3-20-2017

Vocabulary Acquisition: Implementing Word Walls with Images in Science for ELLs

Mary Orr
Cedarville University, morr@cedarville.edu

Vocabulary Acquisition:

Implementing Word Walls with Images

in Science for ELLs

An applied research project submitted in partial fulfillment

for the requirements of the degree of

Masters of Education

Mary Orr

Cedarville University

Abstract

With increased concern about science instruction for ELLs, this quantitative applied research project sought to answer the research question, "Is there a relationship between the vocabulary instructional strategy of a word wall with images (WWwI) and the science vocabulary acquisition for ELLs?" The research design was a pre-test post-test control condition study using a group of ELLs in an ELL classroom for both the control condition and experimental condition. The quantitative data confirmed the results that there is a relationship between the students learning the science vocabulary words with the use of a WWwI since the experimental condition of ELLs experienced the greater increase in means from the unit pre-test to the post-test. Additional results indicated that ELLs liked learning science and thought science vocabulary was important yet challenging to learn. Most importantly, the students confirmed that imagery was important when acquiring science vocabulary.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

When walking into a public school in the United States of America, an individual will notice instantly the diversity of the student population attending kindergarten through twelfth grade. In fact, the United States student population has experienced a major increase because of immigrants, most of whom are English language learners (ELLs) enrolling in the public schools. Currently, every state in the U.S. has ELLs receiving an education in the public school system (Hill & Flynn, 2006; "Putting ELLs on the Map," 2016). Specifically for the 2012-2013 academic year, the United States public schools' enrollment included approximately 10% ELLs in the grades of kindergarten through twelfth grade. The population of ELLs enrolled in kindergarten through twelfth grade in the state of Missouri, the location of the current study, is approximately 5% ("Putting ELLs on the Map," 2016).

Each ELL has different linguistic, cultural, and social experiences (Dong, 2013; Hill & Flynn, 2006). In addition, the ELL knows and understands a previous language and is now learning the English language (Dong, 2013). Vocabulary is the building block for learning a language (Nowbakht, Moinzadeh, & Dabaghi, 2015). To learn a second language, the ELL will progress through several stages of language acquisition for a second language.

Summarizing his seminal work from 1979, Cummins (2000) proposed two different components about ELLs learning a second language. The first component was basic interpersonal communicative skills (BICS). This component focused on ELLs acquiring fluency in conversation. To become fluent in conversation in the second language, the ELL can take about two years. Building on BICS, the second component was cognitive academic language proficiency (CALP). This component focused on ELLs learning the academic content in the

second language. To become academically equivalent with peers who speak English, ELLs take about five to seven years.

To acquire English as a second language, an individual needs to learn conversational English as well as academic language. Hill and Flynn (2006) listed and described Krashen and Terrell's five stages of acquiring a second language from *The Natural Approach* (1983), which build on and expand Krashen's theory: preproduction, early production, speech emergence, intermediate fluency, and advanced fluency. In preproduction, the student is not very verbal and may gesture, such as nodding or shaking the head yes or no. This first stage lasts about zero to six months. In the second stage of early production, the learner possesses minimal vocabulary with one or two word answers or the ability to repeat key phrases. This second stage lasts about six months up to one year. For the third stage, speech emergence is when the student exhibits more comprehension and starts making more simple sentences with some errors. The third stage lasts about one to three years. The fourth stage of intermediate fluency is an important stage when the student can comprehend the second language better and makes few errors with the grammar. The fourth stage takes about three to five years. The goal of acquiring a second language is to reach advanced fluency. During this final stage of second language acquisition, the ELL acquires the ability to speak, write, and comprehend in the second language similar to the fluency of a native speaker of English. The ELL takes about five to seven years to reach advanced fluency.

The ELL also needs help to learn the academic content, which is taught in the English language. Therefore, the teacher needs to teach the English language as well as the academic content to the ELL (Kelly-Jackson & Delacruz, 2014; Pray & Monhardt, 2009). To meaningfully teach the academic content, the teacher needs to account for each ELL's prior

knowledge, primary language, and culture (Dong, 2013; Luykx et al., 2007; Pray & Monhardt, 2009). Some teachers do not always incorporate the ELL's language and culture as much as needed (Lee, Luykx, Buxton, & Shaver, 2007). Without meaningful engagement with the academic content and the English language, ELLs can struggle academically and linguistically. Kelly-Jackson and Delacruz (2014) discussed how ELLs have lower grades in science as well as reading and math. These mathematical and reading skills are important to help ELLs understand science language and skills.

Teachers also feel pressure to maintain and adhere to the academic standards established under the federal and state laws. In addition, the federal and state laws require students, including ELLs, to take standardized tests to evaluate the students' understanding of the academic content and major concepts (Dong, 2013; Lee & Buxton, 2011). By eighth grade, ELLs do not perform well on standardized tests in reading, mathematics, and science when compared to peers whose native language is English (National Center for Education Statistics, 2012).

Moreover, teachers do not feel equipped to teach ELLs who represent a wide range of diverse languages, cultures, and socioeconomic status (SES) levels (Hill & Flynn, 2006). Much research has tried to equip teachers with different research-based teaching strategies to teach ELLs the academic content and particularly the associated vocabulary. To learn the academic content and reach academic achievement, ELLs need to learn the academic concepts, language, and vocabulary words for each discipline (Pray & Monhardt, 2009). In order to acquire content-relevant vocabulary, ELLs must learn workable strategies for vocabulary acquisition. As a result, ELLs can choose to utilize the vocabulary strategy that works most effectively for the students in order to become independent learners (Seyyed & Malekpur, 2015; Zheng, 2012).

One particular study (Zheng, 2012) reported that most students studying at a foreign language university in China do not feel their vocabulary learning strategies were effective.

When teaching vocabulary words to ELLs, teachers primarily utilize two different types of instruction: direct instruction and indirect instruction. When using direct instruction, the student directly interacts with the vocabulary word as well as its meaning and form (Naeimi & Foo, 2015). Strategies for direct instruction include repetition (Seyyed & Malekpur, 2015), sentences containing the vocabulary word (Zheng, 2012), flashcards, dictionaries, and vocabulary lists (Naeimi & Foo, 2015). For indirect instruction, the word interaction is not as emphasized (Naeimi & Foo, 2015); therefore, indirect learning can be considered incidental (Daskalovska, 2014). Indirect instruction has several different strategies (Naeimi & Foo, 2015). Strategies for indirect vocabulary instruction include reading vocabulary words within a text or book, discussing feelings with other students (Daskalovska, 2014), using language learning notebooks, writing diary entries, and discussing the vocabulary words (Naeimi & Foo, 2015).

Definition of Terms

English language learner (ELL). Individual learning the English language in addition to the student's native language (Dong, 2013).

Direct instruction. Vocabulary word learning focused on the vocabulary word's form and meaning (Naeimi & Foo, 2015).

Indirect instruction. Vocabulary word learning not emphasizing the vocabulary word and meaning (Naeimi & Foo, 2015).

Non-linguistic representation. Instruction presenting knowledge through mental images or physical interactions using the five senses (Hill & Flynn, 2006).

Word wall. Classroom support showing the unit's vocabulary word with label and a visual, such as a photograph, placed on the classroom wall (Jackson, Tripp, & Cox, 2011).

Statement of the Problem

When considering the current educational demographics and the increasing population of ELLs in the United States educational system, more teachers should be equipped with effective and research-based instructional strategies in order to help ELLs understand and learn vocabulary to build up academic language and skills as well as English language skills. Currently, teachers do not feel competent to teach ELLs in the academic content classroom (Kelly-Jackson & Delacruz, 2014; Lee & Buxton, 2011). For example, the majority of professors at a foreign language university in China believed their English vocabulary teaching strategies were not effective, but almost 97% of these professors believed learning English vocabulary words was important and needed to be taught (Zheng, 2012).

Due to the deficiency in academic vocabulary language and skills, ELLs are not performing well on standardized tests (Kelly-Jackson & Delacruz, 2014). In addition, ELLs do not possess the vocabulary words in English to learn academic content, specifically in science (Kelly-Jackson & Delacruz, 2014). If teachers can teach ELLs the scientific vocabulary, processes, and concepts, then these struggling students can become literate in science in order to think, talk, and act like scientists (Cohen & Johnson, 2012; Lee & Buxton, 2011).

The problem is that ELLs must learn science vocabulary words to succeed in the classroom and pass standardized tests. As a proposed solution, I implemented the word wall with images (WWwI) instructional strategy to help ELLs learn the necessary science vocabulary words for the science unit. Throughout this applied research project, I considered the following research question to guide this applied research project: Is there a relationship between the

vocabulary instructional strategy of a WWwI and the science vocabulary acquisition for ELLs? For the null hypothesis, there will be no difference in the means for the experimental condition of ELLs using the WWwI and the control condition taught without the WWwI to learn the science unit's vocabulary words, as assessed by a paired t-test analysis with an alpha level of significance of 0.05.

Scope of the Study and Delimitations

For this applied research project, I presented research supporting the necessity that ELLs acquire the vocabulary words to help understand the academic content. Research studies have shown that a word wall with imagery can be an effective tool for acquiring vocabulary words (Huerta & Jackson, 2010; Jackson et al., 2011). However, the scope of this research project evaluated whether the WWwI is an effective or ineffective vocabulary learning strategy for this specific group of ELLs to acquire science vocabulary words within one academic science unit.

In light of standardized tests being used to evaluate more schools across the U.S., more ELLs are taking standardized tests starting in elementary school. The focus of this applied research project was on ELLs who attended one of the ten elementary schools within a public suburban school district located in the state of Missouri. These specific students were more likely to take the standardized tests for science in the upper elementary grades. Therefore, these ELLs also must learn the primary academic vocabulary and concepts in science. Being prepared with the scientific academic vocabulary and concepts should allow ELLs to keep up with peers academically and perform similarly or better on standardized tests.

Significance of the Study

Vocabulary words are the gateway to learning another language, whether it is the English language or science literacy. In fact, vocabulary words are important for all learners to know in

order to pass the standardized tests (Dong, 2013; Seyyed & Malekpur, 2015) and academic classes in school (Pray & Monhardt, 2009). According to Zheng (2012), students at a foreign language school in China thought vocabulary learning was important but boring. To learn vocabulary words effectively, imagery needs to be used during instruction (Hill & Flynn, 2006). Additionally, imagery plays an integral role to help ELLs understand and comprehend vocabulary words (Cohen & Johnson, 2012; Jackson et al., 2011). Furthermore, research studies have proven that imagery, such as photographs or drawings, enhanced the students' learning in science (Cohen & Johnson, 2012; Kelly-Jackson & Delacruz, 2014). A positive benefit for using a drawing or picture is that ELLs can learn the vocabulary word and its definition (Hill & Flynn, 2006; Jackson et al., 2011). Krashen and Terrell (1983) believe that students acquiring a second language must focus on understanding and comprehending vocabulary words' definitions in the second language. There is very little research in the area to evaluate elementary students' understanding and comprehending vocabulary words' definitions in a second language. Zheng's (2012) study with university students at a foreign language university, however, is similar. For example, his research showed that 41% of students and 55% of professors believed the meaning of a vocabulary word was one of the most difficult aspects to learn (Zheng, 2012). However, learning definitions helps the student to start understanding the actual vocabulary word (Nowbakht et al., 2015).

As a direct result of struggling to learn vocabulary and its definitions, the word wall provides an effective and practical solution to teaching ELLs the science vocabulary words. The word wall is a type of non-linguistic representation, which enhances knowledge, since the word wall contains the word and an image (Hill & Flynn, 2006). Because the word wall utilizes the word and an image, this word wall allows ELLs to connect the new science vocabulary words

and concepts with their prior knowledge (Dong, 2013; Jackson et al., 2011; Kelly-Jackson & Delacruz, 2014) and to discuss the different connections and relationships among the different science vocabulary words displayed on the word wall (Jackson et al., 2011; Pray & Monhardt, 2009). Students learn through actively engaging with the academic content (Hill & Flynn, 2006). By completing a word wall with science vocabulary words, students become engaged in actively learning science (Kelly-Jackson & Delacruz, 2014; Nowbakht et al., 2015; Pray & Monhardt, 2009).

Based on the reviewed research and research studies, imagery can help ELLs learn the new science vocabulary words. In addition, imagery can improve the ELL's overall scientific literacy as well as learning science academic concepts. Most importantly, the academic benefits of using imagery help ELLs to close the academic gap, especially in science (Lee & Buxton, 2011; Cohen & Johnson, 2012), and perform better on standardized tests (Dong, 2013; Jackson et al., 2011).

Methods of Procedure

I used the following research question to guide this applied research project: Is there a relationship between the vocabulary instructional strategy of a WWwI and the science vocabulary acquisition for ELLs? For the null hypothesis, there will be no difference in the means for the experimental condition of ELLs using the WWwI and the control condition taught without the WWwI to learn the science unit's vocabulary words, as assessed by a paired t-test analysis with an alpha level of significance of 0.05.

I have read and analyzed journal articles and books about teaching science vocabulary effectively to ELLs. I have searched JSTOR, OhioLink, OneSearch, Ebsco, Education Full Text, ERIC, Education Research Complete, PsychInfo, Google Books, and Google Scholar. In

addition, I have located books in order to obtain more information about effective science vocabulary instruction for ELLs. I also discussed instruction for ELLs with current ELL teachers in public schools. Finally, I have taught and helped many ELLs in my own classroom while teaching abroad at an international school and other classrooms in the American public schools. This applied research project could benefit teachers who teach ELLs by providing an effective instructional strategy to use in a classroom. In addition, ELLs can better visualize the word and remember the vocabulary words' definitions.

Based on the research I reviewed, I completed a quantitative study over six weeks evaluating the effectiveness of using the science unit's vocabulary words in a WWwI to help ELLs. The independent variable was the WWwI focused on learning science vocabulary in a specific science unit. The dependent variable was the ELL's learning. I utilized the materials of a pre-test, a post-test, and a post-intervention Likert scale questionnaire.

The intervention evaluating the WWwI for science vocabulary words involved several steps. First, the students took a pre-test and post-test over the baseline science unit's selected science vocabulary. Each ELL completed the multiple choice pre-test and post-test, and the pre-test and the post-test scores for the baseline science unit, which served as the baseline to evaluate whether the WWwI helped ELLs learn the science vocabulary. Then each ELL took the second unit's multiple choice pre-test. During the second science unit, the teacher and ELLs added the vocabulary word and its corresponding picture to the word wall. By adding the vocabulary word and picture to the word wall, the teacher and ELLs could discuss the vocabulary word as well as the relationships with the science unit's other vocabulary words found on the word wall. Throughout the discussion, ELLs should be able to create deeper meaning and understanding of the science vocabulary. As a result, ELLs should be able to recall and retain the vocabulary

word. After the teacher continued to weave the vocabulary words throughout the unit's science lessons and activities, ELLs viewed the vocabulary words on the word wall multiple times over an extended period of time. Once the second science unit was completed, each ELL completed the multiple choice post-test. The second science unit's pre-test and post-test scores helped me know if the ELLs were able to learn the science vocabulary words with the help of a WWwI, the independent variable. The pre-test and post-test scores from both science units will provide quantitative data.

In addition, the students completed a post-intervention questionnaire. This questionnaire helped provide quantitative data. The questionnaire included questions related to the ELLs' perceptions about science, the importance of science vocabulary, and using a WWwI to learn science vocabulary words.

Chapter 2: Literature Review

When considering vocabulary acquisition for ELLs, several elements influence language acquisition and are important to understand. These influential and important elements include legislation or national standards impacting schools as well as the classroom, the ELL's primary language and culture, and the stages of second language acquisition relating to cognition and vocabulary.

National and State Legislation and Standards

The United States government has enacted and focused on high achievement standards for all students, including ELLs (Huerta & Jackson, 2010; Lee & Luykx, 2005; Luykx & Lee, 2007). For instance, Common Core emphasizes oral language throughout the standards (Wright, 2016). In addition, science standards are provided (Lee & Buxton, 2011); however, no guidelines were given on how to provide quality instruction in science (Luykx, Lee, & Edwards, 2008). Specifically, science is best taught through inquiry (Huerta & Jackson, 2010; Lee & Luykx, 2005; Lee et al., 2007; Luykx & Lee, 2007). However, most teachers are uncomfortable and lack training to teach science with inquiry (Hill, 2016; Lee et al., 2007).

The high standards have forced all students, including ELLs, to take standardized tests, which are considered high stakes tests (Huerta & Jackson, 2010; Lee et al., 2007). In addition, the United States educational policy of English only instruction has changed education for ELLs and minimizes their primary languages (Luykx et al., 2008). As a result, the standardized tests are written in the English language (Gándara & Santibañez, 2016). Specifically in Missouri, ELLs currently take standardized tests in English, including the science test. Standardized assessments cause problems for ELLs (Luykx et al., 2007). For instance, ELLs are learning the English language as well as the content (Lee & Luykx, 2005). ELLs also need time to

understand the academic content in the English language on their grade levels (McDonnough & Cho, 2009). For instance, students must be proficient in science knowledge as well as the English language to succeed on standardized tests and in the classroom (Huerta & Jackson, 2010; Luykx et al., 2007). The language used to describe and discuss the academic content becomes more difficult and specialized as the ELL progresses through more grades. Therefore, the importance of realizing that academic language is socio-cultural, defined as a combination of social and cultural factors, helps the ELL learn more effectively than if the academic language is taught in an isolated manner (Kelly-Jackson & Delacruz, 2014).

