2007

The Language of Science: Vocabulary Insturction in the Inclusion Classroom

Tamara Iwasiw
St. John Fisher College

The Language of Science: Vocabulary Insturction in the Inclusion Classroom

Abstract

Vocabulary is found in all areas of academic study. How the vocabulary is approached with regards to instruction varies widely. Through a review of the literature, multiple strategies have been outlined for use in the classroom. Some of these strategies were employed into action research using the Japanese lesson study model to determine the appropriate method for vocabulary instruction in a particular inner city high school science inclusion classroom. The results of the study were in correlation with the review of the literature where student achievement was impacted by the addition of vocabulary instruction to the regular class curriculum. Student grades were impacted positively as well as confidence in the classroom as students gained an understanding of their vocabulary that was essential to the understanding of the science concepts.

Document Type

Thesis

Degree Name

MS in Mathematics, Science, and Technology Education

1-1-2007

The Language of Science: Vocabulary Insturction in the Inclusion Classroom

Tamara Iwasiw
St. John Fisher College

The Language of Science: Vocabulary Insturction in the Inclusion Classroom

Abstract
Vocabulary is found in all areas of academic study. How the vocabulary is approached with regards to instruction varies widely. Through a review of the literature, multiple strategies have been outlined for use in the classroom. Some of these strategies were employed into action research using the Japanese lesson study model to determine the appropriate method for vocabulary instruction in a particular inner city high school science inclusion classroom. The results of the study were in correlation with the review of the literature where student achievement was impacted by the addition of vocabulary instruction to the regular class curriculum. Student grades were impacted positively as well as confidence in the classroom as students gained an understanding of their vocabulary that was essential to the understanding of the science concepts.

Document Type
Thesis

Degree Name
MS in Mathematics, Science, and Technology Education

The Language of Science: Vocabulary Instruction in the Inclusion Classroom

Tamara Iwasiw

St. John Fisher College

Abstract

Vocabulary is found in all areas of academic study. How the vocabulary is approached with regards to instruction varies widely. Through a review of the literature, multiple strategies have been outlined for use in the classroom. Some of these strategies were employed into action research using the Japanese lesson study model to determine the appropriate method for vocabulary instruction in a particular inner city high school science inclusion classroom. The results of the study were in correlation with the review of the literature where student achievement was impacted by the addition of vocabulary instruction to the regular class curriculum. Student grades were impacted positively as well as confidence in the classroom as students gained an understanding of their vocabulary that was essential to the understanding of the science concepts.

Dedication

To my family for all of their love, motivation and financial support during my college career and for extensive support during this final capstone project.

Acknowledgements

This work would not be possible without the encouragement, support, tremendous lexicon, and classroom of my colleague, Brian Gallagher. It was a pleasure to work collaboratively with him on this project, and for this I owe him great thanks. I would also like to thank Dr. Diane Barrett for her enthusiasm, inspiration and support throughout this master's program and capstone project.

Table of Contents

The Language of Science: Vocabulary Instruction in the Inclusion Classroom

Vocabulary strategies and instruction are important for student learning in many different contexts. Considering the vocabulary load for middle school science classes, direct instruction of key terms is needed along with opportunities to practice and review the terms and their definitions to ensure all students are able to understand the scientific concepts and principles they are studying. This knowledge assists students in their content reading, writing, class discussions, and classroom activities. What implication does this have for the inclusive classroom? It is crucial that teachers reach all students by using effective strategies and actively research in their classroom to develop a consistent approach to regular vocabulary instruction.

This study used the Japanese Lesson Study model to find the vocabulary strategy that best meets the needs of the students involved. Vocabulary lessons were created, co-taught, reviewed, modified and re-taught to find the ideal strategies for student success. These strategies were implemented for future use in the classroom.

Assessments measured success at the conclusion of each lesson. Vocabulary usage was categorized in respect to Bloom's Taxonomy, with success increasing in respect to Bloom's competence levels. For example, the lowest level of success corresponded with Bloom's knowledge while the highest level corresponded with students' evaluation and discrimination between ideas.

