The Effects of Interactive Word Walls on Science Assessments

 of Middle School Students in Special Education

by

Carrie Porco

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**Abstract**

 The purpose of this study was to determine if sixth grade special education students in a co-taught setting using instruction with an interactive word wall, would show significant improvement on a unit posttest when compared to their pretest scores. The results of this study will indicate that there is no significant difference in the achievement level of sixth grade special education students on a science posttest after receiving interactive word wall instruction. To evaluate achievement in this study, the tools used were a pretest and posttest developed by the Anne Arundel County Public School’s Science Department. This study looked at the results of the two instruments used to measure academic growth during this unit. Posttest scores for students after interactive word wall instruction were significantly higher than pretest scores. It would be beneficial to conduct additional studies in this area because there are very few that measure the effects of interactive word walls on student achievement in science.

**CHAPTER 1**

**INTRODUCTION**

The significance of science instruction for students while in middle school, as a part of their daily lives and in their future career is undeniably important and is an invaluable source of information. In the middle school setting, science is one of the four core classes students need to pass to be promoted to the next grade level. Like mathematics, the basic principles of science must be learned before students are able to grasp higher level concepts, making it important that students are successful at each grade level.

The consequences of low achievement in the science classroom can have far reaching negative effects on current educational performance as well as future impacts for students. Initial problems can include poor vocabulary development, low self-esteem, and finally behavior problems due to frustration. Continued low achievement in science can result in repeating the class during summer school or place a student in danger of failing and having to repeat their current grade level. Future negative consequences can include dropping out of school and as a result, more limited job choices. Poor achievement in science can be equally significant in the daily lives of students, outside of academic achievement if they are unable to meet the challenges of solving scientific issues in their lives as they are encountered (Mason, Boscolo, Tornatora, & Ronconi, 2013).

The likelihood of low achievement in the science classroom is more prevalent for students in special education due to their disability, their school experiences, and for some their socioeconomic status. Frequently, special education students come from low socioeconomic backgrounds that influence achievement scores. Ways in which socioeconomic status can influence student success are geographic location of the home, parent status (e.g. single parent, grand parent, or adoptive parent), parental employment and income level, parental education level, and parental attitude toward education (Ramburuth & Hartel, 2010). Students from low income families are not often enrolled in private pre-schools, do not usually travel, and have parental role models with lower education levels. As a result, these students enter the public-school system significantly below their peers (Toth, 2013).

Other difficulties for students with disabilities are due to their specific learning disability and the way it affects their ability to be successful. Students with working memory issues can have difficulty performing an operation or manipulation with it, and producing a result. A helpful solution for these students can be solved by working in groups and performing experiments to demonstrate the standard or skill. Students with comprehension difficulties can have trouble defining vocabulary words and assessing verbal knowledge. Some students are auditory learners while others are visual. Finally, students with reading difficulties can find a science text book that is two years above grade level challenging when they are reading several years below grade level. If the student’s disability is in fluency the text book can be easily read to the student. If the disability is with comprehension, understanding the material is more difficult for the student (Mastropieri, Scruggs, Norland, Berkeley, McDuffie, Tornquist, & Connors, 2006). This study will look at interactive word walls as a strategy for learning and memorizing science vocabulary words.

To help students with learning challenging vocabulary in the science classroom different strategies have been implemented and will be discussed in further detail in chapter two. These strategies include syllable-based reading and morphology.

The practice of co-teaching to learn science vocabulary can be especially beneficial to special education students. In this method of teaching, students benefit from small group instruction with a lower student to teacher ratio where the teacher can focus more on student accommodations and differentiated instruction (Moorehead & Grillo, 2013).

To create an environment that fosters vocabulary development, word walls have played a large role in the primary grades. At the secondary grade level, interactive word walls have been more successful due to students playing an active role in the creation, the importance of vocabulary in the learning process, and the high correlation between vocabulary and reading comprehension (Harmon, Wood, & Kiser, 2009). Another important part in the creation of the interactive word wall is to incorporate associative learning. If students can associate tasks in learning when creating the bulletin board and use the memory of prior experiences it helps to reinforce the information. When students have created, or contributed to the creation of the materials that are displayed on the bulletin board, the association is more likely to be remembered and utilized. It is also important to select words important for comprehension of the material and to teach student friendly definitions.