ELLs experience more limitations due to lack of English proficiency and even misinterpret tests written in English (Luykx et al., 2007; Manyak & Bauer, 2009). The assessment also involves the mainstream society's culture and language (Luykx et al., 2007). Most importantly, the assessment of ELLs should concentrate on the academic content instead of the English language (Elgort & Warren, 2014; Hill, 2016; Robertson, 2016). In fact, the goal of assessment is to evaluate the ELL's understanding of the academic content (Tucker, 2016). Consequently, ELLs do not perform well on standardized tests (Huerta & Jackson, 2010).

Besides high standards and standardized assessments, the U.S. and state governments want highly qualified teachers, but many ELL programs lack quality teachers. Moreover, states also have varying requirements for teacher certification and licensure in ELL programs (Gándara & Santibañez, 2016). In relation to teacher preparation, Lee and Luykx (2005) noted that many teachers lack proper training to teach ELLs, and many ELL teachers do not feel prepared to meet the needs of ELLs (Medina-Jerez, Clark, Medina, & Ramirez-Marin, 2007). In addition, ELL teachers are not receiving consistent and continual professional development to help understand the academic content and diversity to assist students, including ELLs (Gándara & Santibañez,

2016; Kelly-Jackson & Delacruz, 2014; Lee & Luykx, 2005; Lee et al., 2007). Specifically, Lee et al. (2007) found that elementary teachers did not even know the science content during the study. Furthermore, Kelly-Jackson and Delacruz (2014) suggested that teachers need better preparation to create more meaningful activities and lessons in science to help ELLs learn. Teachers must know about teaching strategies and how to use them with ELLs (Goodwin & Hein, 2016; Watson, 2004). The lack of inadequate training and professional development to teach ELLs highlight a problem since a teacher has the most influence directly on the ELL (Luykx et al., 2008).

In 1991, the federal government granted every U.S. school more autonomy to choose how to educate ELLs. Even though states, school districts, schools, and classrooms primarily decide how educational policy for ELLs is implemented, most states struggle to monitor the ELL programs offered in the schools for ELLs. The first problem is evaluating ELL programs in relation to numbers for promotion or standardized test scores. The second problem is that states are reacting instead of actively seeking answers (Luykx et al., 2008). Luykx and Lee (2007) wrote that the ELL program's goal should be for ELLs to understand academic content and vocabulary, but most ELL programs emphasize learning the English language (Luykx et al., 2008). In reality, most ELLs assimilate to the society's mainstream language and culture (Lee & Luykx, 2005). Furthermore, Umansky, Valentino, and Reardon (2016) suggested that ELL programs should have the goal to help the ELL academically, socially, and linguistically.

Lee and Luykx (2005) noted that curriculum is not a one size fits all due to the diverse needs of students, especially ELLs. ELLs must understand the content in order to achieve academic success (Jackson et al., 2011). In addition, the ELL program should have age appropriate curriculum, which includes modifications and accommodations (Gottschalk, 2016).

Luykx et al. (2007) even suggested that assessments, products of the mainstream culture, should receive accommodations and be based on the ELL's abilities and skills. Possible accommodations or modifications of assessments would be shorter tests, extended time (Berg, Petron, & Greybeck, 2012), read aloud, translated (Lee & Luykx, 2005), or performance assessment or an alternative assessment, such as posters, brochures, or portfolios. (Berg et al., 2012; Hansen, 2006; Lee & Luykx, 2005; Medina-Jerez et al., 2007). Realistic expectations for each ELL should be considered and implemented in the classroom (Hill, 2016).

Consequently, every U.S. school can choose how to educate ELLs, but the ELL program should be planned to help the ELL in the long run (Umansky, Valentino, & Reardon, 2016). ELL educational programs choose to educate ELLs through English immersion or bilingualism. English immersion, which is also known as sheltered English instruction, is when the ELL attends the mainstream classroom and must know English before learning any academic content or skills (Lee & Luykx, 2005; Umansky et al., 2016). Gorman (2012) emphasized that English instruction should be gradual for the ELL. Most ELL programs focus on English language acquisition, which aligns with English immersion. Second, bilingual education means the ELL maintains primary language and learns the academic content in both the ELL's primary language as well as the English language (Umansky et al., 2016; Wright, 2016). This means teachers in a bilingual classroom must be bilingual in the ELL's primary language and the English language to effectively help ELLs academically and linguistically (Gándara & Santibañez, 2016; Wright, 2016). Before 1991, the U.S. government wanted ELLs to receive instruction in the ELL's primary language (Luykx et al., 2008). However, not enough bilingual teachers are available to teach in a bilingual classroom for ELLs (Gándara & Santibañez, 2016; Gottschalk, 2016). During a research study, some bilingual teachers did not communicate with the ELL in the

primary language (Lee et al., 2007). Gottschalk (2016) stated that ELLs speak numerous languages, so an ELL bilingual teacher might need to speak multiple languages in an ELL classroom, which is not always possible.

According to Lee and Luykx (2005), the standards-based educational system and accountability should adjust due to the increase of ELLs enrolled in the United States public schools. ELLs should have equal opportunities and access to learn (Luykx et al., 2008). Even though the ELL can or cannot speak English, the ELL still has the ability to learn (Watson, 2004). Therefore, an ELL should be viewed as a person with the ability to contribute to the learning process (Case, 2016). The ELL needs time to reach the grade level due to limited English proficiency. First, ELLs often hold a lower SES, and the ELL can experience a lack of prior knowledge and experience as well as have limited access to materials (Lee et al., 2007). Second, the lack of English language negatively impacts the ELL's academic achievement (Manyak & Bauer, 2009). As a result, ELLs often experience an academic gap with their peers (Goodwin & Hein, 2016). If time is given, the ELL can become an independent learner (Luykx & Lee, 2007) who contributes to learning and achieves academically, linguistically, and culturally (Case, 2016).

ELL's Culture and Languages

The ELL also has to navigate multiple cultures (Scherer, 2016). Culture is comprised of three elements: beliefs, norms, and practices (Luykx, 2008). In addition, culture is socially constructed (Lee et al., 2007) and more difficult to define (Luykx et al., 2007). So the ELL comes with a prior culture (Lee & Luykx, 2005), but the ELL's primary culture can adapt and even change (Luykx et al., 2008) due to sociocultural aspects (Luykx et al., 2007). Language can help preserve the culture as well as help it progress (Zheng, 2012).

Culture also determines how the ELL relates and communicates with other individuals (Case, 2016; Lee et al., 2007). An ELL's home and community is established on the ELL's primary culture and language. Therefore, parents of the ELL should be involved and allowed to participate in the ELL's educational experience (Gándara & Santibañez, 2016; Gottschalk, 2016; Medina-Jerez et al., 2007). The ELL's parents generally value education (Lee et al., 2007). Yet, the ELL's parents may lack the ability to communicate in English (Gándara & Santibañez, 2016); however, schools and teachers still need to figure out a way to communicate with the ELL's parents (Watson, 2004). Schools can also provide cultural examples and resources for ELLs to learn (Dong, 2013; Gándara & Santibañez, 2016; Lee & Buxton, 2011; Lee & Luykx, 2005; Lee et al., 2007; Luykx & Lee, 2007; Medina-Jerez et al., 2007; Méndez, Crais, Castor, & Kainz, 2015).

Besides navigating multiple cultures, the ELL is learning multiple languages (Scherer, 2016). At home and during free time, the ELL speaks his/her primary language (Gottschalk, 2016). An ELL's primary language is not static (Luykx et al., 2008) and can change based on sociocultural contexts (Luykx et al., 2007). Overall, the ELL's primary language is very important to include in the ELL's education (Dong, 2013; Lee et al., 2007; Luykx & Lee, 2007; Wright, 2016) and can even help the ELL succeed academically (Medina-Jerez et al., 2007; Lee et al., 2007; Wright, 2016). In the study by Cena et al. (2013), the use of the ELL's primary language also increased the ELL's general reading and reading skills. Furthermore, the ELL's primary language can help the ELL learn English (Gorman, 2012; Gottschalk, 2016; Lugo-Neris, Jackson, & Goldstein, 2010; Medina-Jerez et al., 2007; Méndez et al., 2015) and English vocabulary (Cena et al., 2013; Lugo-Neris et al., 2010; Luykx & Lee, 2007). For example, Medina-Jerez et al. (2007) demonstrated that ELLs were able to learn English vocabulary

quicker if the vocabulary was given first in the ELL's primary language. Being able to communicate, ELLs were more active learners and used more English when using the primary language. As a result, the ELL can be involved in more classroom discussions (Luykx et al., 2008).

Acquiring a Second Language

Krashen and Terrell (1983) focused on the Natural Approach in order for students to acquire a second language with the sole purpose for the ELL to communicate and understand the English language instead of grammatical proficiency. Therefore, the English message's content not the means is necessary to acquiring the English language. Usually, learning a language means the ELL must learn the English language grammatical rules and how they work in the English language, especially spelling and punctuation. As a result, the ELL focuses on correctly using the English language. Instead, the Natural Approach emphasizes that the ELL should be focused on communicating and understanding the English language and not be afraid to make mistakes.

According to Krashen and Terrell (1983), the Natural Approach has four primary principles. The first principle focuses on listening and reading comprehension of the English language before speaking the English language. The second principle involves the ELL progressing through six stages: nonverbal gestures, single word response, two or three words response, phrases, sentences, and complex speech. These six stages are similar to the five stages outlined by Hill and Flynn (2006) regarding second language acquisition: preproduction, early production, speech emergence, intermediate fluency, and advanced fluency. The third principle focuses on communication in the English language not grammar as the primary goal for any ELL. The final principle is to create a safe and supporting environment for ELLs to interact with

relevant and meaningful content and encourage expression of emotions and feelings (Krashen & Terrell, 1983).

When first learning the second language, the beginning ELL encounters a silent period. During this time, the ELL cannot speak the English language for a couple of hours to a few months (Krashen & Terrell, 1983; Wright, 2016). The length of time for the ELL's silent period depends on the age and context; however, the ELL should not be forced to speak until he/she is ready to speak the English language (Krashen & Terrell, 1983). Even though the ELL can or cannot speak, the ELL still can learn while acquiring the academic content in the English language (Krashen & Terrell, 1983; Watson, 2004; Wright, 2016).

Furthermore, Krashen and Terrell (1983) discussed how the factors of aptitude, individual variation, age, and the ELL's first language can influence how the ELL learns the English language. Aptitude is how easily a person can learn a language while primarily focusing on the rules of grammar, but the language acquisition may not last due to the focus on grammar. Regarding the individual variation, the process is the same, but the learner may have a different set of prior experiences with the second language, comfort with second language use, and personality. For age difference, an adult can be quicker in acquiring proficiency in the second language than a child; however, a child can become more competent in the second language in the long run. Influence from the ELL's first language can explain errors in communication due to the ELL's reliance on the primary language's rules if the English rule is unknown.

Another important theory for language acquisition is dual coding. Cohen and Johnson (2012) summarized dual coding as encoding new material verbally and nonverbally. The verbal element involves speech and writing. The nonverbal aspect includes images, objects, and situations. As a result of encoding the new material verbally and nonverbally, the individual is

able to elaborate the material in the memory. Then the individual easily organizes the new information and recalls it at a later date.

When learning the English language, the ELL's phonological awareness is related to the working memory and vocabulary size. The working memory helps to learn words, which influence phonological memories (Gorman, 2012). Understanding and using shorter and simpler phrases, infants rely on prior experience when learning phonologically (Lany, Gómez, & Gerken, 2007). In fact, phonological awareness of sounds impacts the working memory to decode the sounds to form words; therefore, children need strong working memories to remember and recall sounds and words (Gorman, 2012). Infants and younger children better understand concrete instead of abstract examples, which starts in adolescence. As the individual experiences more in life, then this individual is able to communicate in a more complex pattern due to similar and simpler phonological structure and vocabulary previously experienced (Dockrell, Braisby, & Best, 2007; Lany et al., 2007). Concerning the importance of the ELL's phonological awareness, the ELL's primary language phonological awareness can help the ELL acquire English literacy and skills. Furthermore, the ELL's phonological memory and total vocabulary size can predict the ELL's acquisition of the English language (Gorman, 2012).

Importance of Vocabulary

When an ELL acquires English as a second language, the English language and academic content vocabulary must first be acquired and navigated by each ELL (Fisher & Frey, 2016). Thus, vocabulary helps the ELL communicate and understand the written or spoken message linguistically, socially (Fisher & Frey, 2016; Umansky et al., 2016), and academically, (Fisher & Frey, 2016). Consequently, vocabulary should be taught every day to help students remember and acquire the necessary vocabulary to succeed in school (Calderón, Slavin, & Sánchez, 2011;

Scherer, 2016) and life (Scherer, 2016). Thus, acquisition of vocabulary words is pertinent for the ELL to be able to listen, speak, read, and write in the English language (Nowbakht et al., 2015). However, the teacher struggles to ensure vocabulary is taught along with the other necessary components of the curriculum in the allotted class time (Armon & Morris, 2008). Specifically, the teacher usually spends the most time in class instruction to teach the vocabulary to ELLs (Tucker, 2016) accounting for the ELL's age, culture (Corona & Armour, 2007), and English ability and skills (Colburn & Nguyen, 2012; Corona & Armour, 2007).

Vocabulary words can be very complex. Vocabulary words involve more than the ELL learning and using the definition (Hill, 2016). Each vocabulary word also has a definition, spelling, pronunciation, (Nowbakht et al., 2015) grammatical rules, collocations, associations, and frequencies (Nowbakht et al., 2015; Tekmen & Daloğlu, 2006). If possible, the ELL should know the multiple components of the vocabulary words. To better understand vocabulary words, the ELL must first know and understand the definitions for the vocabulary words (Luykx et al., 2008; Pray & Monhardt, 2009). Krashen and Terrell (1983) emphasized that the ELL must have meaningful connections when first learning the vocabulary words to make meaning. In addition, the academic content, language used by teachers and ELLs, and school policies impact how ELLs understand vocabulary words' definitions (Luykx et al., 2008) and socially interact with other ELLs (Barry, 2008; Luykx et al., 2008). As a result, vocabulary words and concepts have a deeper understanding for the ELL (Husty & Jackson, 2008). Additionally, the vocabulary word's morphology and syntax cannot always help the ELL if he/she does not know the vocabulary word's definition. If the ELL knows the vocabulary word's definition, then the ELL can better learn the vocabulary word's morphology and syntax (Krashen & Terrell, 1983). Furthermore, the more definitions that the ELLs know, then the more vocabulary words that the

ELLs will know (Nowbakht et al., 2015). Most importantly, learning vocabulary words and definitions will continue throughout life (Barry, 2008), since it is impossible to teach every vocabulary word to ELLs (Krashen & Terrell, 1983).

Vocabulary has several different types. The first type of vocabulary is receptive vocabulary or passive vocabulary (Nowbakht et al., 2015). Receptive vocabulary is what an ELL recognizes or understands when listening or reading (Nowbakht et al., 2015; Tekmen & Daloğlu, 2006). The second type of vocabulary is productive vocabulary, which is also known as active or expressive vocabulary (Nowbakht et al., 2015). Productive vocabulary is the total number of vocabulary words an ELL can speak or write (Nowbakht et al., 2015; Tekmen & Daloğlu, 2006). Overall, the ELL has a larger receptive vocabulary base than a productive vocabulary (Nowbakht et al., 2015). For example, receptive vocabulary can help the ELLs' comprehension, but upper elementary students performed better with productive vocabulary (Dockrell et al., 2007)

Vocabulary words are also divided into three different tiers. Tier 1 words are basic vocabulary ELLs should already know. Tier 2 words are vocabulary words ELLs should often read or hear. Tier 3 words are infrequent and need not be known to ELLs (Best, Braisby, & Dockrell, 2006). Gorman (2012) stated that teachers should target tier 2 vocabulary words, and ELLs can indirectly learn tier 1 vocabulary words.

Finally, the breadth and depth of the ELLs' vocabulary is important for the ELL, especially when acquiring the English language. Depending on how well the ELL can effectively use vocabulary learning strategies helps the ELL's vocabulary breadth and depth (Seyyed & Malekpur, 2015). The breadth of vocabulary or the vocabulary size is total amount of vocabulary words known by the ELL. Then the depth of the ELLs' vocabulary is the true

understanding of the vocabulary word. How well an ELL knows the vocabulary word is more important (Nowbakht et al., 2015). However, Tekmen and Daloğlu (2006) noted that vocabulary size was more important for the ELL.