Literature Review

The literature has stated that students are often challenged by technical vocabulary and not prepared with strategies and effective vocabulary instruction for understanding and recalling the meaning of terms used in Science classrooms. Many authors agreed that vocabulary instruction must go beyond reading, writing, and reciting vocabulary and for students to understand and retain word meanings they must appear in a variety of activities and contexts (Appelget, Matthews, Hildreth & Daniels, 2002; Fang, 2006; Williams & Hounshell, 1998). Repetition is important for teaching new vocabulary to students with learning disabilities (Williams & Hounshell). Vocabulary should be pronounced, used in context, written on the board and written on handouts several times for all students including those with learning disabilities. Additionally, students should be able to define and use their vocabulary in activities as well as see connections between the common vocabulary they use and what is found in their science classroom (Appelget, Matthews, Hildreth & Daniels). Harmon, Hedrick and Fox (2000) stated that students must be directly exposed to a word meaning, but to internalize that meaning they must be engaged in sufficient practice that reflects meaningful use of the key term not just repetition of definitions. This repetition of exposure should not consist solely of vocabulary practice as its own part of each lesson by reciting definitions in different formats such as reading and writing from a dictionary, flash card practice and fill in the blank sentences but should also be visible in varied lesson activities. Williams and Houndshell found that, "Science disciplines have specific, unique languages, and a certain amount of vocabulary mastery is required for even a minimal understanding of science concepts"

(p. 29). Vocabulary studies can be incorporated into direct instruction, modeling, guided practice and meaningful applications (Fang).

Essential strategies for vocabulary instruction will be found in this review of the literature. These strategies are broken into three phases; pre-instruction, direct instruction and post-instruction. Pre-instruction strategies include building background knowledge and activating prior experiences, preparation of lessons and teachers, inquiry-based approaches and preteaching strategies, which included roots and affixes. Direct instruction of vocabulary includes writing activities, reading strategies and metacognitive strategies such as mnemonics. Post-instruction strategies include vocabulary review with a focus on vocabulary games and role-plays and class discussions of key vocabulary terms.

Background Knowledge

Young (2005) argued that background knowledge and prior experiences are essential to students' comprehension of vocabulary. Students arrive in the classroom with their own experiences that can be accessed, vocalized and discussed in the classroom. In addition, teachers can provide meaningful experiences in the classroom that will build background knowledge for later use. Student knowledge and understanding is reinforced in inclusive classrooms when the teacher involves students in active learning by activating their past learned knowledge to make connections to new material (Alexakos, 2001). Using a variety of media such as videos, DVDs, and Web sites are a rich source of visual experiences that aid in building vocabulary experiences that can be accessed in later lessons or units (Gregg

& Sekeres, 2006). Williams and Houndshell (1998) found television and videos to be stimulating for students with disabilities. The use of graphics, music, and sounds make learning scientific concepts real. Also, "LD [learning disabled] students feel safe when they are watching a movie because they know they can relax and learn without the threat of being called on to answer questions or read aloud" (p. 30). Additionally, Gregg & Skeres recommended stopping the video to generate class discussions about the examples they saw about their topic and to allow the class to generate definitions of key vocabulary terms. Using these visual strategies also draw on the interest of learners making students excited to learn and contribute their own experiences (Alexakos).

Similar activities for activating and building prior knowledge have been tried and researched in the classroom. Harmon, Hedrick and Wood (2005) emphasized using a contextual-based approach to illustrate the multiple uses of vocabulary words in scientific and everyday situations. Young (2005) used the rate your words strategy as a means for students to access prior knowledge of vocabulary terms. Rate your words is a rating scale that students rate their vocabulary words based on the comfort level they have with each word; words you know, words you almost know, words you think you have seen and words you do not know at all. This prereading strategy helped students to assess and activate their prior knowledge of key vocabulary. Another place connections are made is through the use of picture books, which is a starting point for class discussions activation of prior knowledge (Miller, 1998). Raborn and Daniel (1999) suggested using familiar texts from childhood to activate

prior knowledge, and use these texts to create new experiences for learning in the classroom.