**Statement of the Problem**

The purpose of this study was to investigate the effect of vocabulary instruction using an Interactive Word Wall on the achievement of 23 – sixth grade special education students in a co-taught setting.

**Hypothesis**

The results of this study will indicate that there is no significant difference in the achievement level of sixth grade special education students on a science posttest after receiving interactive word wall instruction.

**Operational Definitions**

* Achievement – The level students reach on the posttest at the end of the unit when compared to the pretest administered prior to instruction.
* Interactive word wall - The interactive word wall utilized during instruction of the unit 7 content contained vocabulary terms and definitions, pictures, artifacts from two labs, and student writing samples assigned during this unit.
* Special Education – The term Special Education refers to all of the students with a current IEP. Students who have a 504 plan were not included under this definition.
* Instruction – The instruction during science unit 7 included activities that required students to use the word wall as a reference to complete various activities and display their work. Some of the activities included were: daily drills and a vocabulary worksheet; engaging in a matching activity to create the states of matter portion of the word wall; a writing assignment, using scientific terminology, to discuss all steps required to separate a mixture; and an area to display artifacts from two related labs.

**CHAPTER II**

**REVIEW OF THE LITERATURE**

This literature review seeks to explore the effects of interactive word walls on science assessments of middle school students in special education. Section one provides an overview of the stages of vocabulary and content vocabulary development. Section two explores the difficulty with learning content vocabulary. Section three explores the strategies to help improve content vocabulary and in section four, a summary is provided.

**Overview on science assessments**

There is serious concern about the way students with disabilities perform on science assessments compared to their peers at the middle school grade level. Looking at data from the National Assessment of Education Progress, eighth grade students with learning disabilities scored lower on the Science assessment than their general education peers by almost one standard deviation (Mastropieri et al., 2006). To reverse this trend some researchers have looked to vocabulary instruction because of its direct relationship with comprehension (Flanigan, Templeton, & Hayes, 2012). For a better understanding of the importance of vocabulary instruction on student achievement in content areas, it is important to look at how vocabulary development occurs; why students with disabilities are so far behind their general education peers in vocabulary acquisition; what specific learning strategies help special education students learn vocabulary and content vocabulary; and what specific teaching methods improve scores on content area assessments in secondary schools.

**Stages of vocabulary and content vocabulary development**

To understand vocabulary acquisition, it is important to look at the reading process that students go through during their education and how it changes over the years. During the preschool and kindergarten years, students learn oral language skills, which will help them with reading comprehension. When students reach kindergarten and first grade, “skills that lead to decoding and word recognition (phonemic awareness, letter-sound knowledge, and quick recognition of high frequency words)” become most important in this stage of development (Connor, Alberto, Compton, & O’Connor, 2014, p. 28). Starting in the second grade and continuing throughout elementary school, the following skills are gradually increased: “reading rate and accuracy, vocabulary, and reading comprehension” to become the new main area of focus (p. 28). By the time students reach the middle school and high school years, “they are expected to use reading as a tool for learning, finding, and using information” (p. 29). When any of these stages are slower to develop, this can be an indication of “reading difficulties or reading disabilities” (p. 29). These stages of reading development, determine how assessments and reading interventions are designed and how learning progress is measured. With research continuing to indicate that students with reading difficulties become further behind as they progress through school, students are being identified earlier to provide reading intervention as early as preschool . By identifying students that early, interventions can be started sooner and eliminate an achievement gap for these students.

**Difficulty with learning content vocabulary**

Acquiring content vocabulary can be difficult for students with disabilities for many reasons. One major difficulty is the significant difference in the amount of vocabulary words acquired by students from middle income and low income families. Difficulties with learning vocabulary can now be traced as far back as pre-school. Using the Peabody Picture Vocabulary Test-III, discernible vocabulary differences in results between the low and middle income African American toddlers were observed (Furey, 2011). When testing children at such an early age, it is very important to choose a test that can provide accurate results.

