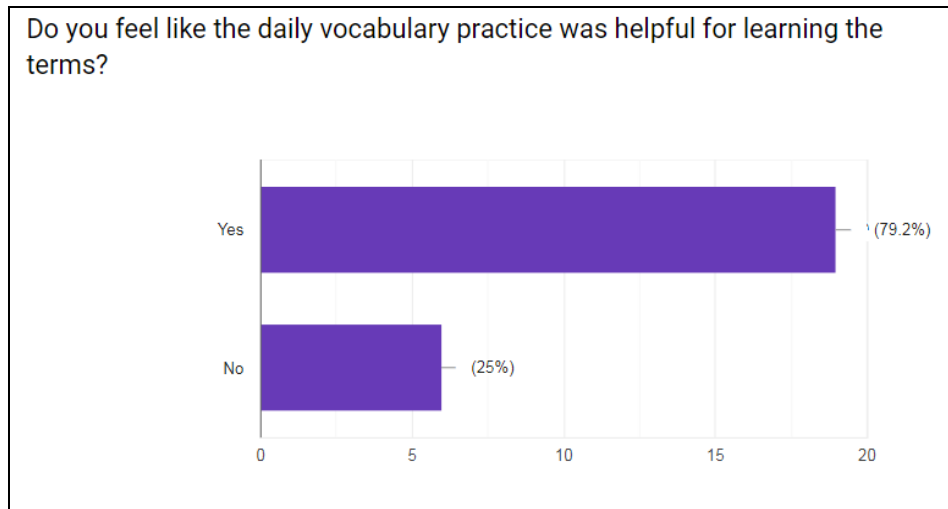
When looking at the results of the data, it appeared that for both the non-technology based and technology based groups, there was a bigger difference in scores between Unit 1 and Unit 2. The Unit 1 mean difference in scores was 16.57 where as the Unit 2 mean differences in scores was 20.14, as seen in Table 7. Looking at these numbers it does appear that students improved more during the Unit 2 Vocabulary test, however I ran a 2 sample T-test and p-value, and the calculations show that there was not a significant difference in improvement between Unit 1 and Unit 2. The p-value of 0.652 indicates that is not a significant change, Data Table 7 and Figure 6.

### **Data and Analysis of Question 2: Do students prefer one method over the other?**

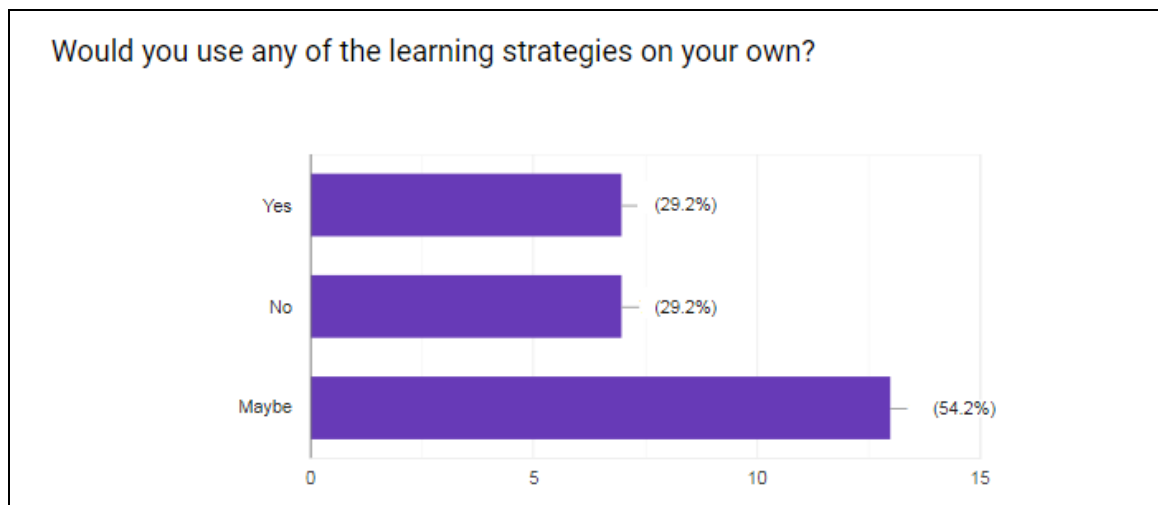
#### **Student Surveys**

At the end of each vocabulary unit, students took a survey on a google form. Their answers were kept anonymous, there were no emails collected on the google form. Figures 5 and 6 show the responses that are relevant to the analysis. These graphs were generated by Google Form.