Preparation

Lesson planning is key to successful vocabulary incorporation. A structured learning cycle that includes engagement, exploration, explanation and extension offers a variety of active educational experiences to benefit all students (Salend, 1998). Vocabulary instruction should be incorporated into each of these learning cycle stages. The literature (Alexakos, 2001; Munk, Bruckert, Call, Stoehramann & Radandt, 1998; Salend, 1998) stated that using big ideas or chunking instructional material to prioritize concepts and focus on important ideas is helpful for all students and especially in inclusive classrooms. As stated by L. Carnine and D. Carnine (2004), "By simplifying the content and focusing instruction on big ideas, the extraneous information typically included in middle school textbooks has been greatly reduced" (p. 210). This method organized student learning and eliminated confusion about details and material that is not essential for understanding a concept. Pasley, Weiss, Shimkus and Smith (2004) stated, "One of the most important aspects of effective science lessons is that they address content that is both significant and worthwhile" (p. 4). It is the teacher's responsibility to interpret the curriculum to teach only the important content when planning both units and individual lessons and activities. Chunking is also an important strategy for reading text. Text should be pre-read by teachers and extraneous material that does not impede the learning of a

new concept can be blocked out with a marker (Alexakos, 2001; Munk, et. al., 1998). Learning through inquiry learning can also facilitate vocabulary instruction since it promotes questioning strategies and hands-on learning (Salend; Schmidt, Gillen, Zollo & Stone, 2002). This method of instruction is also effective in inclusive classrooms since it promotes student centered learning and student researchers. This also provides students with the opportunity to guide their own learning to maximize their individual learning style (Alexakos). Fitzgerald (1996) promoted using technology-assisted tools to support instruction by differing curriculum and teaching approaches for students with learning disabilities. However, Fitzgerald cautioned that the implementation of such a program requires a substantial amount of time from teachers and may not be a feasible approach. Salend promotes the use of technology stating that the internet provides a plethora of information and experiences including exploratory and discovery-based learning as well as communication while offering students control over their curriculum through the choices they have related to their learning. Students with learning disabilities and with behavioral disorders often enjoy spending time using the computer and when well instructed and guided, it can be a powerful learning tool.

An overarching concern is that most science teachers do not have the training to develop lessons that are suitable for inclusive classes. Kirch, Bargerhuf, Turner and Wheatly (2005) stated, "teachers of science and professors teaching science methods have had little training and experience in teaching students with disabilities and were not aware of the research on best practice as it applies to students with disabilities" (p. 176). Kirch et. al. suggested that educators can be prepared for

inclusive classrooms through the use of professional development workshops, but caution that, "one course, however, cannot adequately prepare teachers for the complexity of inclusive classrooms" (p. 176). This includes collaboration with a special education teacher, where available. Some teachers are not receptive to collaborative settings and some simply do not have the experience or training to know how to handle sharing their classroom. Teachers can be educated about effective inclusion models through college courses and specially designed workshops. Harmon et. al. (2005) stated that teachers of all content areas must have training in effective vocabulary instruction strategies for pre-teaching, direct instruction and reinforcement activities. They recommended schools provide these trainings for teachers to gain solid, research-based strategies for to maximize student achievement in the classrooms. Salend recommends schools using specially designed programs like FOSS [Full Option Science System], which has scripted plans that encompass a variety of activities including cooperative learning groups, discovery learning and interdisciplinary activities to teach science language and the use of scientific equipment. Tinker (2001) stated that teachers can gain specialized professional development through the use of online courses. These courses are similar to traditional college courses but foster to busy schedules since the education is independent study. Kirch, et. al. recommended that college programs be changed so that preservice students preparing to be teachers be required to take special education classes and have field experiences with inclusive education classes if they are preparing to teach in a general education setting. This would eliminate the anxiety among teachers when they are involuntarily placed into inclusive classrooms.

Inquiry Based Approach

The literature supported inquiry learning in science has been proven to be an effective way for students to gain knowledge in the subject area as well as vocabulary development (Alexakos, 2001; Schmidt et. al., 2002; Scruggs, Mastropieri, Bakken, & Brigham, 1993). We are in a generation of science reform where we are moving away from the textbook back-to-basics approach to science and towards the method to science education (Scruggs et. al.). Since it has been proven for decades that students with learning disabilities have difficulty with the textbook and worksheet approach to science education, potential benefits to an inquiry-based approach are easy to imagine (Harmon, Hedrick & Fox, 2000; Harmon, Hedrick & Wood, 2005; Reid & Lienemann, 2006; Schmidt et. al., 2002; Scruggs et. al.). In the inquiry-based classroom, reading, which has proven to be difficult for students with disabilities, is de-emphasized and the educational focus is on doing (Scruggs et. al.). In their research, they found when class time was appropriately structured and students were aware of their responsibilities, activity-based inquiry-oriented approached were highly successful in inclusive settings. There results were based on a variety of assessments including performance, discussions and unit tests. They discovered that students with learning disabilities performed at the same level as normally achieving students on assessments. They noted, however that the teachers in their research commented that there was a higher demand placed on behavior management during the implementation stage of this program. Since students are learning questioning skills and are constantly reading and listening for information and writing and