In another study focusing on the validity of instruments used to measure vocabulary development in pre-school children from low-income families, similar results were found. Of the 23 children (16-18 months of age) randomly chosen from volunteers of socioeconomically diverse households, the children from low income households attained 83 unique words at 16 months, and 115 unique words at 18 months, as reported by parents. The children from middle income households were able to attain 115 “unique words” at 16 months and 179 unique words were reported by parents at 18 months (Furey, 2011). Even at such a young age, the achievement gap is already clear and will continue to grow without intervention.

These concerns are not new and researchers have looked at a wide variety of possible reasons for the difference in performance on vocabulary tests. Prior studies have looked at “full-and preterm children as well as a social risk group representing children of mothers who lacked social support and were young, or poor, or had a low level of education” (Furey, 2011, p. 39). The results of those studies found the “weakest correlation was observed for the social risk group” and a “significant correlation (r=.17) was observed between children’s total vocabulary and the family’s Hollingshead Index, a measure of socioeconomic status” (p. 39).

As a result of these early childhood differences, children arrive in kindergarten at different levels of achievement with “expressive language and vocabulary” being the most noticeable (Toth, 2013, p. 203). This gap between academic achievement levels only continues to grow with time. This is demonstrated each time students read from text, the higher performing students comprehend more of what they have read expanding their knowledge and widening the gap. If students are unable to catch up to their grade level peers they can fall behind by several grade levels before they even reach middle school.

Test scores from the National Assessment of Education Progress indicate that both fourth grade students and eighth students continue to have deficits with their higher achieving peers in vocabulary acquisition. According to the study, both fourth grade and eighth grade students achieving “above the 75th percentile in reading comprehension had the highest average vocabulary scores” (Toth, 2013, p. 203). Similarly, fourth grade and eighth grade students that scored “at or below the 25th percentile had the lowest average vocabulary scores” (p. 203). This data also shows the connection between vocabulary and reading comprehension.

In elementary schools the focus is on “rich instruction” that helps to develop vocabulary for younger children, but this environment or approach to teaching is rarely seen in middle schools. Instead, teachers “mention words, provide synonyms, and assign words to look up in the dictionary” (Ford-Connors & Paratore, 2014, p. 4). This strategy becomes even more ineffective when students misinterpret those definitions and then write sentences containing those misrepresentations. An earlier study confirmed the difficulty with definitions and found that when students in the fifth and sixth grades wrote sentences from definitions a large percentage (63%) of the sentences showed a “misunderstanding” of word meanings.

Another difficulty with learning content vocabulary is when students attempt to use a science text book; it is often two grades above grade level. For students with reading difficulties or disability reading below grade level, accessing a text book that is usually two grades above grade level can be very difficult (Mastropieri et al., 2006). In addition, “Approximately 70% of U.S. students in grades 4-12 struggle to read on grade level” (Flanigan et al., 2012, p. 132). For students with reading difficulties or learning disabilities, the demands and challenges of content area curriculum can cause student “frustration, academic failure, loss of access to the general education curriculum, and loss of future opportunities in society” (Mastropieri et al., 2006, p. 130).

**Strategies to help improve content vocabulary**

The articles in this section look at differentiated curriculum as well as differentiated ways of presenting the content. Differentiation in these techniques vary from using a co-teaching model utilizing stations; peer tutoring arrangement; prioritizing vocabulary words;

and drawing pictures and conversing with their neighbors to define words rather than the more traditional method of copying definitions from a book. There are a surprisingly large number of strategies that boast success with teaching vocabulary and/or content vocabulary and the following are some examples of these strategies.