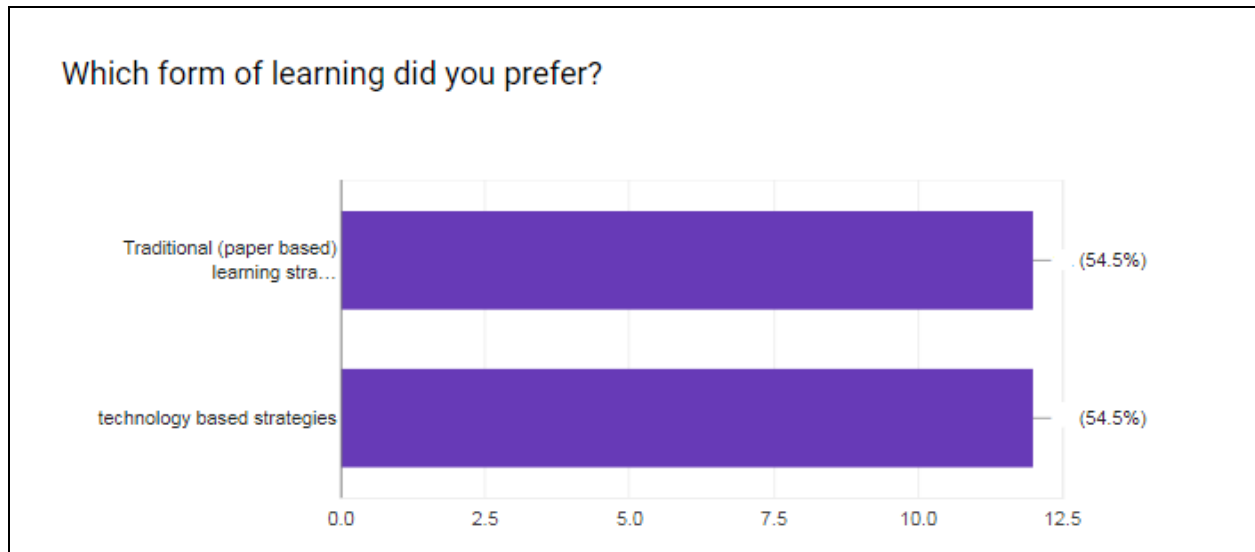
**Figure 5.** Results of question 2 from Survey 1 Indicating that students found daily vocabulary practice helpful.



**Figure 6.** Results from question 3 on Survey 1 Indicating that there was not a definite possibility of students continuing to use strategies on their own.

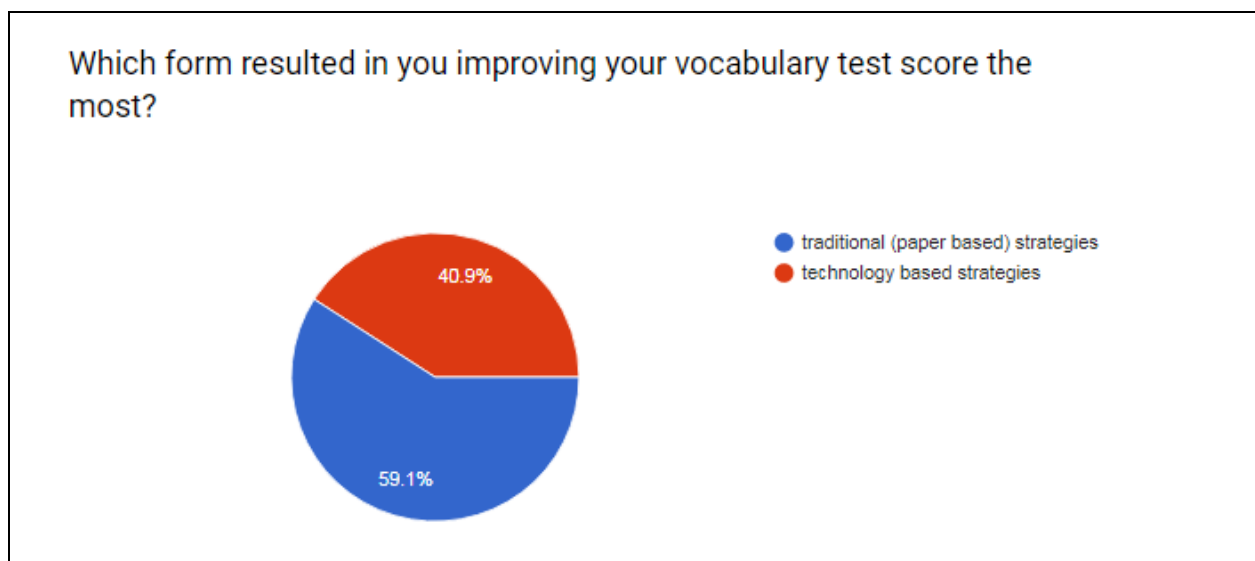
Figure 6 shows the likelihood of students engaging in learning activities on their own.

Once students finished both Vocabulary Units, they took a final survey using a Google Form that I created. The relevant responses are shown in figures 7,8, and 9.



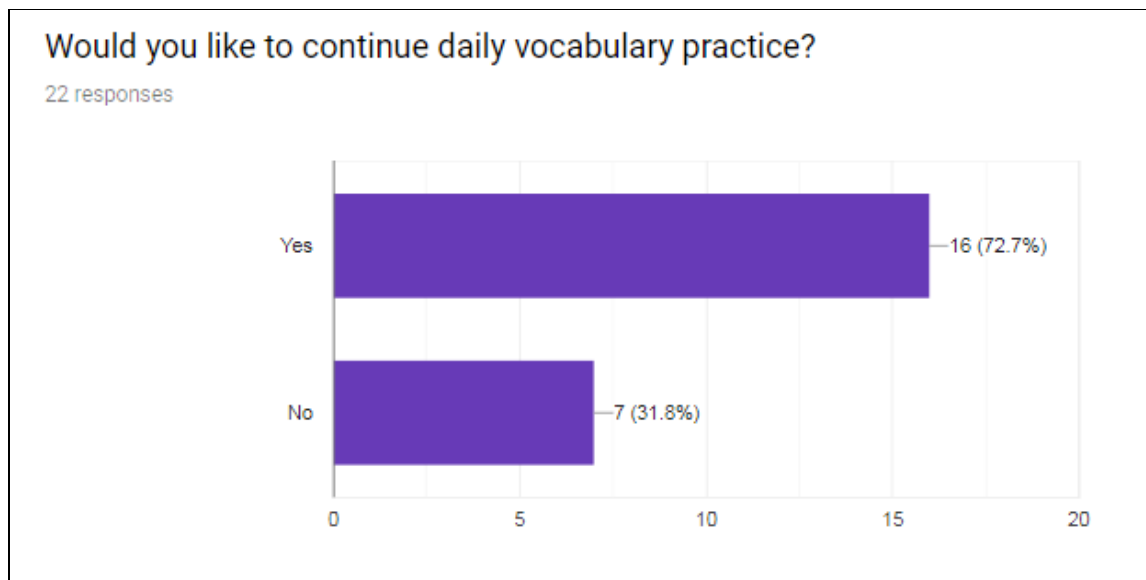
**Figure 7.** Results from question 1 on second survey,