Learning and understanding vocabulary words and their components enables an ELL to succeed in school (Dockrell et al., 2007; Nowbakht et al., 2015; Taboada & Rutherford, 2011). Therefore, vocabulary is one of the most pertinent aspects to allow an ELL to succeed in school (Calderón et al., 2011; Jackson et al., 2011; McDonnough & Cho, 2009). In fact, the more vocabulary words that ELLs in middle and high school know, the more likely they are to achieve success (Flanigan, Templeton, & Hayes, 2012). Often ELLs are more likely to earn lower grades in school due to the lack of vocabulary (Kim & Linan-Thompson, 2013). Consequently, the ELL is more likely to fail at school (Dockrell et al., 2007; Nowbakht et al., 2015; Taboada & Rutherford, 2011). Sadly, an ELL is more likely to quit school and even drop out (Scherer, 2016).

ELLs usually struggle in school with lower academics due to the deficiency of pertinent vocabulary, especially within each academic discipline (Kim & Linan-Thompson, 2013). Academic vocabulary and language can be difficult for the ELL to learn (DeLuca, 2010; Fisher & Frey, 2016). Academic language can also vary based on each academic discipline, especially science (Luykx et al., 2008). Therefore, the ELL needs to learn the academic vocabulary to build the academic content (Best et al., 2006; Kim & Linan-Thompson, 2013; McDonnough & Cho, 2009; Watson, 2004) and understand the concepts (Nabors & Edwards, 2011). Within the science discipline, the ELL needs general and scientific vocabulary to learn, comprehend, and apply scientific content (Taboada, 2012). Most importantly, vocabulary helps the ELL

academically learn and achieve success (Jackson et al., 2011; Medina-Jerez et al., 2007; Méndez et al., 2015; Taboada, 2012; Umansky et al., 2016).

Often, ELLs struggle to read and comprehend texts (Gorman, 2012). If the ELL does not possess the vocabulary, then the ELL cannot read (Lugo-Neris et al., 2010). The ELL must learn and understand the English vocabulary to be able to read (Seyyed & Malekpur, 2015; Tekmen & Daloğlu, 2006). Furthermore, English vocabulary allows the ELL to comprehend the texts being read (Calderón et al., 2011; Elgort & Warren, 2014; Goodwin & Hein, 2016; Gorman, 2012; Nowbakht et al., 2015; Seyyed & Malekpur, 2015). Thus, the ELL's ability to communicate and apply vocabulary can determine the ELL's reading comprehension (Naeimi & Foo, 2015; Taboada, 2012). However, Krashen and Terrell (1983) wrote that ELLs can still enjoy reading even if the ELL does not know all the vocabulary words. As the ELL's vocabulary size increases, then the ELL can effectively read (Tekmen & Daloğlu, 2006) and comprehend (Elgort & Warren, 2014) the text.

English is the language of assessments, including standardized tests. Assessments are used to evaluate the ELL's understanding of academic content and concepts (Taboada, 2012). Therefore, understanding and applying English vocabulary is important to pass an assessment (Dong, 2013; Manyak & Bauer, 2009; McDonnough & Cho, 2009). If the ELL does not know the English vocabulary, then the ELL most likely fails the assessment (Manyak & Bauer, 2009).

If the ELL wants to communicate, then the ELL must learn, understand, and apply vocabulary words (Naeimi & Foo, 2015; Nowbakht et al., 2015; Robertson, 2016). Vocabulary is the key to speaking the English language in class as well as communicating with other individuals (Gándara & Santibañez, 2016; Nowbakht et al., 2015; Krashen & Terrell, 1983; Tekmen & Daloğlu, 2006; Wright, 2016). In class, vocabulary allows the ELL to discuss

academic content (Wright, 2016). In addition, as the English vocabulary size increases, then the ELL can speak more comfortably with native English speakers (Krashen & Terrell, 1983). In fact, the ELL should be able to discuss meaningful real life events with anyone in the English language (Krashen & Terrell, 1983; Nowbakht et al., 2015; Wright, 2016).

Finally, the ELL should know vocabulary to be better prepared for life. By knowing and understanding vocabulary, the ELL builds confidence to speak and write in the English language (Larson, 2014; Nabors & Edwards, 2011). Furthermore, the understanding of vocabulary and language impacts how the ELL sees himself/herself as well as the world (Nowbakht et al., 2015). In addition, the ELL can think and speak like an expert at his/her job (Larson, 2014; Lee & Buxton, 2011). As a result, the ELL can most likely experience economic well-being due to a better understanding of the English language and its vocabulary (Umansky et al., 2016). Most importantly, the ELL can become independent (Seyyed & Malekpur, 2015) and a citizen in the globalized world (Goodwin & Hein, 2016; Kelly-Jackson & Delacruz, 2014; Umansky et al., 2016).

Major ELL Teaching Strategies

In order to learn the English language and vocabulary, vocabulary instruction should be taught every day (Cena et al., 2013) with relevance and meaning (Berg et al., 2012). Two primary teaching strategies are used to teach English vocabulary to ELLs. The first primary teaching strategy to use is direct or explicit instruction (Elgort & Warren, 2014), which helps the teacher use time efficiently (Krashen & Terrell, 1983). By using direct instruction, the teacher primarily emphasizes the English language by explaining and expounding on the vocabulary words (Krashen & Terrell, 1983; Lugo-Neris et al., 2010; Medina-Jerez et al., 2007; Naeimi & Foo, 2015; Taboada & Rutherford, 2011; Wright, 2016) and their definitions (Krashen & Terrell,

1983; Lugo-Neris et al., 2010; Luykx et al., 2008; Taboada & Rutherford, 2011), even multiple definitions (Zheng, 2012), as well as grammatical rules (Wright, 2016). ELLs must possess a larger vocabulary size since vocabulary is the primary focus of direct instruction (Elgort & Warren, 2014). Specifically, lower-achieving ELLs may need more direct vocabulary teaching (Tekmen & Daloğlu, 2006). Usually the teacher lectures (Hansen, 2006; Tucker, 2016), such as 10/2 lecture (Hansen, 2006), or uses mini-lessons, chunks the lesson (Kim & Linan-Thompson, 2013; Lee et al., 2007; Luykx et al., 2008; Tucker, 2016), and differentiates the lesson for the ELL's language skills and abilities (Tekmen & Daloğlu, 2006). As a result of any or all these strategies, ELLs can actively participate in discussion and not feel as stressed (Hansen, 2006). Additionally, the teacher should not need to make as many modifications with direct instruction (Taboada & Rutherford, 2011) with the increased intervention for students (Krashen & Terrell, 1983); therefore, direct instruction is easy for teachers to use in the classroom to help ELLs (Naeimi & Foo, 2015).

The ultimate goal of direct instruction is to encourage ELLs to use the English language and vocabulary in writing proper grammar as well as oral pronunciation (Nowbakht et al., 2015). Direct instruction helps ELLs improve their English vocabulary, including academic content vocabulary, for ELLs of all abilities (Cohen & Johnson, 2012; Kim & Linan-Thompson, 2013; Naeimi & Foo, 2015; Taboada & Rutherford, 2011), and comprehension (Cohen & Johnson, 2012). Furthermore, direct instruction also improved the ELLs' academic achievement (Kim & Linan-Thompson, 2013). Most direct instruction is done through reading and writing (Gorman, 2012). However, a disadvantage of the direct instruction typically focuses on the dominant culture's norms and rules (Lee & Luykx, 2005).

Specific direct instruction teaching strategies involve several different teaching strategies. Students can use word lists or memorization of vocabulary words and their definitions (Goodwin & Hein, 2016; Naeimi & Foo, 2015; Nowbakht et al., 2015; Taboada & Rutherford, 2011) and apply the word in another context (Zheng, 2012). Flashcards can be helpful to memorize vocabulary words and their definitions (Naeimi & Foo, 2015; Zheng, 2012), but Krashen and Terrell (1983) wrote that students do not remember long-term due to lack of storage in the permanent memory. A flashcard can have the vocabulary word and a picture on one side and the definition on the other side (Honnert & Bozan, 2005; Taboada & Rutherford, 2011). Another type of direct instruction teaching strategy has ELLs use dictionaries (Naeimi & Foo, 2015; Nowbakht et al., 2015) to complete assignments or assessments (Luykx et al, 2007). Dictionaries should be multilingual (Case, 2016), child friendly (Kim & Linan-Thompson, 2013; Méndez et al., 2015), and informative of antonyms (Corona & Armour, 2007; Naeimi & Foo, 2015) and synonyms (Corona & Armour, 2007). Most importantly, the ELLs should use a dictionary to translate assignments and assessments (Berg et al., 2012; Medina-Jerez et al., 2007). The teacher may also teach vocabulary words by giving analogies (Medina-Jerez et al., 2007). Word association (Naeimi & Foo, 2015) and word collocations, which are context-dependent words used together, (Zheng, 2012) are two additional direct teaching strategies to help students learn vocabulary. Finally, it is important to teach ELLs cognates (Berg et al., 2012; Gorman, 2012; Manyak, & Bauer, 2009; Nowbakht et al., 2015) so they can learn the different elements of the words, such as roots (Flanigan et al., 2012; Luykx et al., 2008; Zheng, 2012) affixes, or suffixes (Luykx et al., 2008; Zheng, 2012). As a result, the ELLs can develop better lexical understanding (DeLuca, 2010) and recognize English words (Luykx et al., 2008).

The second primary teaching strategy to use is indirect instruction, which is also known as incidental instruction (Taboada & Rutherford, 2011) or implicit instruction (Elgort & Warren, 2014). To learn vocabulary using indirect instruction, some researchers noted that students did not learn any vocabulary (Naeimi & Foo, 2015) or had a harder time learning vocabulary (Kim & Linan-Thompson, 2013). Yet, some students were able to learn vocabulary short-term, and some students showed significant improvements with reading comprehension (Taboada & Rutherford, 2011). When using indirect instruction, students asked a lot more questions and needed help (Naeimi & Foo, 2015). In fact, Tekmen and Daloğlu (2006) and Kim and Linan-Thompson (2013) noted the direct instruction and indirect instruction should be combined to be most effective to benefit ELLs learning vocabulary.

Several different teaching strategies can be used with indirect instruction. First, ELLs can learn the vocabulary word from the meaningful and relevant context (Chung, 2012; Lee et al., 2008; Nowbakht et al., 2015), such as a sentence (Krashen & Terrell, 1983), and even guess the vocabulary's definition (Zheng, 2012), which is natural (Nowbakht et al., 2015). The vocabulary word must be taught meaningfully in context (Barry, 2008; Corona & Armour, 2007; Elgort & Warren, 2014; Lee & Luykx, 2005; Naeimi & Foo, 2015), such as real life situations (Luykx et al., 2008; Luykx et al., 2007; Nowbakht et al., 2015), and expose ELLs to diverse contexts (Kim & Linan-Thompson, 2013) and multiple exposures (Lugo-Neris et al., 2010). Inferring (Barry, 2008; Naeimi & Foo, 2015), guessing from context (Naeimi & Foo, 2015; Nowbakht et al., 2015), and taking notes (Naeimi & Foo, 2015) are three other indirect teaching strategies. Graphic organizers, which are very diverse, can be powerful indirect teaching tools to supplement the ELLs' vocabulary learning (Armon & Morris, 2008; Colburn & Nguyen, 2012; Hansen, 2006; Kelly-Jackson & Delacruz, 2014; Robertson, 2016; Taboada & Rutherford, 2011).

Learning logs can also be an indirect teaching strategy to answer reflective questions about the academic content and vocabulary (Berg et al., 2012; DeLuca, 2010).

The primary indirect vocabulary learning strategy is reading a text or story (Corona & Armour, 2007; Daskalovska, 2014; Elgort & Warren, 2014; Tekmen & Daloğlu, 2006; Tucker, 2016; Zheng, 2012) for academic content (Calderón et al., 2011; Daskalovska, 2014). Zheng (2012) noted that incidental vocabulary learning is harder when only done through reading, especially when vocabulary words are not frequently mentioned in the text (Daskalovska, 2014; Nowbakht et al., 2015; Tekmen & Daloğlu, 2006). The teacher should offer choices to read but also allow ELLs to see the vocabulary in diverse linguistic and structural formats (Soto, Freeman, & Freeman, 2013). Most importantly, ELLs can have differentiated readers (Daskalovska, 2014; Nowbakht et al., 2015; Taboada & Rutherford, 2011). In addition, ELLs should have shortened reading selections (Elgort & Warren, 2014; Tekmen & Daloğlu, 2006).

Besides the two primary teaching strategies of direct and indirect instruction, the use of cooperative or small groups with ELLs is highly encouraged (Lee & Luykx, 2005; Medina-Jerez et al., 2007; Soto et al., 2013; Wright, 2016). ELLs can work with a partner (Soto et al., 2013; Taboada & Rutherford, 2011) or in small groups (Taboada & Rutherford, 2011; Wright, 2016). All students can work on the assignment or project (Naeimi & Foo, 2015), but each student is held accountable to accomplish the group assignment or project (Medina-Jerez et al., 2007). To set up ELLs in small groups, the teacher can differentiate the groups based on language ability (Tucker, 2016), such as English proficiency and the ELL's primary language (Hansen, 2006), reading ability, or writing ability (Tucker, 2016). When ELLs are assigned small groups, ELLs can interact and discuss (Berg et al., 2012; Hansen, 2006; Hill, 2016; Lee et al., 2008), such as think-pair-share or numbered heads (Wright, 2016), and even say, define, and explain the

vocabulary words' meanings (Corona & Armour, 2007; Lugo-Neris et al., 2010). Specifically, English and the ELL's primary language can be used throughout the small group's discussions (Berg et al., 2012; Medina-Jerez et al., 2007) to share academic content (Zheng, 2012) and help ELLs safely and respectfully converse in the English language (Calderón et al., 2011; Case, 2016; Lee & Luykx, 2005; Massery, 2013; Medina-Jerez et al., 2007; Nowbakht et al., 2015) and use academic language (Calderón et al., 2011; Goodwin & Hein, 2016). Furthermore, a cooperative group can help ELLs receive evaluation about the English language and academic understanding (Berg et al., 2012; Massery, 2013). Small group interaction and communication can most effectively and naturally improve the English language skills and abilities for all ELLs (Calderón et al., 2011; Case, 2016; Nowbakht et al., 2015; Watson, 2004; Wright, 2016; Zheng, 2012).

Specifically to teach scientific concepts and vocabulary to ELLs, scientific inquiry is highly encouraged for ELLs (Huerta & Jackson, 2010; Lee et al., 2007; Luykx & Lee, 2007). Inquiry allows ELLs to be active participants to learn about the scientific concepts and apply them as well as learn scientific vocabulary words. In addition, ELLs can base inquiry on their prior knowledge and experiences and even ask more questions to learn. Most importantly, scientists perform inquiry in the real world. Unfortunately, scientific inquiry means more money must be spent on scientific supplies and equipment, which can be expensive (Lee & Buxton, 2011). Small group learning, which can also occur during inquiry, is also effective to teach science to ELLs (Watson, 2004). Moreover, inquiry can also allow ELL's scientific understanding of vocabulary and concepts to be evaluated through individual or group projects (Soto et al., 2013).

To help ELLs actively learn the vocabulary and definitions, ELLs need concrete experiences or materials to clarify the primary concepts and processes in order to broaden the ELL's learning experience and knowledge (Armon & Morris, 2008; Hansen, 2006; Honnert & Bozan, 2005). Teachers can provide manipulatives (Hill, 2016) or real objects to touch (Hansen, 2006; Hill, 2016; Kelly-Jackson & Delacruz, 2014; Lee & Luykx, 2005; Luykx & Lee, 2007; Nabors & Edwards, 2011; Seyyed & Malekpur, 2015; Watson, 2004; Wright, 2016). Real objects easily exemplify concrete vocabulary terms, but ELLs also need concrete examples and experiences to help them understand the more abstract concepts and vocabulary words (Elgort & Warren, 2014). Therefore, laboratory sessions should be completed first before the academic content (Watson, 2004). Additionally, ELLs need demonstration or modeling of processes or definitions to understand the academic concepts or vocabulary (Corona & Armour, 2007; Kelly-Jackson & Delacruz, 2014; Hansen, 2006; Kim & Linan-Thompson, 2013; Luykx & Lee, 2007; Soto et al., 2013). Therefore, ELLs can actively demonstrate the academic content and vocabulary by using actions (Hill, 2016; Seyyed & Malekpur, 2015; Watson, 2004; Wright, 2016; Zheng, 2012) or musical songs or chants (Wright, 2016). Finally, ELLs should be able to visualize the finished written or oral products (Robertson, 2016).