Instruction that uses morphology to teach content vocabulary and overall vocabulary is a strategy that can be taught in a variety of ways. This approach looks at the “approximately 70% of English words that contain Latin prefixes, suffixes, or roots” (Flanigan et al., 2012, p. 133). When using morphology, students are able to study words in more depth to foster understanding. This system also engages students in an intensive reading of “language rich” books and also “word learning” (p.133). When teaching morphology of words, it is important to start with demonstrating the matching of prefixes and suffixes to root words. This can be followed with using graphic organizers to determine root words that share a common prefix. Morphology can also be used to teach spelling and to identify vocabulary across content areas and in real life based on affix or roots.

The Syllable-Based Reading Strategy is a method for learning science vocabulary and content which can be taught in different ways. In one method, the first step in the process is to select “content-obligatory language,” language that is necessary for learning a specific content and “content-compatible language,” language that can be taught in a specific content area but is not needed to be successful in learning the content (Bhattacharya, 2006, p. 120). The teacher would then pick 10 of each type of word and begin the process. To start, the teacher would write down a word to be displayed. Then, the word would be defined for the student. Next, the word would be divided into syllables by the teacher and each syllable would be pronounced separately. Last, the word would be pronounced aloud by the teacher. Guided practice and independent practice would be conducted using the same method. The final process in syllable-based reading is the reading of text passages that contain both content-obligatory language and content compatible words. The students’ science text could be used for this purpose. The reading part of the process is to teach students to not only read words in isolation but also in context. This strategy is for those students who are reading below grade level, who need “spelling patterns and word structure” and are able to make progress recognizing words, improve vocabulary and fluency when reading text, and “comprehension of ‘book’ language such as complex sentences and figures of speech” (p. 122).

Some researchers create methods or strategies for teaching content vocabulary which appear to be created from research and personal experience that they know to be effective. One such strategy is the four-level framework, in which the author states that the before deciding how to best present content vocabulary, educators should be “making the match: students, purposes, words, and strategies” (Flanigan & Greenwood, 2007, p. 227). The purpose of the lesson is taken into consideration when choosing the vocabulary words. In this plan, there is a “four-level framework’ for words . Tier one words need to be taught before the lesson and are necessary for understanding the lesson content. They are the more challenging words and a teacher should allow 15-20 minutes of instructional time. Tier two words are also necessary for understanding content; however, these words do not take as much time to teach. Tier three words do not need to be taught before the reading to understand it, and can be taught during or even after the lesson. Tier four words are words that do not need to be taught because students most likely know them . Then after selecting the vocabulary words, tables are set up for choosing a strategy for teaching a word and the reason for teaching it as well as the tier (level) of the word. The researchers of this vocabulary strategy state that the purpose is to provide a framework for teaching vocabulary and incorporate best practices into the lesson .

The practice of co-teaching in science and math is a good strategy for teaching content vocabulary among many other benefits and is particularly well suited for those two content areas. The authors of this article use the station rotation co-teaching model due to all of the benefits it provides for both general education and special education students. They feel that “station teaching can promote the use of technology and communication while decreasing student-to-teacher ratios and allowing for more direct support and small group instruction” (Moorehead & Grillo, 2013, p. 56). The authors state that while there is a limited amount of support for station rotation as the better fit for teaching general education and special education students, more recent support concludes that the idea of using different co-teaching models increases the effectiveness of the model. This model is also flexible for grouping, allowing each teacher to plan for and teach a station and have a third station for independent work. With both teachers responsible for a station, it allows them both to feel equally responsible for the success of the lesson. It also allows additional teacher support for those students who struggle with science by allowing for more conversation and questions. In a small group setting it is also easier for the special educator to concentrate on IEP goals and objectives. Station Teaching works much the same way for teaching math as it does for science.