This graph indicates that preferences were divided, with half the class preferring technology based strategies and half the class preferring non-technology based strategies. This corresponded with the observations that were made during the class. I found that there were some students were interested in technology while others were interested in the non-technology based strategies.



**Figure 8.** Results from question 2 on the second survey

This graph shows that students thought that the non-technology based strategies were more helpful than the technology based strategies. A possible reason for this belief was that students had an easier time with the non-technology based strategies. A number of students had difficulty with the digital activities.



**Figure 9.** Results from question 3 on the second survey

This graph shows that the majority of the students (73%) wanted to continue with vocabulary practices. This was a surprising result to me, since during class students were very vocal about how displeased they were with the activities.

### **Research Question 2 Analysis**

The purpose of this action research was to determine if there which learning strategy would result in more vocabulary retention. However, it also looked at the importance of including vocabulary practice in students daily routine. The student surveys purpose was to find out which strategy the students preferred and to determine if students found the practices helpful.

In regards to preference of strategies, there was not one strategy that was preferred more than the other. According to the poll, figure 7, 54% preferred the Technology based, and 54% preferred the Non-technology based. The results from the google form survey give numbers seem incorrect, but I think it is the result of one or two students giving two answers to the question, they were allowed to choose more than one answer. When asked which strategy they thought was more helpful, there was a difference in opinions. As shown in figure 8, 59% thought the Non-technology based practices were more helpful, while 41% thought the Technology based practices were more helpful.

In regards to the how helpful the vocabulary practices were to the students, the results indicated that students found the practices helpful. It should be noted that the percent values for these results also do not add up correctly, so I am also assuming some students gave more than one answer for each question. When directly asked if students found the daily vocabulary practices helpful, 79% said yes while only 25% said no. When asked if they would like to continue daily vocabulary practices 73% of the students said yes, and 32% said no, Figure 9. When asked if they would use any of the practices on their own 29% said yes, 29% said no, and 54% said maybe. So according to these results, students did find the activities helpful and feel like it is worth continuing in the future.

## **Chapter 5: Discussion and Conclusion**

### **Technology Based Strategies vs. Non-Technology Based Strategies**

The results of the Action Research showed that when comparing Non-technology based learning strategies to Technology based learning activities, there did not appear to be one method that resulted in better vocabulary retention. Although there was no significant difference, the trend did show that students performed slightly better when they were in the Non-technology based groups. These results were consistent with the students view of how the strategies affected them, the survey showed that more students (59%) believed that the Non-technology based methods were more helpful.

During the study it was apparent by students comments that they did prefer the Non-technology based. Many of the students who were in the Non-technology based strategies for the first Unit did not want to switch to the Technology based strategies for the Unit 2. I had one student who refused to do any work at all for 10 minutes because she did not want to switch to using her computer. During the review activity the Non-technology based students reviewed by playing a matching game with other students, the Technology based students played quizlet games on their own. A student from the technology group told me how unhappy she was that she wasn't in the Non-tech group, because she thought the non-technology activity was better. Also during that activity, all of the students in the Non-technology based group were engaged, while students in the Technology based group took 10 minutes just to start the quizlet activity, and then only spent one or two minutes on the activity.

An issue that may have led to the non-technology strategies having slightly better results than the technology based was that many students had difficulty with completing the technology based activity options. Unfortunately even though the students in this class have had a 1:1 device since the sixth grade, the majority do not know how to do anything but look things up on the internet with them. Given the amount of time I had in the class to spend on vocabulary and teaching content, I was unable to spend more time teaching them how to use the different technology options. So the majority of the activities that the students did on the computer tended to be the same activity that the non-technology based students did, just in a digital format, (examples of students work shows this, appendix N). As pointed out in a study conducted by Norris, Hossain, and Soloway (2013), when computers were used as a supplement there was no improvement in learning. Studies also found that multimodal creations facilitate learning and improve memory (Dubois and Vial, 2000). Students in this study did not push themselves to be more creative and use multi-modes, they only relied on definitions and searching for images on the internet.

### **Pretest Scores vs. Post-Test Scores**

Looking at the average test scores of the pretest and posttest, there definitely was a gain in vocabulary knowledge, although the statistical tests said it was not significant. It is not surprising that there would be an increase in scores, since at the time of the pretest students had very little exposure to the terms, while when they took the post test, students had spent close to two weeks being exposed to all the terms. Researchers, Fisher, Grant, and Frey (2009), Fawcett (2012) and Savino (2011) all emphasize the importance for repeated exposure to new vocabulary terms for learning.