Besides concrete examples or materials, ELLs need visuals to effectively learn vocabulary words (Armon & Morris, 2008; Corona & Armour, 2007; DeLuca, 2010; Hansen, 2006; Hill, 2016; Kelly-Jackson & Delacruz, 2014; Lee et al., 2008; Manyak & Bauer, 2009; McDonnough & Cho, 2009; Medina-Jerez et al., 2007; Watson, 2004). In fact, visuals help ELLs reduce the amount of memory needed to learn vocabulary words (Gorman, 2012) and scaffold the vocabulary learning for ELLs (Best et al., 2006). Drawings, which can be hand-drawn by students (Hansen, 2006), can act as visuals (Armon & Morris, 2008; Cohen & Johnson,

2012; Corona & Armour, 2007; Dockrell et al., 2007; Kelly-Jackson & Delacruz, 2014; Manyak & Bauer, 2009; Watson, 2004) to illustrate the vocabulary word's definition (Corona & Armour, 2007; Hansen, 2006). For example, students can complete art projects to illustrate the ELL's vocabulary understanding (Kelly-Jackson & Delacruz, 2014). In addition, teachers can place posters with charts (Luykx & Lee, 2007; Manyak & Bauer, 2009; Taboada & Rutherford, 2011; Wright, 2016), graphs (Luykx & Lee, 2007; Manyak & Bauer, 2009), or diagrams (Luykx & Lee, 2007; Watson, 2004) throughout the classroom as a reference for ELLs.

Continual interaction and multiple encounters with vocabulary words are important for ELLs. Overall, multi-sensory interaction, such as visuals, real objects, and gestures, etc. (Méndez et al., 2015), for ELLs helps improve their learning (Husty & Jackson, 2008; Manyak & Bauer, 2009). All ELLs, regardless of English language abilities, can learn (Case, 2016), especially vocabulary, as well as increase the English spoken and written abilities (Medina-Jerez et al., 2007). Then ELLs need repeated opportunities to practice the vocabulary words (Cohen & Johnson, 2012; Méndez et al., 2015; Naeimi & Foo, 2015; Nowbakht et al., 2015; Robertson, 2016) as well as their definitions and context, which could be done through activities or games (Corona & Armour, 2007; Taboada & Rutherford, 2011), over time to improve the vocabulary words (Robertson, 2016). Multiple repeated learning opportunities, including review (DeLuca, 2010; Kim & Linan-Thompson, 2013; Tucker, 2016), allows ELLs to be actively involved by practicing the vocabulary words and their definitions (Corona & Armour, 2007; Tucker, 2016).

In today's society, technology is an integral component to include when teaching ELLs (Massery, 2013; McDonnough & Cho, 2009; Seyyed & Malekpur, 2015) and can even be individualized for each ELL (Tucker, 2016) based on language abilities (Medina-Jerez et al., 2007). ELLs can use computers (Gorman, 2012) and computer programs (Hansen, 2006;

Tucker, 2016). The Internet offers many options to learn (Kelly-Jackson & Delacruz, 2014), such as YouTube (Robertson, 2016; Tucker, 2016), online activities and games (Medina-Jerez et al., 2007) Google, Google Translate, and Google Images (Case, 2016). However, the ELL can find academic content and explanation in the ELL's primary language online (Medina-Jerez et al., 2007). Videos can be used to help the ELL learn vocabulary (Case, 2016; Dockrell, et al., 2007; Hansen, 2006; Kelly-Jackson & Delacruz, 2014), and ELLs can replay videos multiple times (Tucker, 2016). In addition, recordings (Robertson, 2016) as well as audio and text-to speech programs can benefit ELLs (Medina-Jerez et al., 2007).

Word Wall with Images

Marzano, Pickering, and Pollock (2001) summarized Paivio (1969, 1970, and 1990) regarding the dual coding theory, which states that knowledge utilizes both a linguistic form, such as the written word and the spoken word, as well as a non-linguistic form, such as imagery. Imagery plays a vital role in helping an ELL to open a door to a second language, which is based in the written and spoken word (Kelly-Jackson & Delacruz, 2014). Imagery helps the ELL to elaborate knowledge (Hill & Flynn, 2006), which enables the ability to recall and acquire the vocabulary (Cohen & Johnson, 2012; Kelly-Jackson & Delacruz, 2014). Imagery allows the ELL to use less memory to remember the vocabulary word and its definition (Gorman, 2012). Concrete words are easier to depict with imagery for ELLs. Therefore, teachers should use imagery, especially during science, while teaching ELLs to learn and understand new concepts as well as vocabulary words and their definitions (Cohen & Johnson, 2012; McDonnough & Cho, 2009). DeLuca (2010) noted that the combination of an image and a vocabulary word provides the teacher with an accurate assessment of the ELL's understanding. Then the teacher can correct any misunderstandings associated with the vocabulary word and its definition. In

fact, Husty and Jackson (2008) noted that every student, including ELLs, effectively learned science vocabulary words through multi-sensory instruction utilizing context.

By using imagery, ELLs simultaneously see visual images and form a mental image, constructing a picture in the mind while ignoring any stimulus (Cohen & Johnson, 2012; Marzano et al., 2001). Mental images also allow ELLs to organize knowledge, which helps with recall (Cohen & Johnson, 2012). However, in Zheng's (2012) study at a foreign language school, only 2.4% of teachers had students learn vocabulary by using cards with pictures and the vocabulary word. The use of imagery can help the student's memory and cognitive development to deeply process and organize the information as well as connect the ELL's prior knowledge and experiences. As a result, the ELL can better learn and understand vocabulary as well as definitions in short-term and long-term recall (Cohen & Johnson, 2012).

To incorporate imagery and vocabulary words, teachers can use word walls. Word walls are considered an indirect teaching strategy to help ELLs acquire vocabulary words (Taboada & Rutherford, 2011). Word walls are visual scaffolds (Jackson et al., 2011), which provide the ELL with the vocabulary word and imagery to use as a learning tool in the classroom (Huerta & Jackson, 2010), especially with the subjects for reading, language arts, and science (Jackson et al., 2011). The most effective word walls contain a real item or an image, which provides a concrete example (Armon & Morris, 2008; Chung, 2012). Most importantly, all students, especially ELLs, more effectively developed and acquired vocabulary words in science (Jackson et al., 2011) and developed scientific writing (Armon & Morris, 2008; Kelly-Jackson & Delacruz, 2014) and discussion (Kelly-Jackson & Delacruz, 2014). However, Taboada and Rutherford (2011) noted that vocabulary learned by indirect learning, such as a word wall, was only short-term instead of long-term retention and recall.

Word walls utilize two non-linguistic forms of learning, which are imagery as well as graphic organizers. Graphic organizers organize knowledge to help ELLs make difficult academic content into a more understandable representation (Hill & Flynn, 2006; Marzano et al., 2001). By using the idea of a graphic organizer, the ELL can elaborate knowledge due to the use of imagery depicting the vocabulary word's definitions (Marzano et al., 2001). Specifically, the word wall utilizes a form of graphic organizer known as a semantic or concept map. A semantic map emphasizes and organizes the most important concepts by non-linguistically displaying relationships. Semantic maps help students, especially ELLs, develop vocabulary, use oral speaking skills, and expose background knowledge and experience (DeLuca, 2010; Dong, 2013; Husty & Jackson, 2008; Jackson et al., 2011; McDonnough & Cho, 2009). By exposing the ELL's background knowledge and experience, the teacher can detect any misconceptions or missing aspects of the ELL's knowledge and individualize the vocabulary teaching. As a result, the teacher can help the ELL connect the ELL's prior knowledge (Dockrell et al., 2007; Dong, 2013; Honnert & Bozan, 2005; Lee et al., 2008; Lee et al., 2007; Luykx & Lee, 2007; McDonnough & Cho, 2009; Medina-Jerez et al., 2007; Nabors & Edwards, 2011; Nowbakht et al., 2015) and experiences (Chung, 2012; Gottschalk, 2016; Hansen, 2006; Honnert & Bozan, 2005; Lee et al., 2007; Luykx & Lee, 2007; Nabors & Edwards, 2011) to the new vocabulary words (Dong, 2013).

Instead of the teacher only teaching ELLs the vocabulary words and definitions, word walls allow ELLs to become more involved in learning vocabulary. ELLs can share prior experiences and knowledge, discuss relationships, write words and definitions, and draw pictures, which elaborates the ELL's knowledge and increases interest and motivation to learn the English language as well as academic content (Huerta & Jackson, 2010; Jackson et al., 2011;

Kelly-Jackson & Delacruz, 2014; Marzano et al., 2001; Zheng, 2012). Most importantly, students can become autonomous learners (Taboada & Rutherford, 2011). Specifically, the interactive word wall allowed ELLs to be autonomous while working on assignments and labs and readily using the word wall to help with the vocabulary instead of being reliant on the teacher (Jackson et al., 2011). Most importantly, word walls help ELLs develop vocabulary and the English language by providing input, which are the science vocabulary words, discussing vocabulary words and their meanings with peers and the teacher using the word wall, as well as output, such as thinking, writing, and discussing like scientists (Kelly-Jackson & Delacruz, 2014; Pray & Monhardt, 2009).

Several different types of word walls can be used in the classroom to help ELLs learn vocabulary words. The first type of word wall is known as a working word wall, which is also known as living word wall. The working word wall is an effective strategy to help ELLs learn vocabulary words. The teacher and ELLs can collaborate to create the word wall with real items (Hill & Flynn, 2006; Huerta & Jackson, 2010). Throughout the classroom discussion, students can use the working word wall to answer close-ended and open-ended questions while learning the vocabulary to better understand the English language and science concepts (Huerta & Jackson, 2010).

The second type of word wall is a bag and tag word wall, which employs semantic maps. ELLs can interact with bag and tag word wall because this wall has a real item, which can be smelled, touched, heard, or seen, contained in a bag. Additionally, the tag is the vocabulary word. The teacher can include the vocabulary word's definition, but it is not necessary. Students can participate by providing the real items, writing the vocabulary word, and even sharing connections between the vocabulary words on the word wall (Husty & Jackson, 2008).

When the ELL makes meaningful connections, then the ELL's vocabulary knowledge can increase (Corona & Armour, 2007). The bag and tag word wall is interactive for all ELLs regardless of language ability, as each ELL can actually touch, see, smell, and even hear the item. As a result, the ELL is more likely to create a continuous, deeper, and more meaningful connection to learn the vocabulary word. Overall, the bag and tag word wall is an effective strategy to use when teaching inquiry-based science as well as science vocabulary words and concepts to ELLs (Husty & Jackson, 2008).

The third type of word wall is an interactive word wall, which represents an entire unit and its lessons. This type of word wall displays the label for the vocabulary word as well as a visual representation of the vocabulary word's definition. However, the definition is an optional feature in an interactive word wall. The vocabulary label and visual representation are displayed in an organized and meaningful setup. As a result, ELLs can process the vocabulary word with a deeper understanding to acquire the vocabulary word and its definition. Furthermore, all students, including ELLs, scored higher on high-stakes tests after continually using interactive word walls and meaningfully engaging with science vocabulary words on interactive word walls (Jackson et al., 2011).

Setting up a word wall is comprised of six steps. The first three steps involve the importance of selecting the unit's vocabulary words, which contain high-frequency words and academic content vocabulary, to be learned by the ELLs. First, the teacher needs to identify the most important vocabulary words to be learned within the unit (Jackson et al., 2011; McDonnough & Cho, 2009). Next, the teacher needs to compare the vocabulary words to the district's science curriculum. Then the teacher selects the unit's vocabulary words that align with the district's curriculum (Jackson et al., 2011).

In the fourth step, the teacher locates the images or real items to use that match the selected unit's vocabulary words. The goal is to help the ELL have a visual representation of the unit's vocabulary words and their definitions (Jackson et al., 2011; Manyak & Bauer, 2009). Real items or color photographs are more effective to help ELLs learn the vocabulary words and their definitions (Manyak & Bauer, 2009; McDonnough & Cho, 2009; Pray & Monhardt, 2009). Therefore, the teacher should not choose clip art or drawings. A very descriptive photograph could potentially cause problems for the ELL to remember or confuse the vocabulary word's definition (Jackson et al., 2011) because ELLs use the image to understand and remember the vocabulary word. Furthermore, photographs can allow ELLs to see the vocabulary word within a real life context (Kelly-Jackson & Delacruz, 2014) and illustrate a variety of definitions (Chung, 2012).

During the fifth step, the teacher designs the word wall as a concept map, similar to a graphic organizer, with the relationships evident among the unit's vocabulary words (Jackson et al., 2011). This design allows the word wall to be more effective (Manyak & Bauer, 2009). Within the designing of the word wall, the vocabulary word's image will be placed by the vocabulary word. As a result, the teacher has supported the ELL's vocabulary development and built the ELL's schema due to the organization of the unit's vocabulary words and images by illustrating connections (Jackson et al., 2011). Vocabulary words must be connected not isolated to effectively help the ELL learn the vocabulary words (Zheng, 2012).

The final step has ELLs build the word wall with the teacher. There are many ways to set up the word wall, but the teacher plans the setup in the fifth step (Jackson et al., 2011). Most importantly, this final step allows both the teacher and ELLs to be a part of the learning process (Huerta & Jackson, 2010; Husty & Jackson, 2008; Jackson et al., 2011). The teacher has the

flexibility to build the word wall at different times throughout the classroom instruction. Therefore, the teacher must know when and how to build or change the word wall. The teacher might have students build the wall at the beginning of the unit or throughout the unit (Jackson et al., 2011).

Critics have identified problems with a word wall. First of all, the teacher may not have the resources needed for the word wall (Kelly-Jackson & Delacruz, 2014). Second, the organization of the word wall takes up the most time to figure out the word wall as a concept map. The teacher must also figure out how to best lay out the word wall, especially with images, on a wall, which could be placed on one or several walls or hung from a ceiling. This organization of the word wall can take up a lot of time, but the teacher's planning of the word wall allows the teacher to know how ELLs can be actively involved with the word wall. If the word wall uses images, finding the best image to demonstrate the vocabulary word's meaning can be very time consuming (Jackson et al., 2011). If the students help photograph the images, then the students need a camera, need to know how to use a camera, and be able to capture the proper image (Kelly-Jackson & Delacruz, 2014). Moreover, the teacher can have a harder time with more abstract science concepts than concrete concepts (Jackson et al., 2011) or nouns (Cohen & Johnson, 2012; Daskalovska, 2014). Finally, teachers must remember to cover the word wall when proctoring any quiz or test; otherwise, the data is compromised (Jackson et al., 2011).

Even with all the challenges of a WWwI, most students and teachers prefer to have a WWwI in the classroom. Most importantly, students are able to visualize and refer to the vocabulary words and their images many times, such as assignments, labs, and discussions, throughout the day, which results in acquiring the vocabulary word and its definition (Cohen &

Johnson, 2012; Jackson et al., 2011; Kelly-Jackson & Delacruz, 2014). Likewise, the use of images or real items allows the student to be actively and personally engaged with the vocabulary word, especially science vocabulary, and remember the definition with a visual image (Jackson et al., 2011; Kelly-Jackson & Delacruz, 2014). In fact, all students, especially ELLs, can benefit from using a WWwI in the classroom. In addition, if a student is able to create an image or provide a real item, then the student is part of the instruction instead of the teacher only directing instruction. Most importantly, the organization of the word wall illustrates the connections among the vocabulary words, which deepens understanding of the vocabulary words and the English language (Jackson et al., 2011; Pray & Monhardt, 2009). By organizing the WWwI, the teacher can effectively organize the unit and lessons with the vocabulary words as well as visuals for the students (Jackson et al., 2011; McDonnough & Cho, 2009).

Chapter 3: Methodology

This applied research project focused on implementing a WWwI to evaluate whether elementary-aged ELLs were able to more effectively learn science vocabulary words due to the necessity of learning science concepts and vocabulary to take standardized tests.

Population of the Study

After Cedarville University's Institutional Review Board and this public school district's Institutional Review Board approved my applied research project, I met with the principal of the elementary school to discuss the research proposal. Then I discussed the applied research project with both ELL teachers, Ms. A. and Ms. B., who taught at this elementary school. My research focused on ELLs attending this elementary school within a public suburban school district in Missouri. Each ELL's parent or legal guardian received an informed consent form to sign and return to allow the ELL to participate in the applied research project. The ELLs themselves also gave verbal assent to participate in the applied research project. To provide confidentiality for participants of this applied research project, I assigned each ELL a random number in order to conduct random sampling.

For the purpose of this applied research project, I focused on an ELL pull out program comprised of 49 ELLs enrolled in first grade through fifth grade. First grade and second grade had 13 students in each ELL class. Third grade and fourth grade consisted of two ELLs in each class. Four ELLs from fifth grade participated (see Table 1). Six ELLs in the program did not return the informed consent forms, and nine ELLs had participated in the pilot study during May 2016. I removed these 15 ELLs from participation in this applied research project. Therefore, I collected data from 34 ELLs during this applied research project, which took place in the fall of 2016. This specific group of ELLs who participated in the applied research project was very

diverse, representing varying English language skills and abilities. Nine different ethnicities were also included: American, Bosnian, Cameroonian, Ethiopian, Indian, Micronesian, Nepalese, Somali, and Sudanese (see Table 2). Twelve different languages were spoken among the ELLs: Afran Oromo, Amharic, Bosnian, Chuukese, Ejaghem, English, Nepali, Oromo, Somali, Sudanese, Tigrigna, and Urdu (see Table 3). Sixteen male students and 18 female students participated in this applied research project (see Table 4). Of all the ELLs participating in this applied research project, 82% were on free and reduced lunch statuses, suggesting a lower SES.