The articles in this section emphasize the importance of vocabulary and suggest that interactive word walls used as a functional resource are more effective than traditional ones. While some of these studies look at ELL students, students from poverty and students with learning disabilities, often have a similar lack of vocabulary back ground to draw from when trying to learn science content. As a result, their test scores are frequently basic due to this lack of background knowledge. In the first article, the author stresses how important it is that “students are actively engaged in meaningful tasks with the artifacts,” and teachers incorporate them into their lessons (Harmon, Wood, Hedrick, Vintinner, & Willeford, 2009, p. 398). As in elementary school, middle school students need “print rich classrooms” that motivate students to learn content vocabulary (pp. 398-399). When interviewing students about word walls, researchers determined that while students felt that word walls were important for learning in the classroom (80% agree), they were not able to tell how word walls could help them with word meanings. Students were also asked to compare two word walls for their opinion on which one was most useful, and students picked the one that had visuals with “colors and symbols” (p. 405). They stated that “the details” were more useful in remember the meaning of the word (p. 405). Incorporating a visual image, a technique better known as the keyword method has been proven to be successful (through research) in helping students remember words. Therefore, using pictures on the word wall would be beneficial to all students. Students need to stop learning the meanings of words by using a dictionary of glossary and learn to “internalize” them through “multiple exposures to words in a variety of contexts” (p. 401).

Interactive Word Walls are another strategy that can be taught in a variety of ways. For example, some word walls consist of just words used for spelling and word recognition while others contain pictures and artifacts that help with learning and remembering meaning. Typically, word walls are located in the front of the classroom in an area visible to all students. However, one middle school took their word walls “out of the room and into the hall” (Yates, Cuthrell, & Rose, 2011, p. 31). This middle school also had a word wall in both the classroom and the hallway. By having a word wall in the hallway, teachers felt it would increase comprehension and students would be able to retain the meaning of content vocabulary words longer. This word wall, constructed by the entire eighth grade team including students, incorporated all of the content areas. It was an ongoing process that lasted all year. By choosing the hallway to display the word wall, students walked by the wall more than once a day and it became a focus of their attention and conversations. Before long students were offering their own suggestions of words to add to the wall.

**Summary**

Vocabulary is an essential part of literacy and comprehension of content area curriculum. It is important to understand how vocabulary in general and content vocabulary specifically is developed. It is also imperative to have strategies in place to help close the gap between students with poor vocabulary skills and those who are on grade level. Once students start to close the learning gap with content area vocabulary, their scores on content area assessments will improve, as well as their confidence and enthusiasm for learning.

**CHAPTER III**

**METHODS**

The purpose of this study was to investigate the effect of vocabulary instruction using an Interactive Word Wall on the achievement of 23 – sixth grade special education students in a co-taught setting.

**Design**

The format of this study lends itself to the action research design. To measure achievement on a consistent basis, a pretest, containing multiple choice questions and a posttest, containing multiple choice, and at least one brief constructed response question, is administered for each science unit. While the design of the pre-test and posttest vary slightly, (e.g. the posttest contains one or more brief constructed response questions) the latter often proves to be more challenging. Student scores on both the pretest and posttest will vary. Constraints on this study were the size and immobility of the interactive word wall. It does not allow for the flexibility of pulling small groups to another classroom or a comparison group to occupy that sixth-grade classroom.

**Participants**

This focus of this study is based on Unit 7 of the sixth-grade science curriculum. The topics covered in this unit are states of matter and physical and chemical changes. Both regular education and special education students participated in the creation of the interactive bulletin board and could view the information as it was created and displayed throughout the unit.

The sixth-grade special education students who participated in this study are in two science co-taught classes. All of these students have academic goals on their **Individualized Education Program (IEP)**. The demographics of the selected special

education student population are as follows. There are 13 male and 10 female special education students. The majority of the students are Caucasian with 20 students falling under that category. Of the remaining students, 2 are African American and 1 is Pacific Islander.

The total school population is 930 students, with 312 sixth grade students, 329 seventh grade students, and 289 eighth grade students. Official enrollment data is collected and reported by the school system by September 30th of each school year. The school state capacity is 1,051 students bringing the school to 92% capacity and closed to out of area transfers only.

In 2014, all student’s county wide took the Partnership for Assessment of Readiness for College and Careers (PARCC) Assessment for language arts and math. There is not a science test included in the PARCC assessment at this time. Currently, students are being assessed using Maryland School Assessment (MSA) in eighth grade. To prepare for unit assessments and the PARCC assessment, students are given weekly Common Formative Assessment (CFA) assessments in the four core courses (e.g. language arts, math, science, and social studies) with a limited number of questions to determine their level of understanding of the current material being presented. These scores are presented at a weekly meeting and strategies are discussed for re-teaching of the standards where students performed in the basic range.