During the study it surprised to find that 79% of the students found the daily vocabulary practices helpful and 72% of the students wanted to continue with them. These results confirm Fawcett's (2009) findings that students need and want routine, and routines help students develop independence. During my observations I did notice that by the second unit, students did work much more independently, they were not asking for help as much, and they did not need as much prompting to get their work completed. During the first unit, it would take 30 minutes for students to define three words, by the second Unit they were completing three terms in 10 minutes.

### **Comparing Unit 1 results to Unit 2 results**

As the students became more familiar with the routine and the strategies, I think the benefit to learning vocabulary increased. I did notice an increase in score differences between Unit 1 and Unit 2, even though the statistical tests did not prove this to be significant I do think that it was noteworthy. During the first Unit, the routine of vocabulary practice was new, and many students appeared not put much effort into their work or they were confused about what to do. By the second Unit, students were familiar with the activities and use to the routine, so the quality of the work improved which probably increased their ability to learn the terms.

### **Limitations**

Throughout the Action Research, there were a number of limitations that possibly affected the validity of the results. The first limitation is the student sample that was used for this study, the sample should include a "cross section of all students" (Ary, et al., 2018, p. 149). My study focused on students in a remedial class who tend to struggle academically and half of the participants had IEPs. This is a limited sample set of the entire population, so results might

have been different if I included a wider variety of students. The sample size of the population was also a factor. Although the Action Research was intended for a class of 29 students, only 14 students took part in the study. The results from just 14 students may not be a good indication of how all students would perform since “a larger sample is more likely to be a good representative of the population than a smaller sample” (Ary et al.,2018, p. 157).

Another limitation to this study was the students motivation to actually take the pretest and post-test seriously. I suspected that a number of students cheated on the first pretest, since four of the students had a 100% on the second page of the test, and the rest of the class barely got one correct on that page. Also for those students, their post-test scores were lower than their pretest scores. I also had some test where it appeared that the students did not try at all, for example one student had a 35% as their pretest score and then a 9% for their post test score. Most of the students in this class will only complete work if it is worth points, so since these Vocabulary Test did not affect their course grade, they had not motivation to actually try.

Another limitation that I found was that even though my students have been using technology since the 1;1 program started when they were in 6th grade, they have limited knowledge of how to use technology besides looking information up on the internet. For example, during this study I had to show students how to put a picture on a google slide, all my students needed to learn how to make a copy of the google slide that I shared with them, and students using the provided instagram post needed assistance on how to put test on the picture. While the students were given more options for completing their work, they were all more comfortable doing the most basic of the options, which tended to just be the same activities that the non tech students were doing, but in a digital format. If the students were more familiar or



comfortable with the different apps that they could have chosen from, the results might have been different.

A final limitation to this Action Research was the amount of time spent on the study. Initially I had hoped to make it through three Vocabulary Units, however we only made it through two. It took much longer to get through the Units for a number of reasons, the first major reason was how long it took the students to actually complete their work. During the first Unit there were days where we were spending more than half the class on vocabulary, leaving less time to teach the content. By the time we got to the Unit 2, students began working on their Vocabulary practices faster, but we had a couple of days that we either didn't meet because of assemblies, or met for a shorter length of time. The final Vocabulary Unit the students were going to be able to choose the style they preferred the most. It would have been interesting to see if giving the students choice would increase learning even more.

### **Implications**

At the conclusion of this action research, I have determined that there is the potential for further research based on multiple questioning factors that became apparent during the study. One factor that was not considered during my research was the differences in academic levels among the students involved in this study. The students' abilities in this study include; learning disabilities, attention difficulties, behavioral issues, and students with no apparent academic disadvantages. I'm curious to find out if one method of study correlates to academic improvement or vocabulary retention for each different group. For instance, I predict that kinesthetic activities kept students more focused than the digital activities, so perhaps students with attention disorders would perform better with the non-technology based strategies. Further

research to test how different types of students improve with the different strategies would give more meaningful results to these question.

Another factor of the study that suggests that further research could be helpful, was the fact that not all the students were fluent with technology. The research would have possibly had different results if the students were more fluent with technology. The difficulty that many of the students had with the different options for the technology strategies, limited how helpful those activities actually were. If this action research was repeated it would be beneficial to make sure the students learned how to work with each of the strategies that were available for their use.

The technology difficulties my students faced had implications on how I will teach after this study. I realized that students had very limited skills with using technology as a result of this study, so I plan to introduce new tools to them that will be helpful in the future for all classes. It is also a finding that I think other teachers need to be aware of. Many teachers assume that since they have been using technology since they were little kids, students will be coming to the classroom with more skills than they have. So when choosing activities for students to do with technology, adequate time needs to be spent teaching them how to use it. This was a point that Greenwood (2004) discussed in his paper, stating the need for teachers to model and explicitly teach strategies to students.

The results of this study also imply that teachers should be including more time in their lessons for vocabulary practice. Students did perform better on the post-test after spending close to two weeks with daily practice. Even if the the statistical test did not find the improvements to be significant, the fact that students found it helpful and wanted daily practice indicates that it is a practice that is beneficial. Previous research has also shown the importance of daily

vocabulary practice (Fawcett, 2009). I will be making it a point to increase vocabulary activities in all my classes from here on out.