speaking for communication in the elementary inquiry classroom, students naturally developed their repertoire of scientific vocabulary during every lesson (Scmidt, et. al.). They found students having many ways to practice language arts for literacy development while learning science concepts. Literacy improved naturally since students were discovering and recording information as a part of every lesson. Contrary to this, Scruggs, et. al. found that in a middle level classroom, vocabulary was at the lowest level of acquisition in both inquiry and textbook approaches. They stated, "Although the activity-based condition resulted in a slight advantage in vocabulary learning, it is clear that neither technique contained adequate vocabulary enhancing strategies" (p. 10). Therefore, they recommended supplementing any program with additional vocabulary learning procedures, "to generate higher levels of learning and understanding of all relevant content" (p. 10). Just as there are many different learning styles, there are many different teaching strategies that have been tested and proven to be effective in the classroom. However, the research suggested that students with learning disabilities not only enjoy the activity-based inquiry-oriented approach to science education, but they also learn and retain information more efficiently in this setting.

Preteaching Vocabulary

There is a consensus among the literature that states there must be time given in science classrooms for preteaching new vocabulary. Munk et. al. (1998) found preteaching vocabulary promotes improved decoding and comprehension. They

recommended breaking vocabulary down into a few terms at a time to relieve the overwhelming number of terms in each unit. L. Carnine and D. Carnine (2004) stated that students are faced with an abundance of vocabulary that to ensure comprehension, new vocabulary must be taught at the beginning of each new concept. In addition, these vocabulary words must be practiced with daily exercises to promote retention. Young (2006) discussed beginning vocabulary instruction with a vocabulary questionnaire, which is a pre-test without the word test. This showed teachers where students were with vocabulary knowledge and can focus instruction. It is also recommended that this questionnaire be given after students have had meaningful experiences with vocabulary as evidence for learning.

Fang (2006) stated, "Technical terms in science often have Greek or Latin origins" (p. 508). These multi-morphemic terms typically have common prefixes suffixes and roots. To understand these terms, direct instruction of roots and affixes can be beneficial for students (Carnine & Carnine 2004; Fang; Harmon et. al., 2000). Activities for students to decode the word begin with identification of the affixes, and then students can look at the root word (Carnine & Carnine). In their research, Harmon et. al., (2005) found that teaching Greek and Latin roots such as micro-, bio-, and gene-, in science assists students at all levels discover meaning of new terms. From the beginning of the school year, teachers can provide direct instruction of affixes, and as a class, a chart can be made and posted for reference. Students can be taught to highlight known affixes when presented with new vocabulary, and students can ask questions or have class discussions (Harmon et. al. 2000). During research, teachers created word charts for students to break their vocabulary down and visualize

the prefixes, suffixes and roots (Fang). This also helped students to understand the commonalities and differences between their terms. These carts were effective when completed individually or in collaborative group situations. L Carnine and D. Carnine found "Students generate the meanings of new words, applying the affix definition. Once an affix has been introduced, it is reviewed over the course of the year" (p. 207). This strategy assisted students in decoding and pronouncing key vocabulary terms.

Writing Activities

Writing activities provide additional practice for vocabulary instruction (Harmon et. al., 2000; Montelongo, Berber-Jimenez, Hernandez, & Hosking, 2006; Salend, 1998). Salend initiated journals and learning logs as a good place for students to practice using their vocabulary in writing while they reflected upon their learning. Upon initial introduction, this was also a good place for students to list and define key terms. Students can apply basic knowledge of vocabulary terms when completing sentences that have vocabulary words intentionally left out (Fang, 2006; Harmon, et. al., 2000; Montelongo, et. al.). These sentence completion activities were useful in study guide formats to provide students with access to words and meanings for review. Alternatively, when students paraphrase vocabulary to put the definition in their own terms they make a deeper connection with the term and have a greater chance for retention (Fang; Harmon, et. al. 2000). Students can develop a word chart to practice using new vocabulary and to see the relationships between words, which can be posted in the classroom or kept in their folders for future reference (Fang).