Design of the Study

I used the following research question to guide this applied research project: Is there a relationship between the vocabulary instructional strategy of a WWwI and the science vocabulary acquisition for ELLs? For the null hypothesis, there will be no difference in the means for the experimental condition of ELLs using the WWwI and the control condition taught without the WWwI to learn the science unit's vocabulary words, as assessed by a paired t-test analysis with an alpha level of significance of 0.05.

This quantitative, pre-test post-test control condition study was implemented in order to evaluate the effectiveness of using the science unit's vocabulary words in a WWwI to help ELLs. The control condition was made up of the same group of ELLs as the experimental condition, with the ELLs learning a science unit with the benefit of the WWwI. (For clarity, "control condition" refers to the unit of science instruction without the WWwI; "experimental condition" refers to the unit of science instruction implemented with the WWwI.) I collected pre-tests and post-tests from the control condition, which did not include the independent variable, as well as pre-tests and post-tests from the experimental condition, which used the WWwI (Johnson & Christensen, 2008). The experimental condition unit's pre-test was taken before the intervention,

and the experimental condition unit's post-test followed the intervention of the WWwI. The independent variable was the WWwI. This learning strategy was used to teach science vocabulary throughout a specific science unit. The total applied research project covering both science units took about six weeks to complete. The dependent variable was the ELL's learning, which was demonstrated through two pre-tests, two post-tests, and a post-intervention Likert scale questionnaire from each ELL.

Procedure

The intervention method for evaluating the WWwI for science vocabulary words involved multiple steps (see Appendix A). First, the control condition took a multiple choice pre-test over the control condition's science unit's selected science vocabulary (see Appendix B). This initial pre-test did not include a WWwI. Then the ELL teacher and ELLs looked over the vocabulary words in their textbooks. Next, the ELLs wrote the vocabulary words on "Powerful Words," (see Appendix C) a vocabulary graphic organizer. This specific vocabulary graphic organizer included the vocabulary word, a student-friendly definition, and student drawing. To practice the vocabulary words, the ELLs completed Quizlet activities of matching and spelling as well as several games and drills. Additionally, the teacher and the ELLs read a story from a basal reader, which included all of the unit's vocabulary words. After practicing the words, the students received a writing prompt using the key vocabulary words. After three weeks, each ELL took a multiple choice post-test (see Appendix D) over the control condition's science unit's selected science, which did not include the intervention. A comparison of the control condition pre-test and post-test scores provided a baseline to test the effectiveness of the independent variable.

With the experimental condition's unit, the steps were similar, except for the intervention

of a WWwI (see Appendix A). First, each ELL took a multiple choice pre-test over the selected vocabulary words from the experimental condition's science unit (see Appendix E). At this point, the teacher introduced the vocabulary along with images to add to the word wall—the intervention (see Figure 1). Next, the ELLs wrote the vocabulary word, wrote a student-friendly definition, and drew a hand-drawn image on the "Powerful Words" graphic organizer. Then the ELLs completed Quizlet activities of matching and spelling as well as games and drills. Additionally, the ELLs read a story from a basal reader that included all the vocabulary words. To practice the words in writing, the ELLs composed a writing selection using vocabulary words based on a writing prompt. When the experimental condition's science unit was completed after three weeks, each ELL took the multiple choice post-test (see Appendix F). Comparing the differences in scores between the pre-test and post-test allowed me to evaluate whether the ELL had learned the science vocabulary words better with the help of a WWwI, the independent variable.

By adding the vocabulary word and image to the word wall, the teacher and ELLs could discuss each vocabulary word independently or relationally as a part of the collection of words comprising the unit. As the ELL teacher continued to weave the vocabulary words throughout the experimental condition's lessons and activities, ELLs were able to view the words and their images on the word wall numerous times over an extended period of time. It was hoped that the applied research project's outcome would allow the experimental condition members to be able to create deeper meaning and understanding of the science vocabulary due to the variety of opportunities of exposure, especially from the WWwI. As a result, ELLs would be able to recall and retain the vocabulary words, spell them, and write a paragraph using the words.

In order to do statistical analysis, I chose to use a paired t-test analysis. A paired t-test

analysis allowed me, the statistician, to compare homogenous groups of individuals (Morrell & Carroll, 2010). With this applied research project, the paired t-test analysis enabled me to compare scores of the control condition pre-tests and post-tests without the WWwI to the experimental condition pre-tests and post-tests with the WWwI. As a result, I could evaluate whether the intervention was effective for this group of ELLs.

As the final step for this applied research project, I obtained the ELLs' perceptions on the effectiveness of using the WWwI by having the ELLs complete a brief post-intervention questionnaire (see Appendix G) which used a Likert scale with five choices ranging from strongly agree to strongly disagree. This questionnaire also allowed me to evaluate the ELLs' perceptions about science, the importance of science vocabulary, and the use of a WWwI.

Pilot study. I conducted a partial pilot study, which made use of the experimental portion of the study and included 12 ELLs enrolled in second grade, third grade, and fourth grade. The ethnicities of the study participants included in the partial pilot study consisted of American, Ethiopian, Micronesian, Somali, Taiwanese, and Vietnamese (see Table 5). The ELLs possessed diverse English language skills and abilities including six different primary language languages, consisting of Amharic, Chuukese, Oromo, Somali, Taiwanese, and Vietnamese (see Table 6). Eight males and four females participated in this partial pilot study (see Table 7).

Because the partial pilot study only included the experimental condition, I made some important modifications for the research portion of this project that were implemented in fall of 2016. The pilot study confirmed the need to create a control condition and collect both the experimental condition’s and control condition’s pre-test scores and post-test scores to evaluate the effectiveness of the WWwI.

Second, only one ELL teacher was included in the partial pilot study. In order to obtain a larger sample size, I decided to include two ELL teachers, Ms. A. and Ms. B. Because two ELL teachers were involved in the applied research project, I wrote detailed procedures to follow (see Appendix A), which were similarly implemented throughout the pilot study. Additionally, I wanted to include more ELLs to incorporate more diversity of English language skills and abilities, ethnicities, and primary languages. Therefore, I included the ELLs enrolled in first grade through fifth grade in the public elementary school's ELL pull out program.

Finally, I was careful to choose straightforward, clear images to use with the vocabulary word on the word wall. Some of the science vocabulary words were very abstract, so time and patience were required to find the appropriate and uncomplicated image for each vocabulary word in the unit. If the vocabulary word's image was too elaborate, then the word and its definition could be misunderstood or misinterpreted by the study participants.

Data collection method. Regarding data collection in this applied research project, I collected five pieces of quantitative data. The first and second pieces of data were the control condition's unit pre-test and post-test scores, which did not include the intervention of the WWwI. The third and fourth pieces of data collected were the experimental condition's pre-test and post-test scores, which included the intervention. The last piece of data collected was the post-intervention questionnaire, which was completed by each ELL after the experimental condition's unit post-test.

Relevant ethical considerations. The ELLs participating in this applied research project experienced no physical, mental, or emotional harm. A parent or legal guardian of each student participant signed an informed consent form. The ELLs also gave verbal assent to participate in this applied research project. In addition, all of the ELLs' data was kept confidential.

Independent variable. The independent variable for this applied research project was the intervention of the WWwI. The applied research project was implemented by two ELL teachers teaching first grade through fifth grade ELLs, which allowed me to test the independent variable of a WWwI. Furthermore, the ELLs completed baseline pre-tests and post-tests of the control condition's science unit vocabulary words without the independent variable. Then the students completed pre-tests and post-tests of the experimental condition's unit vocabulary words learned with the help of a WWwI. I also assessed the ELLs' perceptions of science, the importance of science vocabulary, and the WWwI, the intervention, by having the ELLs complete a Likert scale questionnaire.

Methods of data analysis. By completing a pre-test and a post-test in the experimental condition's science unit with a WWwI, I was able to compare the control condition's unit pre-test and post-test scores with the experimental condition's unit pre-test and post-test scores. For each unit, I gathered the pre-test and post-test scores from both the control and experimental condition's science units and then completed a paired t-test analysis for the same research participants (Johnson & Christensen, 2008; Morrell & Carroll, 2010) in Excel to compare the means of the pre-test and the post-test to reach a more valid conclusion about the effectiveness of the intervention. Next, I used the control condition's pre-test and post-test scores to perform a paired t-test analysis to compare the means of the control condition's pre-test and the post-test scores, which acted as the baseline to compare with the means from the experimental condition's pre-test and post-test scores. Then I completed a paired t-test analysis for the mean of the experimental condition's pre-test and post-test scores. Being able to evaluate whether there was a difference between the means of the control condition and experimental condition helped me assess the effectiveness of using a WWwI as an instructional strategy to teach science vocabulary

words to these ELLs. In addition, I checked the significance level by using the alpha level of 0.05. In order to evaluate whether the intervention helped the students learn the science vocabulary, the difference between the test means of the control condition and the experimental condition should show a positive difference with a significance level showing the *p* value less than the alpha level of 0.05. If the WWwI did not help the ELLs learn the science vocabulary, then the difference between the means of the control condition's and experimental condition's unit tests should indicate a negative difference and indicate a significance level with the *p* value greater than the alpha level of 0.05.

For data analysis of the post-intervention questionnaire, I collected the data from each question and recorded that data in Excel to create a bar chart. Next, I summarized the data using the mode for each question. This data analysis process allowed me to see and evaluate the ELLs' perceptions about using a WWwI to learn vocabulary and science vocabulary.

Safeguards to internal and external validity. Validity was important to consider with this applied research project. I took several measures to help with internal validity. For problems regarding history, I removed the ELLs who had participated in the partial pilot study. Regarding the instrumentation's validity, I used National Geographic's *Reach* pre-tests and post-tests for each grade level. As a result, each grade level took similar and consistent pre-tests and post-tests. As to external validity, I took precautions with the selection of participants for this applied research project. The ELL participants in this applied research project were representative of the ELLs who attended the elementary school within the public suburban school district. In addition, the pre-tests and post-tests were collected and then stored separately in a labeled folder. I recorded the pre-test scores and the post-test scores in Excel, but I performed the analysis of the data at a later date. Most importantly, the confidentiality of ELLs

was ensured through random sampling for the data. Finally, two ELL teachers completed the applied research project but with similar methodological procedural steps. Therefore, this applied research project could potentially be generalizable for other ELL classrooms using a WWwI, but this applied research project primarily evaluated if this specific group of ELLs enrolled in the public suburban elementary school's pull out ELL program benefitted by using a WWwI to acquire scientific vocabulary.

Chapter 4: Results and Analysis

Overview

This applied research project sought to evaluate the effectiveness of using a WWwI for ELLs as a successful learning strategy to acquire science vocabulary words. The research question to guide this applied research project was: Is there a relationship between the vocabulary instructional strategy of a WWwI and the science vocabulary acquisition for ELLs? The WWwI was implemented to hopefully help a group of ELLs more effectively acquire science vocabulary words. The methods for achieving this goal and measuring the success of this learning intervention involved having the students complete a unit pre-test, lessons, activities, and post-test as a control condition and then completing another unit (a unit with new material) pre-test, lessons, activities, and post-test as an experimental condition. After completing a paired t-test analysis, the quantitative results of the comparison for the control condition and the experimental condition indicated statistical significance for the control condition as well as the experimental condition. A positive increase in the mean between the pre-test and post-test was noticed with the ELLs learning science vocabulary words without a WWwI as well as with a WWwI, which saw the greater increase between the pre-test and the post-test. However, the greater mean achieved on the unit post-test was noted with the ELLs in the control condition not using the WWwI.

I used a post-intervention questionnaire to obtain the ELL's perceptions regarding science, the importance of science vocabulary, and the WWwI, which was vital to better understand whether the WWwI was an effective learning strategy for ELLs to acquire science vocabulary words. Based on the questionnaire's results, the majority of ELLs liked learning science and thought science vocabulary words were important to know; although, only half of

the ELLs thought they did well in science and thought science vocabulary words were easy to learn. Most importantly, the majority of ELLs believed the images on the word wall helped them to learn the science vocabulary words; although, only half of the ELLs thought the WWwI helped them to learn the science vocabulary words. In conclusion, most of the ELLs viewed the WWwI as a favorable means for acquiring the science vocabulary words.

Intervention Effects: Data, Analysis, and Perceptions

Both the control condition and the experimental condition of ELLs took the National Geographic's *Reach* pre-test and post-test for each unit to evaluate the acquisition of the science unit's vocabulary words. Each unit's pre-tests and post-tests were similar and required the ELLs to know each science vocabulary word and its definition covered throughout the unit. For data analysis, I used a paired t-test analysis to compare the control condition's pre-test and post-test without a WWwI and then the experimental condition's pre-test and post-test with a WWwI. I also formulated more descriptive statistics to complete further data analysis. The intervention of the WWwI positively affected the ELLs' acquisition of the science vocabulary words by achieving the greater increase; however, the ELLs were still able to achieve a positive increase between the pre-test and post-test and a greater mean on the post-test without the intervention (see Table 8).

Overall, the ELLs had favorable perceptions about the WWwI as it helped them to learn the science vocabulary words and their definitions. The questionnaire's results support the positive effect of the WWwI to help the ELLs acquire the science vocabulary words. Additionally in an informal conversation, both Ms. A and Ms. B, the ELL teachers, noted that the ELLs referred to the WWwI on their own to increase learning, quickly made connections

with the vocabulary and other related words, and improved in the vocabulary word's spelling and writing.

Intervention Comparison: Data, Analysis, and Perceptions

Control condition without the word wall with images. The mean for the control condition's pre-test was 83.56% and post-test was 91.06%. There was a slight positive increase of 7.5% for the control condition taking the unit's pre-test and completing the post-test three weeks later than the experimental condition. The standard deviation was 20.56 for the pre-test and 11.65 for the post-test. In addition, the control condition of ELLs was able to achieve a smaller standard deviation on the unit post-test (see Table 9). Overall, the quantitative results indicate that the control condition consisting of 34 ELLs was able to slightly improve the test scores and achieve the greater average earned for the post-test when compared to the experimental condition's post-test average.

Experimental condition with word wall with images. The experimental condition of ELLs achieved a mean of 78.24% for the pre-test and 90.15% for the post-test. This experimental condition achieved the higher increase for the means of 11.91% between the pre-test and post-test than the control condition. However, these ELLs did not earn the higher mean for the unit's post-test; the group without the WWwI earned the higher mean. Concerning the standard deviation, the pre-test was 22.00, and the post-test was 13.64 (see Table 10). Overall, the experimental condition experienced a higher, positive increase of the means between the unit's pre-test and the post-test (see Figures 2 and 3) even though the experimental condition's post-test score was slightly less than the control condition's post-test score (see Table 1).

ELLs' perception of the word wall with images. The questionnaire revealed important information concerning the ELLs' perceptions about science, the importance of science

vocabulary, and the WWwI (see Figure 4). For the first question, 28 ELLs (82.35%) stated they strongly agreed that they liked learning science. With the second question, 19 ELLs (55.88%) strongly agreed that they thought they did well in science class. Questions three and four discussed the ELLs' perceptions of science vocabulary words. Twenty-four ELLs (70.59%) strongly agreed that science vocabulary words were important to know. Then 16 ELLs (47.06%) indicated they strongly agreed science vocabulary words were easy to learn. Finally, the last three questions evaluated the ELLs' perceptions regarding the WWwI. In fact, 21 ELLs (61.76%) strongly agreed the WWwI helped them learn the science definitions better. Twenty-one ELLs (61.76%) also strongly agreed that the images on the word wall helped the ELLs learn the science vocabulary words. However, only 12 ELLs (35.29%) strongly agreed that they learned the science vocabulary words better without a word wall. On the other hand, 15 ELLs (44.12%) strongly disagreed that science vocabulary words were better to learn without a WWwI.

Summary of Findings

The control condition of ELLs was given the science unit's vocabulary pre-test, which required each student to match the science vocabulary words to their definitions. Then the students completed the unit's lessons and activities. After three weeks, the control condition of ELLs completed the unit post-test by matching the science vocabulary words to their definitions.

Before any introduction of the intervention of the WWwI for the experimental condition, the ELLs took the science unit's vocabulary pre-test by matching the unit's science vocabulary words to their definitions. Next, all the ELLs were able to discuss the unit's vocabulary words as well as their relationships using the WWwI throughout the unit's lessons and activities. After

three weeks, the ELLs took the unit post-test that required the ELL to match the science vocabulary words to their definitions.