A final implication for further study would be the importance of student choice. There was a lot of push back from my students when they were placed in a strategy group that they did not like, and that could have impacted the type of work that they did and overall how much they learned. Providing different choices also is important for students who have accommodations for their learning. For example one of the students in the study has an accommodation in his IEP that he is allowed to turn in all work in a digital format because of his poor motor skills. When different options are available, it is easier to accommodate students such as this. I unfortunately was not able to perform the part of my study where the students would have the option to choose the strategy of their liking. It would have been interesting to see if there were significant increases in scores when students were given choice.

In conclusion, this action research has led me to take steps that will improve and refine my teaching. I plan to spend more time teaching and modeling different vocabulary strategies, making it a regular part of my weekly instruction. I also plan to provide my students with more choices for how they want to engage in activities, providing both technology based and non-technology based strategies. Based on the results of this research, both means of learning can be beneficial, and having the option of choice makes it even more beneficial. As Marzano (2009) pointed out in his research, there is no proven strategy that works for everyone, you have to find one that works for you and the environment you are teaching in.

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## Appendix

### *Appendix A. Initial Email sent to parents:*

Good Afternoon Parents,

Today your student should be bringing home a parental permission form for you to sign. I am requesting permission for your students to participate in an action study research project that I am conducting for my Master's degree. The research project is focusing on using different vocabulary strategies to help increase students vocabulary retention. I will be comparing strategies that use technology with strategies that do not use technology. I hope to find out if the use of technology will increase vocabulary learning.

All students will get a chance to try all of the learning strategies, and it is my hope that not only will their vocabulary retention increase, but that they will learn new strategies that they can then use in other classes. I chose to focus on vocabulary learning because of the large number of terms that students need to learn in order to have a basic understanding of Biological concepts.

The action research project will take place over 1.5 months, the amount of time that we will cover 2 Units. The research will not take away from normal instruction in the classroom, instead it is intended to enhance instruction.

All information gathered by me about the students during the study will remain anonymous in the paper. Your students names will be replaced with code numbers and those codes will remain safely locked in an office at my home.

Participation in the study is voluntary, and there are no negative consequences if you or your student decide not to participate. All students will learn the new vocabulary strategies if they do or do not participate. If a student does not participate, I will not include any results from quizzes or finished work in the final report.

Please return the signed permission form by \_\_\_\_\_

Thank you for your consideration!

Linda Morley

IBC and AP Environmental Studies

Downingtown East High School

*Appendix B. Second email sent to parents.*

Good Afternoon Parents,

I am writing to remind you to remind you that I will be beginning my action research study next week. If you permit your student to participate in the study, please send in the signed parent consent form within the next two days. If you have any questions, please reach out to me.

Thank you,

Linda Morley

IBC and AP Environmental Studies

Downingtown East High School



## *Appendix C. Parent permission form.*

### **PARENT PERMISSION FORM**

Comparison of Vocabulary Learning Strategies. Which strategies will increase vocabulary retention, traditional paper based strategies or technology based strategies?

#### **Key Information**

Linda Morley and Sarah Eckert from University of the Arts are conducting a research study to examine which type of learning strategy will result in the greatest increase in vocabulary retention. Linda Morley is a teacher at Downingtown East High School and will be leading the vocabulary training in the sophomore level IBC class. Students who participate in this study will be introduced to new learning strategies for vocabulary retention. They will also take a few short surveys and vocabulary quizzes.

We are requesting permission from you to enroll your student into this study. Your student has also been given an assent form to read and sign. He or she will only be enrolled into this study if both you and your student agree to participate.

You and your student get to choose whether your student will participate in this research. If your student does not participate, there will not be any consequences and their grade in IBC will not be affected. They will still work on the vocabulary activities but will have the opportunity to choose which activities they complete.

We do not anticipate that there will be any risk associated with this research. Your student may benefit from this research by increasing the amount of vocabulary terms that they will know for the Keystone Exam.

If you have any questions about the research, please contact Linda Morley at [lmorley@dasd.org](mailto:lmorley@dasd.org) or (610)363-4400 (ext. 5725)

#### **Purpose and Duration**

The purpose of this study is to examine which type of learning strategy will result in the greatest increase in vocabulary retention. This study will last during the time frame of two Units, about 1.5 months

#### **Selection of Subjects**

This class has been chosen to participate in the study because of the large amount of vocabulary terms that are associated with Biology content. Students may benefit from learning new strategies. There are 29 students that have been asked to participate.

#### **Description of Study**

If your student participates in this study, he or she will randomly be placed into one of two groups. The two groups are the non-technology based learning strategies group or the technology based learning group. Each vocabulary unit will start with a pretest. The pretest includes 20-25 vocabulary terms, and the format will be matching terms to correct definitions. The pretest grade will not be calculated into the course grade. For the remainder of the unit, students will spend 10 -15 minutes a day practicing vocabulary learning strategies, using technology-based or non-technology-based strategies. Observations on engagement in regards to each strategy will be made and recorded. Examples of work at the end of the study may be selected to include in final report (no names will be attached to the work). At the end of the unit, students will retake the pretest, this grade will be recorded in the grade book. After the posttest students will take an anonymous 4 question survey. The results of this survey will be included in the report. The survey will have no impact on their grade and will include questions that ask if they found the

strategies helpful and if they would use any in the future. Students will then repeat the same process, but in the other group. Therefore, students will all have an equal chance to try different strategies. For the third vocabulary unit, students will have the choice of which type of learning strategies they would like to use. Results of the quizzes and surveys will be de-identified and not used in any future research.

### **Risks**

There are no foreseeable risks associated with participating in this study. You or your student may request to drop out of the study at any time. If your student drops out of the study, they will continue with vocabulary practice, but their results will not be included in the report.