On the 2014 school performance report for reading, this school did not meet the percent proficient for all students or for special education students. It was proficient in the following categories: American Indian or Alaska Native, Asian, Hispanic/Latino of any race, and two or more races. Math and science data was not provided in the school

progress report.

Some of the special programs offered by this suburban middle school to help support students academically are; Positive Behavioral Interventions and Supports (PBIS) and an after-school program which helps students in language arts and social studies on Tuesday afternoons and math and science on Thursday afternoons. After school activity buses are available to transport students.

**Instruments**

This study looked at the results of two instruments used to measure academic growth during this unit. Both assessments were created by the science department of Anne Arundel County Public Schools. At the beginning of Unit 7, students were administered a Pretest to determine prior knowledge, and at the end of the unit, a posttest was administered to measure academic growth. The Pretest usually consists of ten multiple choice questions and the posttest normally has nine multiple choice questions and one BCR (brief constructed response). However, the Unit 7 Post Assessment consists of eleven multiple choice questions and two BCR’s. Finalized copies of the Posttest Test Maps for the unit are not usually available until after the very beginning of the unit.

The State Curriculum and Common Core Curriculum Frame Works guide that incorporates standards for each unit also contains an essential vocabulary list specifically for that unit. The vocabulary terms that were used in developing the interactive word wall were selected from that list.

**Procedures**

The word wall was created using vocabulary terms and pictures or photographs, a

strategy that has been successful in studies for English as a second language learners and special education students. The word walls were separated into three sections due to available space and were created as students were learning that section of the unit. The first section was on states of matter, evaporation and condensation. It was created and available for student use at the beginning of the unit. It contained pictures that would help students to have a better understanding of the vocabulary words. The second section was on mixtures and was created while the students were learning that portion of the unit. The mixtures section had photographs from two labs that students completed and two demonstrations by the teacher. The students completed a lab on chromatography and the separations of their ink dots on paper were also displayed. Photographs of the results of the mixtures lab were displayed demonstrating that mixtures can be separated. The third section of the word wall contained student writing assigned during this unit. When each new section of the word wall was created, it was introduced to the students and they were encouraged to use the information during assignments. Vocabulary words were introduced and defined during drills, class discussions, and assignments.

The Literacy Coach for the school also collaborated on an activity requiring students to consult the word wall or their text book to complete an activity which consisted of filling in the correct vocabulary word to complete statements, as well as completing a writing assignment using scientific terminology to discuss all steps required to separate a mixture. Pictures from the final results of that lab were on the word wall as well as vocabulary terms that were used during each step of the lab. This activity was created to encourage students to utilize the word wall. Random student assignment from this activity and a quiz BCR were chosen and displayed on the “Writing like a Scientist” section of the word wall.

Instruction for Unit 7 of the science curriculum was approximately 18 days. The Pretest for Unit 7 was administered on Monday, May 11th and the Posttest was administered on Thursday May 14th and Friday, May 15th. Several days during the unit were not spent on instruction due to PARCC assessment and an assembly. The word wall went up in sections based on the timing of the lesson material. It remained up and was available for students to use during assignments and assessments. It consisted of vocabulary words and pictures/photo graphs and a few facts specific to particles, organized by students, in the section on matter. Written definitions for vocabulary words were not displayed.

**CHAPTER IV**

**RESULTS**

The purpose of this study was to investigate the effect of vocabulary instruction using an Interactive Word Wall on the achievement of 23 – sixth grade special education students in a co-taught setting.

The pretest and posttest science results for sixth grade students following interactive word wall vocabulary instruction were analyzed using a t test for paired subjects. The results are reported in Table I.