For data analysis, I used the paired t-test analysis. I conducted a paired t-test analysis to compare the control condition's pre-test and post-test. Additionally, I conducted a paired t-test analysis to compare the experimental condition's pre-test and post-test. Then I compared the results of the control condition and experimental condition to evaluate the effectiveness of the WWwI. For both groups, statistical significance was indicated based upon the results of the paired t-test analyses. The means of both the experimental condition and control condition of ELLs achieved a positive increase between the unit pre-test and post-test. The greater mean difference between the unit pre-test and post-test was exhibited by the experimental condition of ELLs using the WWwI; however, the control condition without the WWwI had the greater overall mean achieved on the post-test. Therefore, the WWwI was an effective, supplemental learning strategy; however, it did not help the ELLs achieve the greater mean on the post-test, which was actually higher for the control condition's post-test.

Finally, the quantitative results from the post-intervention questionnaire further indicated that ELLs enjoyed utilizing the WWwI throughout the science unit, which helped improve the ELLs' acquisition of science vocabulary words and their definitions, usage, spelling, and writing. Additionally, ELLs liked learning science but do not think they did well in science class. However, ELLs believed science vocabulary words were important to learn but hard to learn. Overall, these results indicate the WWwI was an effective learning strategy due to the use of images on the word wall to help this specific group of ELLs' acquisition of science vocabulary words.

Chapter 5: Discussion and Implications

Vocabulary development is of pivotal importance to the advancement of ELL language acquisition and skills (Fisher & Frey, 2016; Nowbakht et al., 2015; Umansky et al., 2016. Scientific vocabulary is particularly important because the acquisition of these skills and terminology is paramount for all students to pass required standardized tests and to be successful in school and later in life (Calderón, Slavin, & Sánchez, 2011; Scherer, 2016). Based on these assertions, the purpose of this applied research project was to explore the relationship of a WWwI as a learning strategy for the acquisition of science vocabulary words for ELLs. The research question for this project was: "Is there a relationship between the vocabulary instructional strategy of a WWwI and the science vocabulary acquisition for ELLs?", and the results of this applied research project rejected the null hypothesis and showed that the research question can be answered with "yes." According to quantitative data presented, the WWwI was a beneficial, supplemental learning strategy to effectively teach science vocabulary for this group of ELLs. Yet, the data does not demonstrate that the WWwI was more beneficial than the activities and other lessons used with the control condition. However, data suggests that ELLs valued the images placed on the word wall with the vocabulary words according to the results of the post-intervention questionnaire.

Interpretation of the Results

Control condition without the word wall with images. After completing the paired t-test analysis, the quantitative data analysis showed statistical significance between the control condition's pre-test and post-test scores with the *p* value at 0.004. The statistical significance was determined by using a two-tailed distribution, and 0.004 was less than the alpha level of 0.05 ($p < 0.05$). Additionally, I used the means from both the pre-test (83.56%) and the post-test

(91.06%) to determine the difference between the control condition's pre-test and post-test means, which indicated a positive increase of 7.5%. The control condition achieved the higher mean on the post-test. Consequently, the ELL teacher's routine science lessons and activities are beneficial to help ELLs learn the necessary science vocabulary

Moreover, the difference for the standard deviation between the pre-test (20.56) and post-test (11.65) for the control condition indicated a decrease of 8.91, which meant the ELL's post-test scores were less spread out than the pre-test scores. Due to the standard deviation of 11.65 for the post-test, some variability still existed. Overall, the control condition still improved in learning the science vocabulary words throughout the science unit without the WWwI and also achieved the greater mean on the post-test.

Experimental condition with word wall with images. Upon completion of the paired t-test analysis, the experimental condition experienced statistical significance between the unit pre-test and post-test. Using the two-tailed distribution for the *p* value, the experimental condition *p* value was 0.0001, which was significantly less than the alpha level of 0.05 ($p < 0.05$). Additionally, the means from the experimental condition's pre-test (78.24%) and post-test (90.15%) were used to determine the positive difference of 11.91%. Therefore, the experimental condition experienced the greater, positive increase of mean scores between the pre-test and post-test, which would indicate that the WWwI was a beneficial learning strategy for this specific group of ELLs.

Finally, the standard deviation saw a decrease between the experimental condition's pre-test (22.00) and post-test (13.64) and amounted to a difference of 8.36. Therefore, the experimental condition had the lesser difference with the standard deviation between the pre-test and post-test. Yet, the standard deviation for the post-test indicated some variability, which

could potentially be related to the vocabulary words' complexity or the difficulty of content within the scientific unit. Based on the quantitative data analysis for the experimental condition of ELLs, the WWwI can be considered an effective learning strategy.

Comparison of control condition and experimental condition. The differences in pre-test and post-test means were statistically significant for both the control condition and the experimental condition since the *p* value for each group was less than the alpha level of 0.05 ($p < 0.05$). Therefore, the results of the WWwI's use could potentially help other ELLs acquire science vocabulary.

When comparing the means for the control condition and experimental condition, several factors are important to consider. First, the control condition achieved the higher mean of 91.06% on the post-test, and the experimental condition only achieved the mean of 90.15% on the post-test. As a result, the experimental condition's post-test mean was 0.91% less than the control condition's mean on the post-test. The negative difference on the post-test for the experimental condition could be related to the experimental condition encountering more difficult words or more abstract content throughout the science unit. Most importantly, the control condition only earned a positive increase of 7.5% for the mean between the pre-test and post-test, while the experimental condition achieved the greater, positive increase of 11.91% for the mean between the pre-test and post-test (see Tables 9 and 10). Hence, the WWwI can still be considered a beneficial, supplemental learning strategy to help ELLs acquire the science unit's vocabulary words.

With a decrease of 8.91 for standard deviation, the control condition decreased more from the pre-test to the post-test, while the experimental condition only decreased by 8.36 from the pre-test to the post-test. Yet, the control condition experienced the greater decrease for

standard deviation from the pre-test to post-test. Nevertheless, both the control condition and experimental condition experienced a decrease of standard deviation to indicate the variability lessened from the pre-test to the post-test. On the other hand, the experimental condition's post-test scores were farther spread out at 13.64, and the control condition's post-test scores were less spread out at 11.65. Hence, the experimental condition's post-test demonstrated more variability, which could be related to the experimental condition needing to learn potentially more difficult vocabulary words or more complex scientific content in the unit.

ELLs' perception of the word wall with images. The quantitative data analysis demonstrated in a bar chart (see Figure 4) for the post-intervention question indicated important ELL perceptions concerning science, science vocabulary, and the WWwI. The majority of ELLs liked learning science; however, half of the ELLs only thought they did well in science class. Furthermore, about three-quarters of the ELLs believed science vocabulary words were important to know. Yet, about half of the ELLs thought science vocabulary words were easy to learn, and about a quarter of the participants were unsure if science vocabulary words were easy to learn. Therefore, ELLs want to learn more scientific content, which requires learning scientific vocabulary words, but struggle to learn the scientific concepts due to the fact that vocabulary words can be difficult to acquire and recall for ELLs.

Concerning the WWwI, while the majority of ELLs believed the images on the word wall helped them learn the science unit's vocabulary words. Responses about the WWwI helping ELLs to learn vocabulary words were contradictory. The ELLs shared that the WWwI helped them learn the more abstract vocabulary words. In fact, about half of the ELLs strongly disagreed that the science vocabulary words were easier to learn without a WWwI; however, over a third of the ELLs strongly agreed the science vocabulary words were easier to learn

without a WWwI. These seemingly conflicting opinions could be related to the ELLs encountering different and more difficult science vocabulary words in the control condition from the experimental condition or possibly misinterpreting the questionnaire's statement. Overall, most ELLs preferred the images on the word wall to help acquire the science unit's vocabulary words. ELL responses to survey questions did not reveal a conclusive decision concerning whether the science vocabulary words were easier to learn without or with a WWwI in the classroom.

Relation of the Results to the Literature

With the rise in demand for the implementation of national and state standards as well as required standardized tests, ELLs must encounter effective learning strategies to master science vocabulary. By building up the ELL's understanding of vocabulary words, the ELL student can start to understand the academic content in order to achieve success in the classroom and maintain linguistic proficiency equivalent with English-speaking peers. Additionally, the acquisition of scientific vocabulary allows the ELLs to think, talk, and act like scientists (Cohen & Johnson, 2012; Lee & Buxton, 2011). Specifically, the ELLs participating in this applied research project confirmed that science vocabulary words were important to know and learn, but they can also be challenging to learn, which can hinder the overall learning process. Since the participating ELLs liked learning science, research that examines the benefits of various teaching strategies, such as the WWwI, should continue in order to help ELLs succeed in science and apply its concepts to real life.

The results obtained during this applied research project support the research about word walls and the importance of imagery when teaching science vocabulary to ELLs (Cohen & Johnson, 2012; Jackson et al., 2011; Hill & Flynn, 2006; Jackson et al., 2011). Concerning the

WWwI, the written vocabulary word and imagery, which are based on the dual coding theory (Cohen & Johnson, 2012; Marzano et al., 2001), were present for the ELL to view multiple times as a group or an individual (Kelly-Jackson & Delacruz, 2014). For example, when the ELL instructor was teaching a lesson, discussing relationships among vocabulary words, or completing an activity, the ELLs were able to relate the various vocabulary words and create meaningful connections (Cohen & Johnson, 2012). This helped the ELLs acquire the vocabulary word (Cohen & Johnson, 2012; Gorman, 2012; Hill & Flynn, 2006; Kelly-Jackson & Delacruz, 2014). In addition, the ELLs could view the WWwI to complete an independent task, such as writing or spelling the vocabulary word, by looking directly at the WWwI. Most importantly, the ELLs, regardless of English language ability, were able to participate in the scientific learning process (Case, 2016; Cohen & Johnson, 2012; McDonnough & Cho, 2009). Furthermore, the ELLs confirmed that imagery was important to help learn the vocabulary words. This would also confirm that imagery helps lessen the memory required to acquire the vocabulary and recall it later on the experimental condition's post-test, even though it had a lower mean when compared to the control condition's post-test (Gorman, 2012).

The WWwI had some negative aspects, which correlated with the research. First, the setting up and organization of the WWwI was quite challenging (Jackson et al., 2011). Once I obtained each science unit's vocabulary words, I needed to find a descriptive yet not too elaborate image example. I also tried to ensure each image was culturally relevant with multiple ethnicities represented in all images. Then I cut out and laminated each vocabulary word and its colorful image. This time consuming process required patience and diligence and was even potentially costly from a financial standpoint. Next, I helped each ELL teacher select a location for each grade's WWwI in the ELL classroom. The goal was to ensure the students could make

connections among the unit's vocabulary and hopefully deepen their understanding of the science unit's vocabulary words and their definitions. Regardless of the challenges associated with the WWwI, the images were beneficial in helping the ELLs learn the vocabulary word and their definitions (Jackson et al., 2011; Kelly-Jackson & Delacruz, 2014; Manyak & Bauer, 2009; McDonnough & Cho, 2009; Pray & Monhardt, 2009).

In conclusion, the dual coding theory of linguistic form—the written word—and non-linguistic form—the image—were important to help the ELL acquire the vocabulary word by associating the word and image in order to build meaningful connections. Therefore, the results from this applied research project indicate the WWwI could be a beneficial, supplemental learning strategy to help ELL students learn the vocabulary words with imagery even though the experimental condition did not achieve the higher mean on the unit post-test. Furthermore, the greater positive difference for the mean between the experimental condition's pre-test and post-test mean showed that ELLs could potentially learn and better understand more abstract, scientific terms when a WWwI is accessible and used in the classroom.

Biblical Integrative Component and Implications

ELLs are viewed too often as either economic assets or liabilities for a community. ELLs are unique individuals who have very different needs, strengths, and weaknesses, yet they possess diverse backgrounds, knowledge, culture, language, talents, and abilities. According to Genesis 1:26-28 (English Standard Version), every human being (including each ELL) has inherent value and should be treated with respect because God made man in His own image. As a result, ELLs, even those who are in the early language acquisition stages, should be treated with respect and valued as students who can contribute to the learning process and curriculum. Therefore, every administrator and teacher who interacts and teaches ELLs should ensure that

every ELL and his/her family are accepted, treated with respect and compassion, provided with support, and effectively communicated with as needed.

Within the classroom, ELLs struggle to learn and master the required academic content, which is based on specialized vocabulary words. Therefore, ELL students need highly qualified, understanding, patient, and compassionate teachers who provide them with appropriate and individualized support as well as supplemental materials in order to achieve success in the classroom and outside of school. Additionally, ELLs must experience an engaging and meaningful curriculum by using effective, research-based learning strategies, such as word walls and imagery, in order to best teach them the vocabulary and linguistic skills they need to succeed. Despite lower proficiency in English, ELLs can also meaningfully interact with the academic content, so they can apply the academic content and knowledge in real life and school as well as throughout the ELL's community. By learning the scientific vocabulary and concepts, then the ELL can also learn to interact and communicate with peers, which will aid them as they learn to openly and honestly communicate and relate with others in school and later in life. Most importantly, the teacher should also be willing to help develop each ELL's talents and abilities instead of only focusing on the mastery of academic content and achieving a passing score on a standardized test.

If ELLs are not provided with the appropriate support and learning strategies and supplemental materials, then ELLs are more likely to struggle academically (Soto et al., 2013). These struggles have the potential to even affect their future opportunities in life. If ELLs are not able to learn the academic content and material, then they will continue to struggle acquiring the English language skills and will fail to become linguistically proficient and academically competent when compared to English-speaking peers. Unfortunately, ELLs who are in lower

SES, limited in English, and struggle academically are more likely to drop out of school (Kim, 2011; Scherer, 2016; Sheng, Sheng, & Anderson, 2011; Soto et al., 2013). As noted by Kim (2011), the National Center for Research on Evaluation, Standards, and Student Testing's Report 810 reported 25% of ELLs are more likely to drop out of high school while only 15% of non-ELLs drop out for the years of 2006 through 2008 for an unspecified state. Subsequently, ELLs who drop out of high school attain lower paying jobs, which can eventually result in financial hardship and fewer opportunities in life.

On the other hand, if an ELL can learn and master the academic content and apply it in school, then academic success can be achieved. In addition, the ELL can even apply academic content to real life in order to achieve success after the school years. Then the ELL can also become a stronger individual who not only cares for the family, but also contributes to the community as well. Most importantly, ELLs can benefit and serve the American society and their primary cultures and people groups. Ultimately, ELLs can reach other cultures and people groups to transform them by being ministers of reconciliation (2 Corinthians 5:18-19) and ambassadors of truth (2 Corinthians 5:20).

Strengths of the Study

Several strengths are important to consider for this applied research project. The diversity of ELLs participating in this applied research project was critical because of variations in their ethnicities, primary languages, and genders. The ELLs were also enrolled in first grade through fifth grade levels. Additionally, this applied research project was implemented in a very organized research design (pre-test and post-test control condition) with specified, chronological methodological procedures to be implemented by both ELL teachers of the control and experimental conditions of ELLs. Consequently, this organized setup allowed both ELL teachers

to implement instruction of the science units in a similar, consistent manner to the control and experimental conditions. Most importantly, the only new learning strategy I used in this applied research project was the WWwI for the purpose of acquiring science vocabulary to see if the WWwI was an effective or ineffective learning strategy for ELLs. The rationale for implementing only one learning strategy was to minimize the number of variables at play throughout this applied research project. This allowed me to evaluate the effectiveness of using the independent variable of the WWwI for learning the science vocabulary words. Finally, the use of the paired t-test with the two-tailed distribution for the *p* value indicating statistical significance provided a clear answer to the research question.

Limitations of the Study

Several limitations were involved in this applied research project even though I tried to limit any confounding variables throughout this applied research project. I only collected data from thirty-four elementary ELLs enrolled in first grade through fifth grade; therefore, no ELLs in middle school or high school were included. This applied research project only focused on ELLs who were enrolled in a pull out ELL program funded by the federal and state governments in a public suburban elementary school. This funded educational program provided ELLs with English instruction to learn the English language as well as academic content in an ELL classroom. Since this study was conducted in a public school, ELLs attending international, private, or religious schools were not involved. I also did not include ELLs who were enrolled in bilingual programs to learn English as a foreign language and the academic content in the ELL's native language or English. Finally, the practice effect of the ELLs could challenge the internal validity due to the ELLs taking a pre-test and a post-test as a control condition and then taking a pre-test and a post-test as an experimental condition. Most importantly, the difference in means

between the post-test scores of the control condition and the experimental condition could be attributed to the potential difficulty associated with the experimental condition's science unit's vocabulary words as well as the more abstract academic content, which is a confounding variable. Perhaps the greatest limitation to this applied research project would be the assessment of different unit vocabulary words for each grade level in both the control condition and experimental condition.

Suggestions for Future Research

This applied research project could generate a number of future research studies. First, a future research study could consider the implications of ELLs selecting their own images to use on the word wall in the classroom. In fact, it would be interesting to explore the question of whether ELLs would be able to achieve more meaningful and engaging connections with the image and the vocabulary word by taking an active part of the tool-creation process as opposed to the educator locating the images to use on the word wall in the classroom. So the ELLs could possibly achieve a greater mean on the unit post-test by utilizing a tool designed to assist them in acquiring science vocabulary skills, which they helped create.