### **Benefits**

The students may benefit by learning new vocabulary learning strategies that they can use in other classrooms. Another possible benefit is that they will be better prepared for the Keystone exam since Biology content understanding relies heavily on knowing a large amount of vocabulary terms.

### **Alternatives/Standard Treatment(s)**

If students choose not to be participants in the study, they will continue to use the vocabulary strategies of their choice.

### **Confidentiality**

All information acquired during this study will be kept confidential. Data will be stored securely and will be made available only to persons conducting the study unless participants specifically give permission in writing to do otherwise. No reference will be made in oral or written reports that could link participants to the study.

Student's names will be replaced with numbers in order to keep results confidential. Any student work that is included in the final report will be kept anonymous and I will obtain permission from student before including it.

### **Refusal or Withdrawal of Participation**

Participation is voluntary, refusal to participate will not affect the student's grade in any manner. Participants may discontinue participation at any time.

### **Subject's Rights**

.You can obtain further information from the study investigator, Linda Morley at [lmorley@dasd.org](mailto:lmorley@dasd.org), or (610) 363-4400, or Sarah Eckert at [seckert@uarts.edu](mailto:seckert@uarts.edu) or If you have questions concerning your child's rights as a research subject, you may contact the IRB administrator at [irb@usciences.edu](mailto:irb@usciences.edu) or 267-295-3295.

### **Consent**

I have been informed of the reasons for this study. I have read this consent form, have initialed each page, and have received a signed copy. I agree to allow my child to participate in this study voluntarily

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Parent Name

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Parent Signature

---

Date

### **Investigator's Affidavit**

I have carefully explained to the subject the nature of the above project. I hereby certify that to the best of my knowledge the person who is signing this consent form understands clearly the nature, demands,

benefits, and risks involved in his/her participation and his/her signature is legally valid. A medical problem or language or educational barrier has not precluded this understanding.

\_\_\_\_\_  
Signature of Investigator

\_\_\_\_\_  
Date

## ***Appendix D. Minor Assent Document***

**Project Title:** Comparison of Non-technology and Technology-based Vocabulary Learning Strategies

**Investigators:** Sarah Eckert (University of the Arts) and Linda Morley

### **Key Information**

Linda Morley and Sarah Eckert from the University of the Arts are conducting a research study that will look at which vocabulary learning strategy will result in the greatest increase in vocabulary retention. Participants will practice using new strategies, and will be asked to take a few surveys and quizzes.

We are asking you to enroll in this study because of the large amount of new vocabulary terms that students are asked to learn in Biology. Your parent or guardian will also be given a consent form to read and sign. You will be enrolled into this study if both you and your parent or guardian agree to participate.

Participation in this research study is your choice, if you do not want to participate, there will no consequences and your grade in IBC will not be affected. You will still be introduced to the learning strategies and expected to complete them, but you can choose which ones you want to complete.

We do not expect any risks involved in this research. You may benefit from this research by increasing the amount of vocabulary terms that you will know for the Keystone Exam.

If you have any questions about the research, you can ask Mrs. Morley in class.

### **Purpose and Duration**

The purpose of this study is to examine which type of learning strategy will result in the greatest increase in vocabulary retention. The study will last during the time frame of two Units, about 1.5 months.

### **Description of the Study**

If you choose to participate, you will randomly be put into one of two groups. The two possible groups are non-technology-based learning or technology based learning. Each vocabulary unit will start with a quiz. The quiz includes 20-25 vocabulary terms, and the format will be matching terms to correct definitions. *This quiz grade will not be included in the course grade.* For the rest of the unit, you will spend 10 -15 minutes a day practicing vocabulary learning strategies, either using technology-based or non-technology-based. While you practice, I will observe the entire class and document which strategies are more engaging. Examples of work at the end of the study may be selected to include in the final report. Any work that gets chosen will not include any names. At the end of the unit, you will take a second quiz, this grade will be recorded in the grade book. After the second quiz students will take a short 4 question survey. The survey will have no impact on your grade and will include questions that ask if you found the strategies helpful and if you would use any in the future. We will then repeat the same process, but you will switch groups, so you will all have an equal chance to try different strategies. For the third vocabulary unit, you will have the choice of which type of learning strategies you would like to use. Results of quizzes and surveys will be de-identified and not used for future research.

### **Benefits**

By participating in this study you will learn new vocabulary strategies. Participation may also help improve your score on the Keystone exam since Biology content understanding relies heavily on knowing a large amount of vocabulary terms. The study will also help me help future students.

### **Participation**

Participation in the study is voluntary. You do not have to be in this study if you do not want to be. If you do not wish to participate, you will still take part in the daily vocabulary lessons, but none of your results will be included

in the final paper. You may also ask to drop out at any time. If you choose not to participate, or drop out at any time, there will be no negative consequences

If you decide you would like to participate in the study, please sign below

I, \_\_\_\_\_, want to be in this research study.