**Table I**

*Pretest and Posttest Results Following Interactive Word Wall Vocabulary Instruction.*

Word Wall Vocabulary Instruction

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test | Mean | N | Standard Deviation | t | Significance |
| Pretest | 37.9 | 22 | 15.26 | 6.69 | 0.000\* |
| Posttest | 62.1 | 22 | 14.60 |

\*P = 0.000

The null hypothesis is rejected. Posttest scores for students after interactive word wall instruction were significantly higher than pretest scores.

**CHAPTER V**

**DISCUSSION**

The purpose of this study was to investigate the effect of vocabulary instruction using an Interactive Word Wall on the achievement of 23 – sixth grade special education students in a co-taught setting.

**Results**

The use of an Interactive Word Wall to improve student vocabulary on Unit 7 of the sixth-grade science curriculum, states of matter and physical and chemical changes, showed significant improvement on post test scores over pretest scores.

**Implications**

Implications for teaching science vocabulary in the future as a result of this study, should focus on whether the interactive word wall was successful in raising test scores on the Science Quarterly Assessment because it is an effective tool in teaching vocabulary or were their other factors influencing its effectiveness, including how valid the results are. One factor that may have influenced its effectiveness is that students need to develop automaticity in referring to word walls as a tool or strategy for learning in much the same way they would use other reference materials. In this study, students only had access to an interactive word wall for the first time this marking period, and yet seemed to utilize it enough to improve their test scores. The students’ direct involvement in creating the interactive word wall also seemed to help them remember to use it as a reference tool.

**Theoretical Consequences**

Theoretical consequences of using interactive word walls in vocabulary acquisition with positive results from previous research will be a change in the methods for teaching vocabulary. Previous studies clearly indicate that the theory of looking up definitions in a dictionary and memorizing them as a method for teaching vocabulary words has limited impact on student comprehension (Harmon et al., 2009). Just memorizing or displaying vocabulary terms is not enough for students to grasp the full meaning of the words. They need to “engage in higher levels of cognitive processing, such as critically analyzing, evaluating, and applying word meanings in meaningful contexts with multiple opportunities to use new words in different contexts” (p. 402). The interactive word wall display alone is not enough to acquire new vocabulary comprehension. Students must use the pictures, artifacts, definitions, and writing samples in constructive ways. In this study, the interactive word wall was used to complete drills, assignments, and foster class discussions. In another activity students had to match words to definitions in order to complete one section of the word wall. Active engagement by students with the interactive word wall is the key to learning science vocabulary.

**Threats to Validity**

There are several possible threats to the validity of this study. First, the pretest and the posttest were in different formats. The pretest consisted of all multiple-choice questions and the posttest was a combination of multiple choice questions and two BCR (brief constructed response) questions. Another possible threat to validity is the fact that there was not a comparison group. Both co-taught classes contributed to the word wall in the form of vocabulary words, experiment results, and writing samples. The other two classes that use that science classroom are not co-taught and did not contribute to or use the interactive word wall.

**Comparison of Results to Other Research**

The results of this study validate the importance of vocabulary development in science instruction and the importance of interactive word walls which is also supported by previous research. In another study using middle school students that was able to use a control group, the assessment results were also positive. Like this study, special education students were included in their grouping along with regular education students. When students were allowed to study the same specific list of words prior to taking the test, which included writing definitions and responding to sentence prompts, the scores between the two groups of students were similar. However, at the end of the unit, students were given a delayed test of the final words and those students who were in the word wall group scored higher on just the sentence completion section than the students who did not participate in the word wall instruction. “These students demonstrated a sustained higher level of understanding of the word meanings and were able to successfully apply them to the meaningful prompts. This more long-term, deeper level of understanding of vocabulary is the goal of vocabulary teaching and has the possibility of influencing reading comprehension” (Harmon et al., 2009, p. 406).

In a different study the authors looked at interactive word walls in the four core classes’ language arts, math, science, and social studies in one specific middle school, and found interactive word walls to be a “promising instructional tool” at that school based on improved state test scores and positive comments from teachers and students (Yates et al., 2011, p. 36).