Another future research study could evaluate the effectiveness of a word wall in other educational institutions, such as a private, religious, or international schools. These educational institutions could have ELLs enrolled with different motivations for learning, which could influence the research study's outcomes to evaluate the WWwI's effectiveness or ineffectiveness.

A future research study could also consider the use of a WWwI in a bilingual classroom for ELLs. Would the ELLs benefit more with the science vocabulary words listed in English

with the vocabulary word's image? Or would the ELLs have a greater acquisition of the science vocabulary by using the ELL's primary language and English as well as the image?

Additionally, the research study could be extended to evaluate the ELLs' long-term recall of science vocabulary words using a WWwI. Therefore, the ELLs could take a similar control condition's post-test and experimental condition's post-test several months later to evaluate the effectiveness of a WWwI for ELLs to acquire science vocabulary words over the long run. This would help evaluate if the WWwI helped the ELLs' short-term or long-term acquisition and recall of the science vocabulary words.

Moreover, a future research study could track the ELLs' acquisition of science vocabulary over an extended period, such as six months or up to a year, covering multiple science units. As a result, the vocabulary complexity as a variable could be ruled out over time to evaluate the effectiveness of the WWwI for ELLs in the classroom.

Furthermore, a future research study could evaluate the effectiveness of a WWwI with quantitative and qualitative data. Specifically for qualitative data, the ELL teachers and ELLs could be interviewed. The ELLs' could also provide writing samples. These two types of qualitative data could help with further data analysis to evaluate the WWwI's effectiveness.

Finally, a future research study consisting of a larger sample size of ELLs could involve measuring each ELL's English language ability as well as each science vocabulary word's difficulty level. Consequently, the WWwI could potentially be better evaluated as effective or ineffective while also considering the diverse ELL's language abilities and even the science vocabulary word's complexity and difficulty.

References

Armon, J., & Morris, L. J. (2008). Integrated assessments for ELL. *Science and Children, 45*(8), 49-53.

Barry, A. K. (2008). *Linguistic perspectives on language and education*. Upper Saddle River, NJ: Pearson Education Inc.

Berg, H., Petron, M., & Greybeck, B. (2012). Setting the foundation for working with English language learners in the secondary classroom. *American Secondary Education, 40*(3), 34-44.

Best, R. M., Braisby, N., & Dockrell, J. E. (2006). Lexical acquisition in elementary science classes. *Journal of Educational Psychology, 98*(4), 824-838. doi:10.1037/0022-0663.98.4.824

Calderón, M., Slavin, R., & Sánchez, M. (2011). Effective instruction for English learners. *The Future of Children*. 21(1), 103-127.

Case, A. F. (2016). Let social interaction flourish. *Educational Leadership, 73*(5), 51.

Cena, J., Baker, D., Kame'enui, E., Baker, S., Park, Y., & Smolkowski, K. (2013). The impact of a systematic and explicit vocabulary intervention in Spanish with Spanish-speaking English learners in first grade. *Reading & Writing, 26*(8), 1289-1316. doi:10.1007/s11145-012-9419-y

Chung, S. F. (2012). Research-based vocabulary instruction for English language learners. *Reading Matrix: An International Online Journal, 12*(2), 105-120.

Cohen, M. T., & Johnson, H. L. (2012). Improving the acquisition and retention of science material by fifth grade students through the use of imagery interventions. *Instructional Science, 40*(6), 925-955. doi:10.1007/s11251-011-9197-y

Colburn, A., & Nguyen, H. T. (2012). Every word you speak. *Science Teacher, 79*(4), 58-61.

Corona, E., & Armour, L. (2007). Providing support for English language learner services. *Library Media Connection, 25*(6), 34, 36-37.

Cummins, J. (2000). BICS and CALP. In *Routledge Encyclopedia of Language Teaching & Learning* (pp. 76-79). Taylor & Francis Ltd / Books.

Daskalovska, N. (2014). Incidental vocabulary acquisition from reading an authentic text. *Reading Matrix: An International Online Journal, 14*(2), 201-216.

DeLuca, E. (2010). Unlocking academic vocabulary. *Science Teacher, 77*(3), 27-32.

Dockrell, J. E., Braisby, N., & Best, R. M. (2007). Children's acquisition of science terms: Simple exposure is insufficient. *Learning & Instruction, 17*(6), 577-594. doi:10.1016/j.learninstruc.2007.09.005

Dong, Y. R. (2013). Powerful learning tools for ELLs: Using native language, familiar examples, and concept mapping to teach English language learners. *Science Teacher, 80*(4), 51-57.

Elgort, I., & Warren, P. (2014). L2 vocabulary learning from reading: Explicit and tacit lexical knowledge and the role of learner and item variables. *Language Learning, 64*(2), 365-414. doi:10.1111/lang.12052

Fisher, D., & Frey, N. (2016). Setting clear learning purposes for ELLs. *Educational Leadership, 73*(5), 84.

Flanigan, K., Templeton, S., & Hayes, L. (2012). What's in a word? Using content vocabulary to generate growth in general academic vocabulary knowledge. *Journal of Adolescent & Adult Literacy, 56*(2), 132-140. doi:10.1002/JAAL.00114

Gándara, P., & Santibañez, L. (2016). The teachers. *Educational Leadership, 73*(5), 32.

Goodwin, B., & Hein, H. (2016). Tap ELLs' strengths to spur success. *Educational Leadership, 73*(5), 82.

Gorman, B. K. (2012). Relationships between vocabulary size, working memory, and phonological awareness in Spanish-speaking English language learners. *American Journal of Speech-Language Pathology, 21*(2), 109-123. doi:10.1044/1058-0360(2011/10-0063)

Gottschalk, B. (2016). 10 (usually wrong) ideas about ELLs. *Educational Leadership, 73*(5), 62.

Hansen, L. (2006). Strategies for ELL success. *Science and Children, 43*(4), 22-25.

Hill, J. (2016). Engaging your beginners. *Educational Leadership, 73*(5), 17.

Hill, J. D., & Flynn, K. M. (2006). *Classroom instruction that works with English language learners*. Alexandria, VA: Association for Supervision & Curriculum Development.

Honnert, A. M., & Bozan, S. E. (2005). Summary frames: Language acquisition for special education and English language learner students. *Science Activities: Classroom Projects and Curriculum Ideas, 42*(2), 19.

Huerta, M., & Jackson, J. (2010). Connecting literacy and science to increase achievement for English language learners. *Early Childhood Education Journal, 38*(3), 205-211.

Husty, S., & Jackson, J. (2008). Multisensory strategies for science vocabulary. *Science and Children, 46*(4), 32-35.

Jackson, J., Tripp, S., & Cox, K. (2011). Interactive word walls: Transforming content vocabulary instruction. *Science Scope, 35*(3), 45-49.

Johnson, R. B., & Christensen, L. B. (2008). *Educational Research: Quantitative, Qualitative, and Mixed Approaches* (Third ed.). Los Angeles, CA: Sage Publications, Inc.

Kelly-Jackson, C., & Delacruz, S. (2014). Using visual literacy to teach science academic language: Experiences from three preservice teachers. *Action in Teacher Education, 36*(3), 192-210.

Kim, J. (2011). *Relationships among and between ELL status, demographic characteristics, enrollment history, and school persistence* (CRESST Report 810). Los Angeles, CA: University of California, National Center for Research on Evaluation, Standards, and Student Testing (CRESST).

Kim, W., & Linan-Thompson, S. (2013). The effects of self-regulation on science vocabulary acquisition of English language learners with learning difficulties. *Remedial and Special Education, 34*(4), 225-236.

Krashen, S. D., & Terrell, T. D. (1983). *The natural approach: Language acquisition in the classroom*. Hayward, CA: Alemany Press.

Lany, J., Gómez, R. L., & Gerken, L. A. (2007). The role of prior experience in language acquisition. *Cognitive Science, 31*(3), 481-507.

Larson, S. C. (2014). Using a generative vocabulary matrix in the learning workshop. *Reading Teacher, 68*(2), 113-125.

Lee, O., Adamson, K., Maerten-Rivera, J., Lewis, S., Thornton, C., & LeRoy, K. (2008). Teachers' perspectives on a professional development intervention to improve science instruction among English language learners. *Journal of Science Teacher Education, 19*(1), 41-67.

Lee, O., & Buxton, C. (2011). Engaging culturally and linguistically diverse students in learning science. *Theory into Practice, 50*(4), 277-284.

Lee, O., & Luykx, A. (2005). Dilemmas in scaling up innovations in elementary science instruction with nonmainstream students. *American Educational Research Journal, 42*(3), 411-438.

Lee, O., Luykx, A., Buxton, C., & Shaver, A. (2007). The challenge of altering elementary school teachers' beliefs and practices regarding linguistic and cultural diversity in science instruction. *Journal of Research in Science Teaching, 44*(9), 1269-1291.

Lugo-Neris, M. J., Jackson, C. W., & Goldstein, H. (2010). Facilitating vocabulary acquisition of young English language learners. *Language, Speech & Hearing Services in Schools, 41*(3), 314-327. doi:0161-1461(2009/07-0082)

Luykx, A., & Lee, O. (2007). Measuring instructional congruence in elementary science classrooms: Pedagogical and methodological components of a theoretical framework. *Journal of Research in Science Teaching, 44*(3), 424-447.

Luykx, A., Lee, O., & Edwards, U. (2008). Lost in translation: Negotiating meaning in a beginning ESOL science classroom. *Educational Policy, 22*(5), 640-674.

Luykx, A., Lee, O., Mahotiere, M., Lester, B., Hart, J., & Deaktor, R. (2007). Cultural and home language influences on children's responses to science assessments. *Teachers College Record, 109*(4), 897-926.

Manyak, P. C., & Bauer, E. B. (2009). English learners: English vocabulary instruction for English learners. *The Reading Teacher, 63*(2), 174-176.

Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement.* Alexandria, VA: Association for Supervision & Curriculum Development.

Massery, L. (2013). Making conversation stick. *Language Magazine, 13*(1), 29-31.

McDonnough, J. T., & Cho, S. (2009). Making the connection. *Science Teacher, 76*(3), 34-37.

Medina-Jerez, W., Clark, D. B., Medina, A., & Ramirez-Marin, F. (2007). Science for ELLs: Rethinking our approach. *Science Teacher, 74*(3), 52-56.

Méndez, L. I., Crais, E. R., Castro, D. C., & Kainz, K. (2015). A culturally and linguistically responsive vocabulary approach for young Latino dual language learners. *Journal of Speech, Language & Hearing Research, 58*(1), 93-106. doi:10.1044/2014_JSLHR-L-12-0221

Morrell, P. D., & Carroll, J. B. (2010). *Conducting Educational Research: A Primer for Teachers and Administrators*. Boston, MA: Sense Publishers.

Nabors, M. L., & Edwards, L. C. (2011). Science: A second language for ELL students. *Kappa Delta Pi Record, 47*(3), 133-136.

Naeimi, M., & Foo, T. C. V. (2015). Vocabulary acquisition through direct and indirect learning strategies. *English Language Teaching, 8*(10), 142-151.

National Center for Education Statistics. (2012, April). *Reading, mathematics, and science achievement of language-minority students in grade 8* (Issue Brief No. 2012-028). Washington, DC: NCES.

Nowbakht, M., Moinzadeh, A., & Dabaghi, A. (2015). Issues in vocabulary learning and teaching. *Modern Journal of Language Teaching Methods, 5*(2), 247-259.

Pray, L., & Monhardt, R. (2009). Sheltered instruction techniques for ELLs. *Science and Children, 46*(7), 34-38.

Putting ELLs on the map (2016). *Educational Leadership, 73*(5), 9.

Robertson, K. (2016). A lesson in taking. *Educational Leadership, 73*(5), 56.

Scherer, M. (2016). Broken English and other embarrassments. *Educational Leadership, 73*(5), 7.

Seyyed, A. O., & Malekpur, A. (2015). Vocabulary learning strategies from the bottom-up: A grounded theory. *Reading Matrix: An International Online Journal, 15*(2), 235-251.

Sheng, Z., Sheng, Y., & Anderson, C. J. (2011). Dropping out of School among ELL Students: Implications to Schools and Teacher Education. *Clearing House, 84*(3), 98-103.

Soto, M., Freeman, Y. S., & Freeman, D. (2013). In for the long haul. *Language Magazine, 13*(1), 24-28.

Taboada, A. (2012). Relationships of general vocabulary, science vocabulary, and student questioning with science comprehension in students with varying levels of English proficiency. *Instructional Science, 40*(6), 901-923.

Taboada, A., & Rutherford, V. (2011). Developing reading comprehension and academic vocabulary for English language learners through science content: A formative experiment. *Reading Psychology, 32*(2), 113-157.

Tekmen, E. A., & Daloğlu, A. (2006). An investigation of incidental vocabulary acquisition in relation to learner proficiency level and word frequency. *Foreign Language Annals, 39*(2), 220-243.

Tucker, C. (2016). More diversity demands new approaches. *Educational Leadership, 73*(5), 86.

Umansky, I. M., Valentino, R. A., & Reardon, S. F. (2016). The promise of two-language education. *Educational Leadership, 73*(5), 10.

Watson, S. (2004). Opening the science doorway: Strategies and suggestions for incorporating English language learners in the science classroom. *Science Teacher, 71*(2), 32-35.

Wright, W. E. (2016). Let them talk! *Educational Leadership, 73*(5), 24.

Zheng, S. (2012). Studies and suggestions on English vocabulary teaching and learning. *English Language Teaching*, *5*(5), 129-137.

Appendix A

Methodology Procedural Steps

METHODOLOGY

Control Condition

Procedural Steps of Methodology *without* Word Wall with Images (~3 Weeks)

1. Take the pre-test
2. Look over vocabulary words in textbook
3. Take the vocabulary words and place in "Powerful Words" Vocabulary Organizer
    a. Go through the "Powerful Words" Vocabulary Organizer with vocabulary words and their definitions
    b. Draw own sketch for each vocabulary word
4. Complete Quizlet
    a. Day 1: 2 Activities (Matching and Spelling)
    b. Day 2: Games/Drills
5. Read a basal story from the reader (Story includes all the vocabulary words)
6. Using a writing prompt, write a writing sample using the unit vocabulary words
7. Take the post-test

Experimental Condition

Procedural Steps of Methodology *with* Word Wall with Images (~3 Weeks)

1. Take the pre-test
2. Look over vocabulary words in textbook
    a. Introduce the vocabulary words with their corresponding images for the ***word wall with images***
3. Take the vocabulary words and place in "Powerful Words" Vocabulary Organizer
    a. Go through the "Powerful Words" Vocabulary Organizer with vocabulary words and their definitions
    b. Draw own sketch for each vocabulary word
4. Complete Quizlet
    a. Day 1: 2 Activities (Matching and Spelling)
    b. Day 2: Games/Drills
5. Read a basal story from the reader (Story includes all the vocabulary words)
6. Using a writing prompt, write a writing sample using the unit vocabulary words
7. Take the post-test
8. Complete the post-intervention questionnaire

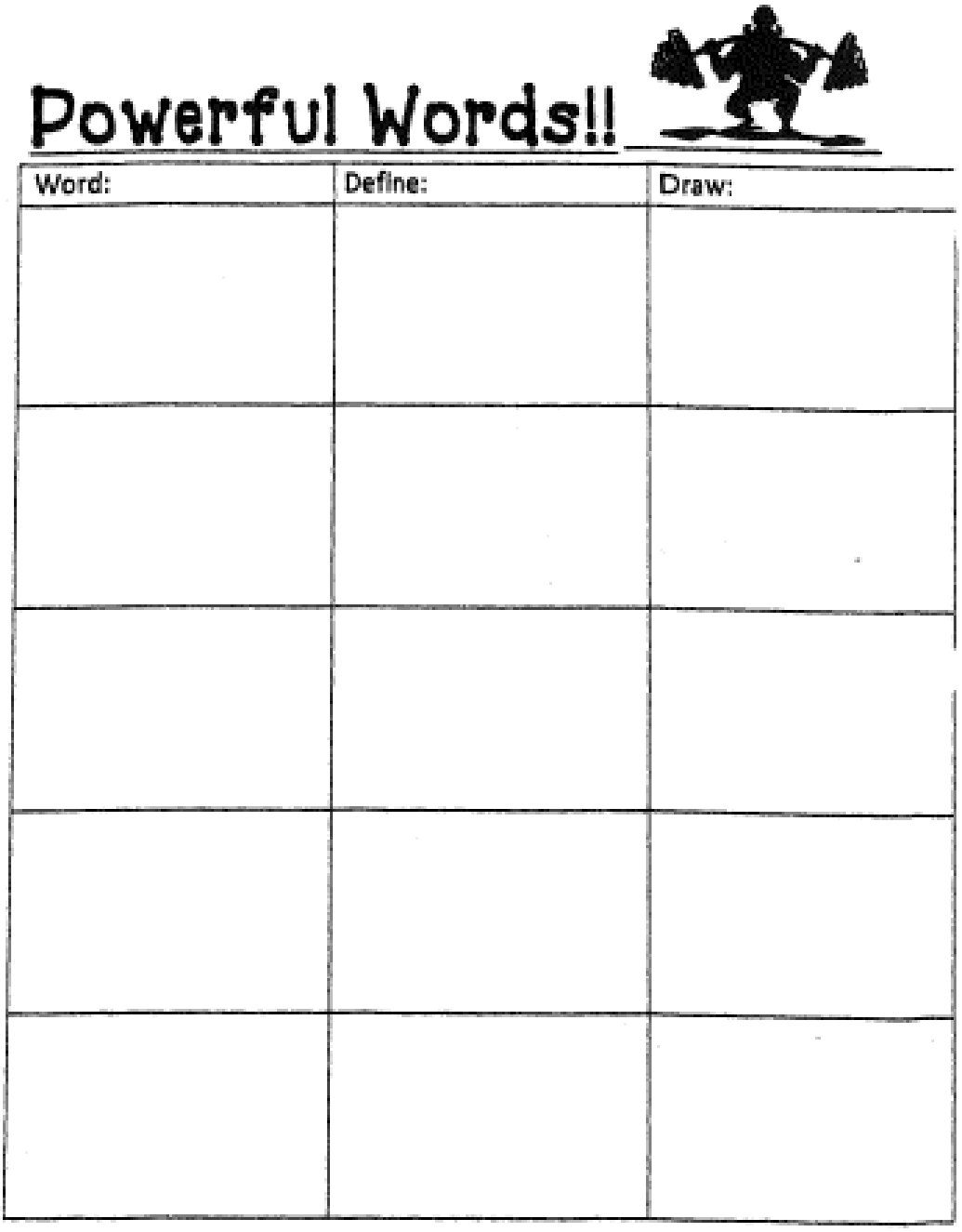
Appendix B

Control Condition's Science Vocabulary Words

1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade
Breathe	Animals	Amount	Adaptation	Absorb
Drink	Color	Behavior	Defend	Heat
Eat	Habitat	Decrease	Predator	Reflect
Living	Insects	Increase	Prey	Thermal
Move	Shape	Supply	Trait	Transmit
Nonliving	Size	Balance	Behavior	Assume
Alive	Adaptation	Control	Characteristic	Event
Exercise	Defend	Interact	Response	Explanation
Health	Hide	React	Strategy	Power
Energy	Safe	Scarce	Survival	
Food	Survive			

Appendix C

"Powerful Words" Vocabulary Organizer



Created by Ms. B for use in her classroom. Permission given for inclusion in this paper.