\_\_\_\_\_

(Sign your name here)


\_\_\_\_\_

(Date)

Appendix E. Unit 1 Vocabulary Pretest and Post-test

Name \_\_\_\_\_

Genetics Vocabulary part. 1

<p>1. _____ When two alleles for a trait are the same</p> <p>2. _____ Genetic makeup of an organism</p> <p>3. _____ When both alleles of a gene are expressed in the Phenotype</p> <p>4. _____ The <u>allele</u> that will be expressed even if there <u>is</u> only on copy</p> <p>5. _____ The study of heredity</p> <p>6. _____ Sequence of DNA that codes for a protein and <u>thus</u> determines the trait.</p> <p>7. _____ <u>How</u> often a particular allele appears in a population</p> <p>8. _____ One of a number of different forms of a gene</p> <p>9. _____ Structure within the nucleus that contains the <u>genetic</u> information</p> <p>10. _____ The <u>chromosomes</u> that do not determine the sex <u>of</u> the organism</p> <p>11. _____ <u>Two</u> different alleles for the trait are present</p> <p>12. _____ sex cells</p>	<p> a. Allele</p> <p>b. Allele frequency</p> <p>c. Chromosomes</p> <p>d. <u>Codominance</u></p> <p>e. Autosome</p> <p>f. Dominant allele</p> <p>g. Gamete</p> <p>h. Gene</p> <p>i. Genetics</p> <p>j. Genotype</p> <p>k. Heterozygous</p> <p>l. homozygous</p>
---	---

13. \_\_\_\_\_ Diagram showing the gene combinations that might result from a genetic cross
14. \_\_\_\_\_ A photograph of chromosomes grouped in order in Pairs
15. \_\_\_\_\_ Trait controlled by two or more genes
16. \_\_\_\_\_ Neither allele is completely dominant, resulting in a blend of the two
17. \_\_\_\_\_ The passing on of traits from parents to their offspring
18. \_\_\_\_\_ genes that have more than two alleles
19. \_\_\_\_\_ the physical expression of a trait
20. \_\_\_\_\_ Specific characteristic that varies from one individual to another
21. \_\_\_\_\_ A trait that is found on either of the sex chromosomes
22. \_\_\_\_\_ The chromosomes that determines the sex of the organism (X and Y)
23. \_\_\_\_\_ An allele that will only be expressed when there are two present

- a. Incomplete Dominance
- b. Inheritance
- c. Karyotype
- d. Multiple alleles
- e. Phenotype
- f. Polygenic trait
- g. Punnett Square
- h. Recessive Allele
- i. Sex-linked trait
- j. Sex chromosomes
- k. trait

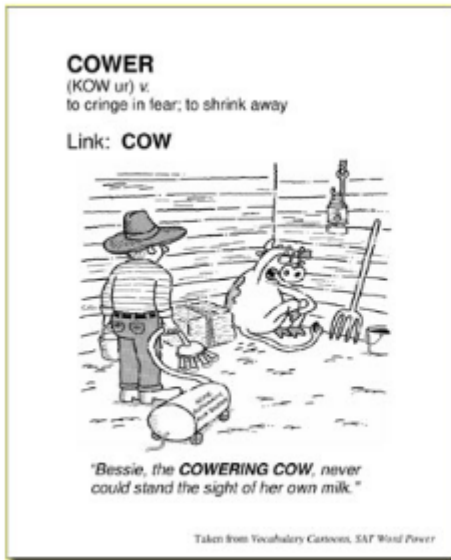
*Appendix F. Frayer Model Template (Used by both Non Technology and Technology based groups)*

Definition	Characteristics
Word parts Use in a sentence	Picture that will help you remember

Word



Appendix G. Model of Cartoon for Non Technology Strategies:



**environment:** the air, water, and other natural elements on earth that support life



David Racine, for Magoosh IELTS

Appendix H. Quizlet vocabulary list used to print out flashcards for matching game.

<b>Quizlet</b>		<b>Genetics and Inheritance vocabulary</b>
		Study online at <a href="https://quizlet.com/_6bop51">quizlet.com/_6bop51</a>
1.	<b>allele</b>	different versions of a gene
2.	<b>allele frequency</b>	How often a particular allele appears in a population
3.	<b>autosome</b>	Any chromosome that is not a sex chromosome
4.	<b>chromosome</b>	structure within the nucleus that contains the genetic information
5.	<b>co-dominance</b>	heterozygous genotype that expresses both alleles of the trait
6.	<b>dominant allele</b>	The allele that is expressed
7.	<b>gamete</b>	specialized cell involved in sexual reproduction
8.	<b>gene</b>	Sequence of DNA that codes for a protein and thus determines a trait
9.	<b>genetics</b>	the study of heredity
10.	<b>genotype</b>	The genetic makeup of a given trait
11.	<b>heterozygous</b>	Having one of each allele (2 different alleles for a trait)
12.	<b>homozygous</b>	Having two of the same alleles
13.	<b>Incomplete dominance</b>	Heterozygous phenotype that is a blend of the two homozygous phenotypes
14.	<b>inheritance</b>	Passing of traits from parents to offspring
15.	<b>karyotype</b>	A picture of all the chromosomes in a cell arranged in pairs
16.	<b>multiple alleles</b>	genes that have more than two alleles
17.	<b>phenotype</b>	The appearance of a trait
18.	<b>polygenic trait</b>	traits determined by a number of different genes
19.	<b>Punnett Square</b>	diagram showing the gene combinations that might result from a genetic cross
20.	<b>recessive allele</b>	Allele that can only be expressed if there are two of them
21.	<b>sex chromosomes</b>	Chromosomes that determine the sex of an individual (X and Y)
22.	<b>sex-linked trait</b>	traits that are found on the sex chromosomes
23.	<b>trait</b>	specific characteristic that varies from one individual to another