In one final article, the authors cite, a study that found interactive word walls help ELL (English Language Learners) to develop a deeper understanding of science concepts (Jackson, Tripp, & Cox, 2011). They also reported that in another study, “scores on high-stakes tests increased across all student groups when teachers used interactive word walls and provided opportunities for students to encounter and use science vocabulary in authentic and engaging ways” (p.45).

**Implications for Future Research**

When using interactive word walls, they are most successful when students are actively engaged in meaningful tasks with the artifacts (Harmon et al., 2009). When conducting additional studies involving interactive word walls, it would be important to have a comparison group to determine if achievement could be attributed to the interactive word wall. Additional time for students to practice using interactive word walls as a learning tool would also be helpful in establishing their effectiveness. Measuring growth over a longer period of time than one unit in science would help even more students to automatically refer to them. Using similar instruments in the form of a pre-assessment and post assessment would eliminate all concerns about the pre-assessment being less challenging than the post assessment. Finally, more student activities using the interactive word wall demonstrating how to properly use them through teacher modeling and student practice would produce even more positive results.

R**eferences**

Bhattacharya, A. (2006). Syllable-based reading strategy for mastery of scientific information. *Remedial and Special Education*, *27*(2), 116-123.

Connor, C.M., Alberto, P.A., Compton, D.L., & O’Connor, R.E., & National Center for Special Education Research (2014). Improving reading outcomes for students with or at risk for reading disabilities: A synthesis of the contributions from the Institute of Education Sciences Research Centers. NCSER 2014-3000

Flanigan, K., & Greenwood, S.C. (2007). Effective content vocabulary instruction in the middle: Matching students, purposes, words, and strategies. *Journal of Adolescent &Adult Literacy*, *51*(3), 226-238.

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). doi: 10.1002/JAAL.00114

Ford-Connors, E. & Paratore, J.R. (2014). Vocabulary instruction in fifth grade and beyond: Sources of word learning and productive contexts for development. *Review of Educational Research. 85*(1), 50-91

Furey, J.E. (2011). Production and maternal report of 16- and 18- month-olds’ vocabulary in low-and middle-income families. *American Journal of Speech-Language Pathology, 20*, 38-46

Harmon, J. M., Wood, K.D., Hedrick, W. B., Vintinner, J., & Willeford, T. (2009). Interactive word walls: More than just reading the writing on the walls. *Journal of Adolescent & Adult Literacy 52*(5). doi: 10.1598/JAAL.52.5.4

Harmon, J. M., Wood, K. D., & Kiser, K. (2009). Promoting vocabulary learning with the interactive word wall. *Middle School Journal*, *40*(3), 58-63

Jackson, J., Tripp, S., & Cox, K. (2011). Interactive word walls transforming content

vocabulary instruction. *Science Scope*, *35*(3), 45-49

Mason, L., Boscolo, P., Tornatora, M., & Ronconi, L. (2013). Besides knowledge: A cross-sectional study on the relations between epistemic beliefs, achievement goals, self-beliefs, and achievement in science. *Instructional Science: An International Journal Of The Learning Sciences, 41*(1), 49-79

Mastropieri, M.A., Scruggs, T.E., Norland, J. J., Berkeley, S., McDuffie, K., Tornquist, E. H., & Connors, N. (2006). Differentiated curriculum enhancement in inclusive middle school science: Effects on classroom and high-stakes tests. *The Journal of Special Education, 40*(3), 130-137

Moorehead, T. & Grillo, K. (2013). Celebrating the reality of inclusive STEM education: Co-teaching in science and mathematics. *TEACHING Exceptional Children*, *45*(4), 50-57

Ramburuth, P. & Hartel, C.J., (2010). Understanding and meeting the needs of students from low socioeconomic status backgrounds. *Multicultural Education & Technology Journal 4*(3), 153-162

Toth, A. (2013). Not just for after lunch: Accelerating vocabulary growth during read-aloud. *Reading Teacher, 67*(3), 203-207

Yates, P.H., Cuthrell, K., & Rose, M. (2011). Out of the room and into the hall: Making content word walls work. *Clearing House: A Journal Of Educational Strategies, Issues* *And Ideas, 84*(1), 31-36