Appendix D

Examples of Test Questions for Control Condition*

1st Grade	
The plant is _____. a. fast b. long c. alive	Brushing your teeth is good for your _____. a. name b. health c. power
2nd Grade	
The desert is a dry _____. a. habitat b. monkey c. building d. birthday	She _____ the gift so her dad cannot see it. a. calls b. hides c. looks d. shows
3rd Grade	
The _____ of a candy is how much there is. a. gift b. action c. impact d. amount	To _____ means to make a person or thing do what you want. a. learn b. control c. identify d. understand
4th Grade	
One _____ of a raccoon is that it can climb trees. a. trait b. style c. group d. medium	A _____ is a feature. a. reward b. reason c. ceremony d. characteristic
5th Grade	
The sun _____ energy. a. transmits b. discovers c. remembers d. understands	When you _____ something, you think it is true without checking the facts. a. assume b. collect c. repair d. finish

*Pre-tests and post-tests were those created by National Geographic for use with their Reach program for teaching elementary ELLs at grade levels 1, 2, 3, 4, and 5.

Frey, N., Kratky, L., Lesaux, N., Short, D., Linan-Thompson, S., & Turner, J. (2011). *National Geographic Reach*. Menasha, WI: Hampton-Brown Company.

Appendix E

Experimental Condition's Science Vocabulary Words

1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade
Bud	Features	Drought	Command	Circuit
Flower	Food	Ecosystem	Imitate	Conduct
Leaf	Predators	Food Chain	Memory	Current
Petal	Prey	Level	Pattern	Electrical
Seed	Shelter	River	Skill	Insulate
Sun	Water	Competition	Tool	Solar
Height	Attack	Nature	Ability	Volt
Length	Attract	Negative	Communication	Watt
Light	Message	Positive	Inherit	Alternate
Project	Recognize	Resources	Language	Decrease
Ready	Seem		Learn	Energy
				Rely
				Obstacle

Appendix F

Examples of Test Questions for Experimental Condition*

1st Grade	
I am so proud of my science fair _____. a. surface b. project c. holiday	This basketball player's _____ is seven feet. a. plane b. height c. school
2nd Grade	
The giraffe's long neck is a _____ that helps the giraffe eat. a. school b. library c. feature d. window	The light from a bulb will _____ a moth to it a. attract b. contain c. identify d. understand
3rd Grade	
The big fish eats the small fish. This is part of a _____. a. duty b. night c. television d. food chain	A _____ is a contest or struggle between two or more people or animals. a. benefit b. solution c. volunteer d. competition
4th Grade	
The baby _____ its mother's smile. a. completes b. imitates c. weaves d. limits	To _____ means to get things, usually from parents. a. guide b. practice c. inherit d. perform
5th Grade	
A wire _____ electricity. a. invents b. respects c. conducts d. performs	The _____ is the movement of electricity through a wire. a. society b. silence c. current d. light

*Pre-tests and post-tests were those created by National Geographic for use with their Reach program for teaching elementary ELLs at grade levels 1, 2, 3, 4, and 5.

Frey, N., Kratky, L., Lesaux, N., Short, D., Linan-Thompson, S., & Turner, J. (2011). *National Geographic Reach*. Menasha, WI: Hampton-Brown Company.

Appendix G

Post-Intervention Questionnaire

Word Wall Questionnaire

Directions: For each question, please circle one of the choices: (1) Strongly Agree, (2) Agree, (3) Unsure, (4) Disagree, or (5) Strongly Disagree.

	Strongly Agree	**Agree**	**Unsure**	**Disagree**	**Strongly Disagree**
I like learning science.	1	2	3	4	5
I think I do well in science.	1	2	3	4	5
I think science vocabulary words are important to know.	1	2	3	4	5
I think science vocabulary words are easy to learn.	1	2	3	4	5
I think the word wall helped me learn the definitions better.	1	2	3	4	5
I think the pictures helped me learn the science vocabulary words.	1	2	3	4	5
I think I learned the science vocabulary words better without a word wall.	1	2	3	4	5

Table 1

ELL Class Sizes for the Applied Research Project's Participants

	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	Total
ELL Class Size	13	13	2	2	4	34
Total	13	13	2	2	4	34

Table 2

Ethnicities of the Applied Research Project's Participants

	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	Total
American	1	1			1	3
Bosnian		1				1
Cameroonian	1					1
Ethiopian	4	5	2		1	12
Indian	1					1
Micronesian	4	3		1	1	9
Nepalese		1				1
Somali	1	2			1	4
Sudanese	1			1		2
Total	13	13	2	2	4	34

Table 3

Primary Languages Spoken by the Applied Research Project's Participants

	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	Total
Afran Oromo	1	1	1			3
Amharic	2	4			1	7
Bosnian		1				1
Chuukese	4	3		1	1	9
Ejaghem	1					1
English					1	1
Nepali		1				1
Oromo		1	1			2
Somali	2	2			1	5
Sudanese	1			1		2
Tigrigna	1					1
Urdu	1					1
Total	13	13	2	2	4	34

Table 4

Genders of the Applied Research Project's Participants

	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	Total
Males	6	7		1	2	16
Females	7	6	2	1	2	18
Total	13	13	2	2	4	34

Table 5

Ethnicities of the Pilot Study's Participants

	2nd Grade	3rd Grade	4th Grade	Total
American			1	1
Ethiopian	2	1	1	4
Micronesian	1		1	2
Somali	1	1	1	3
Taiwanese	1			1
Vietnamese		1		1
Total	5	3	4	12

Table 6

Primary Languages Spoken by the Pilot Study's Participants

	2nd Grade	3rd Grade	4th Grade	Total
Amharic	1	1		2
Chinese	1			1
Chuukese	1		1	2
Oromo	1		1	2
Somali	1	1	1	3
Vietnamese		1	1	2
Total	5	3	4	12

Table 7

Genders of the Pilot Study's Participants

	2nd Grade	3rd Grade	4th Grade	Total
Males	3	2	3	8
Females	2	1	1	4
Total	5	3	4	12

Table 8

Comparison of Post-tests for Science Vocabulary Acquisition

Science Vocabulary Acquisition		
	Control Condition (n=34)	Experimental Condition (n=34)
Mean	91.06	90.15
Standard deviation	11.65	13.64

Table 9

Comparison of Pre-test and Post-test for Control Condition

Control Condition		
Without Word Wall		
	Pre-test (n=34)	Post-test (n=34)
Mean	83.56	91.06
Standard deviation	20.56	11.65

Table 10

Comparison of Pre-test and Post-test for Experimental Condition

Experimental Condition		
With Word Wall	Pre-test (n=34)	Post-test (n=34)
Mean	78.24	90.15
Standard deviation	22.00	13.64

Figure 1. Picture of Second Grade's Word Wall with Images

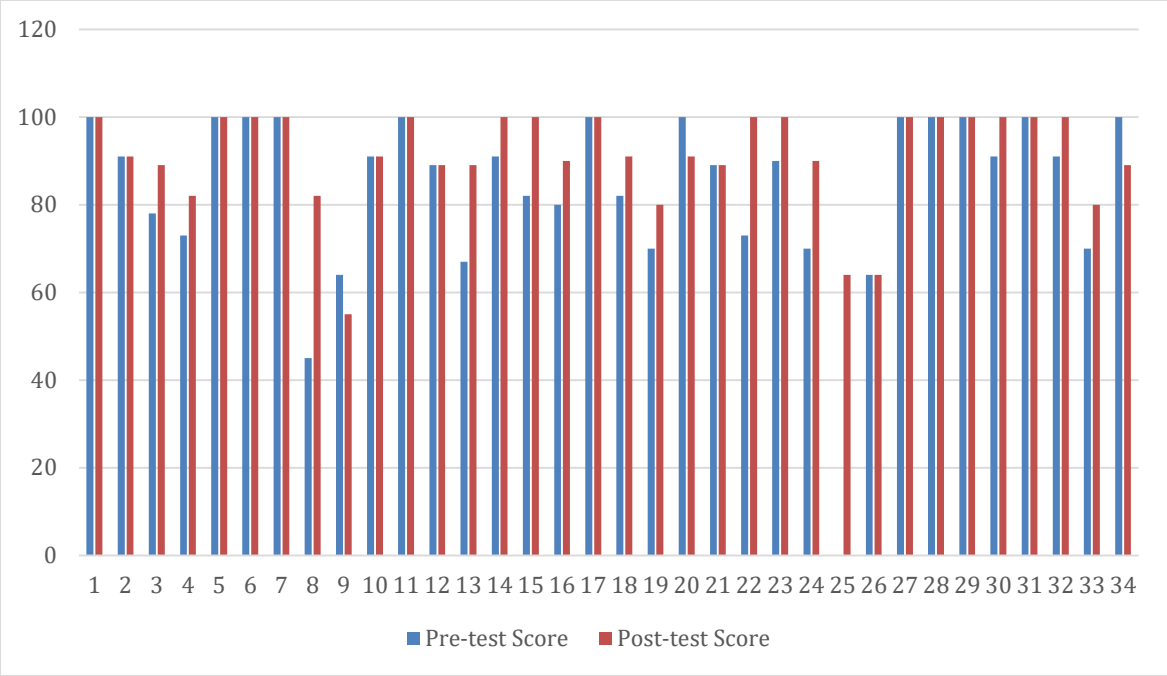


Figure 2. Control Condition's Pre-test and Post-test Scores

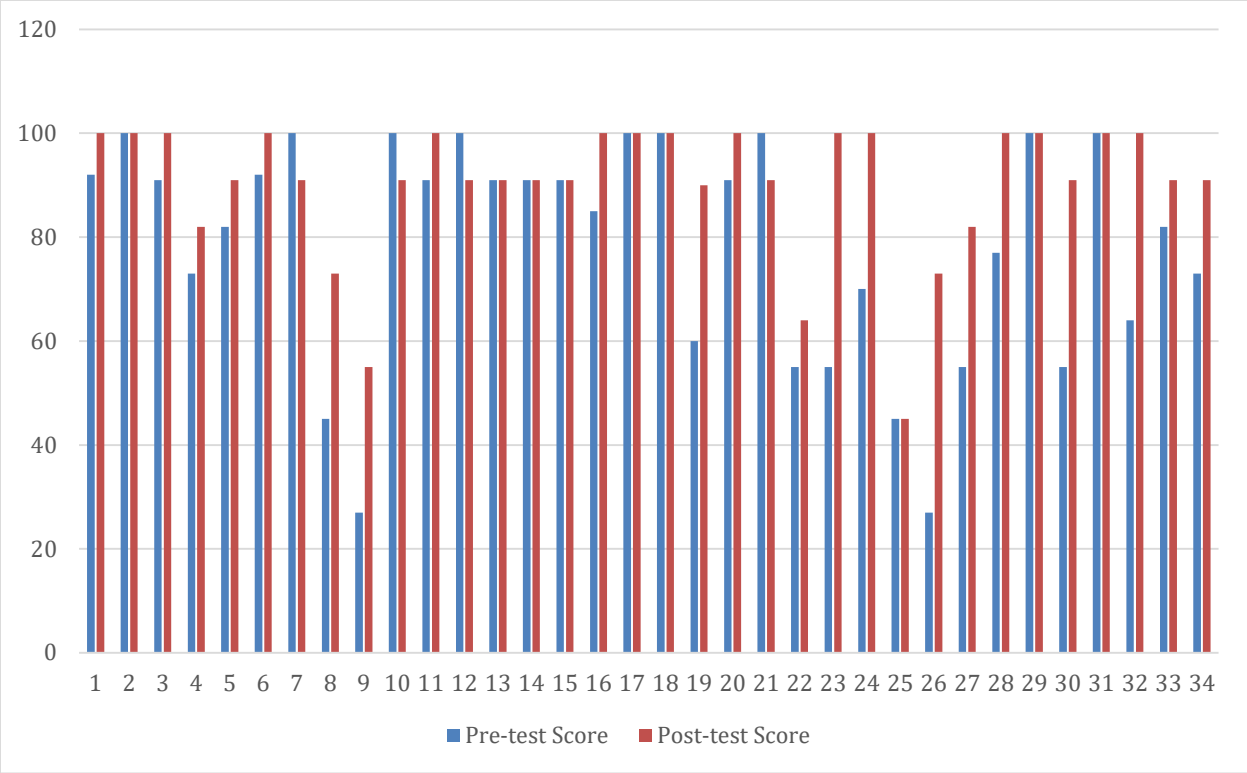


Figure 3. Experimental Condition's Pre-test and Post-test Scores

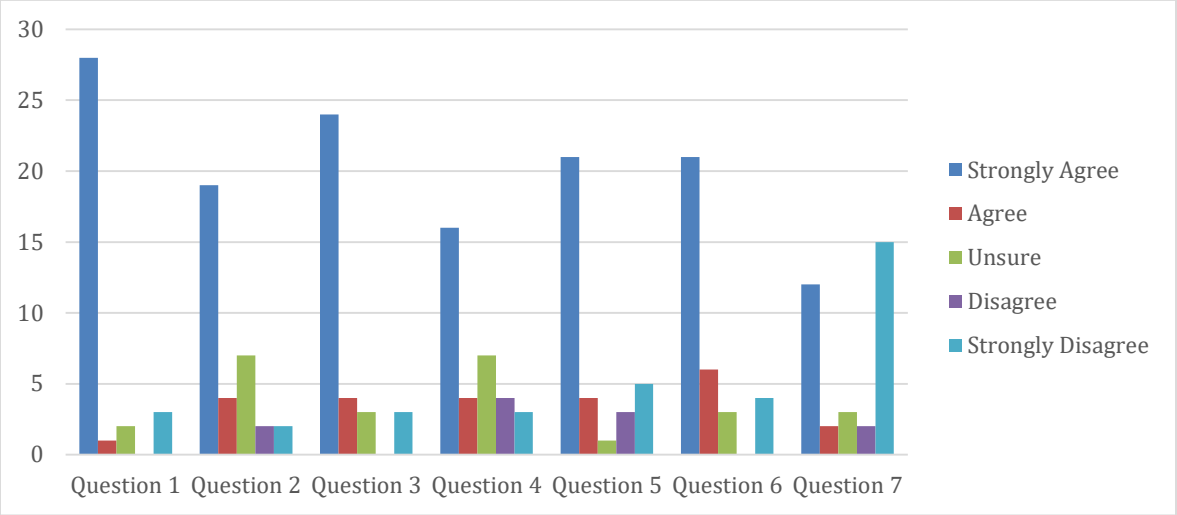


Figure 4. Post-Intervention Questionnaire's Results of the ELLs' Perceptions