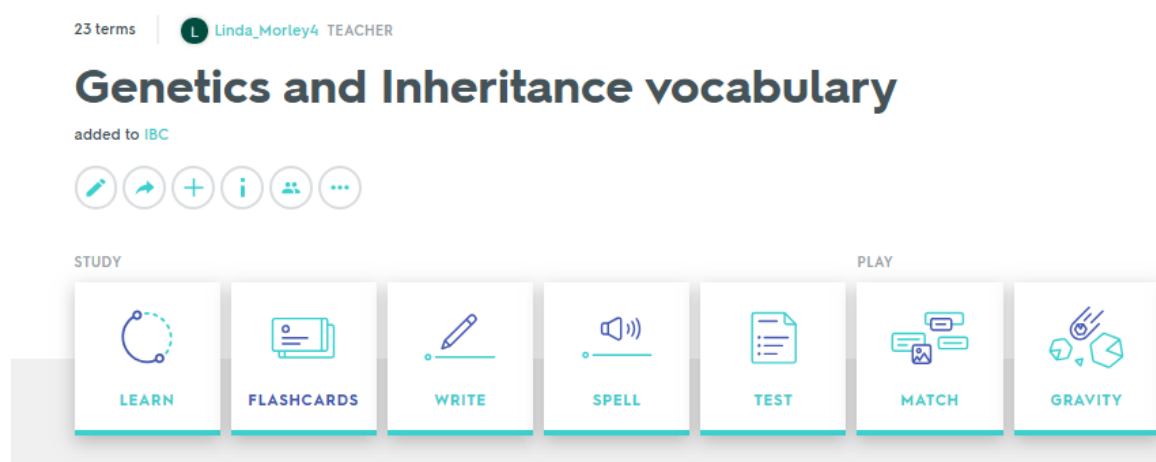
*Appendix I. Instagram post example for Technology Based strategy*



Example of Word Art option for Technology based



*Appendix J. Quizlet Review Options for Technology based group*



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## Vocabulary Learning Strategies Survey

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post vocabulary test survey

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This form is automatically collecting email addresses for Downingtown Area School District users. [Change settings](#)

Which type of strategies did you use for this chapter?

☐ Non-technology based (paper) learning strategies

☐ Technology based learning strategies

Do you feel like the daily vocabulary practice was helpful for learning the terms?

☐ Yes

☐ No

Would you use any of the learning strategies on your own?

☐ Yes

☐ No

☐ Maybe

---

Which vocabulary strategy did you prefer?

---

Appendix L. Unit 2 Vocabulary Pretest and Post-test

Name \_\_\_\_\_ date \_\_\_\_\_

Genetics Vocabulary Part 2

1. \_\_\_\_\_ A type of mutation in which a portion of a genetic material or a chromosome is duplicated
2. \_\_\_\_\_ Changes in the number or structure of chromosomes
3. \_\_\_\_\_ The use of cellular and biomolecular processes to develop technologies and products
4. \_\_\_\_\_ Disorder in which some of the body's own cells lose the ability to control growth
5. \_\_\_\_\_ The removal of a gene or section of the chromosome
6. \_\_\_\_\_ producing genetically identical genes, cells, or organisms
7. \_\_\_\_\_ an enzyme that acts like a pair of molecular scissors, capable of cutting targeting sections of DNA
8. \_\_\_\_\_ process in which homologous chromosomes exchange portions of their chromatids during meiosis
9. \_\_\_\_\_ scientific tests or techniques used in connection with the detection of crime
10. \_\_\_\_\_ mutation that shifts the "reading" frame of the genetic message by inserting or deleting a nucleotide
11. \_\_\_\_\_ The exchange of genetic material between multiple chromosomes or between different regions of the same chromosome

- a. Biotechnology
- b. Cancer
- c. Chromosomal mutation
- d. Cloning
- e. Crossing-over
- f. Deletion
- g. Duplication
- h. Forensics
- i. Frame-shift mutation
- j. Gene recombination
- k. CRISPR

12. \_\_\_\_\_ Chromosome rearrangement in which a segment of a chromosome is reversed end to end
13. \_\_\_\_\_ Mutation in which the codon reading is changed to stop codon
14. \_\_\_\_\_ Process of making changes in the DNA code of living organisms
15. \_\_\_\_\_ Change in DNA sequence that affects genetic information
16. \_\_\_\_\_ The caps at the end of each strand of DNA
17. \_\_\_\_\_ The transplantation of normal genes into cells in place of missing or defective ones
18. \_\_\_\_\_ A chromosomal segment is moved from one position to another
19. \_\_\_\_\_ A mutation in the DNA that do not have an effect on the organisms phenotype
20. \_\_\_\_\_ Error in meiosis in which homologous chromosomes fail to separate
21. \_\_\_\_\_ Any organism whose genetic material has been altered using genetic engineering techniques
22. \_\_\_\_\_ A mutation that occurs in one or a few nucleotides

- a. Gene therapy
- b. Genetic engineering
- c. Genetically modified organism
- d. Inversion
- e. Mutation
- f. Nondisjunction
- g. Nonsense mutation
- h. Point mutation
- i. Silent mutation
- j. Telomeres
- k. translocation

## Post Study Survey

Form description

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Which form of learning did you prefer?

- ☐ Traditional (paper based) learning strategies
- ☐ technology based strategies

Which form resulted in you improving your vocabulary test score the most?

- ☐ traditional (paper based) strategies
- ☐ technology based strategies

Would you like to continue daily vocabulary practice?

- ☐ Yes
  - ☐ No
-



Appendix N. Examples of Technology and Non Technology Based Frayer Model