Young (2005) discussed a semantic feature analysis for vocabulary acquisition. Research has shown that this strategy to have been effective for students with disabilities and struggling readers. In the semantic feature analysis, there is a column for vocabulary terms on the left hand side of the page and a list of features in the top row. During vocabulary instruction or reading, students are instructed to put a plus (+) by features associated with the term and a minus (-) by features not associated with the term. Students should be introduced to this strategy as a whole group modeled activity, after which, students should work with the strategy in small collaborative groups and during independent work time.

Munk et. al. (1998) offered a strategy they call response cards. They described this strategy as using prepared cards or blank boards, one for each student where students could respond to a question or statement and then when the teacher gives a signal, each student must hold up the card for the teacher to see. Through their research, they discovered that this was an effective way to increase student involvement in the acquisition of science vocabulary. Response cards can be used in a variety of settings including whole class and small group as well as for a variety of disciplines, which provides consistency that students with disabilities thrive on. Since each student responded at the same time, this was also an effective assessment strategy, which guided future instruction.

Graphic organizers are another form of vocabulary writing that can be used in many different ways to organize and show relationships between vocabulary words (Gregg & Sekeres, 2006; Harmon et. al., 2000; Montelongo et. al., 2006). In their research, Harmon et. al., (2005) established that using graphic organizers to show

relationships between terms is highly effective in content area vocabulary instruction. Gregg and Skeres use two different graphic organizers consistently, Venn diagrams and webs where students were instructed to fill in the teacher made templates. As a modification for students with disabilities they recommended filling the organizers out as a class on the board or overhead, asking students to participate in discussion, and copy the information onto their individual worksheets. Similarly, Munk et. al. (1998) discussed the use of advance organizers as a framework for recording, organizing, and classifying vocabulary. These organizers contain large amounts of information in a way that can be recalled and applied easily. This proved to be beneficial when teachers asked students to complete creative writing assignments as well as review before assessment. An organizing strategy Young (2005) has employed in the classroom is a definition map. To support using this strategy, Young said, "The map helps them review their background knowledge and make meaningful connections, which is very important because dictionary definitions could be confusing to students, and they might select an incorrect or partial definition" (p. 13). Young offered three guiding questions for definition maps; what is it, what is it like, and what are some examples. These guiding questions were put into circles for students to complete and each circle was connected to the center circle, which contained the key vocabulary term. Schmidt et. al. (2002) used the KWLQ organizer with their research group. In this model, K stood for what the students know, W stood for what the students want to know, L stood for what the students learned and Q stood for more questions the students have. They found this strategy helpful for activating and assessing prior knowledge along with guiding the discussions and learning for

future sessions. It also helped to show students that learning is a continuous quest instead of ending at the conclusion of each unit.

Harmon et. al. (2000) presented many other effective writing activities to enhance vocabulary learning and practice. As part of their research they used creative writing strategies in the science classroom. They established students had more interest when they were given a variety of activities that provided the opportunity for them to express themselves creatively. These strategies included students writing interview questions and writing riddles, which students enjoyed interacting with their peers and trying to solve each other's riddles. These activities fostered communication and working collaboratively with peers. They also required students to practice writing descriptive paragraphs and writing summarizing paragraphs using key vocabulary words. Letters and brochures also aided in student collaborations, and in preparation for assessment, students were directed to create illustrations of key terms and write clues for review. Galles (2005) took a different direction with writing vocabulary by collaborating with the English teacher for writing activities. They worked together to incorporate poetry and vocabulary having students write their works in both of their classes. Upon completion of their assignment, students submitted copies to each teacher to be graded with a rubric the teachers collaboratively generated. After the teachers had reviewed the student work, they provided students with the opportunity to read their poem aloud to the class. They found, "Student retention of vocabulary increased dramatically, and they started bringing in material from history and Spanish classes" (p. 12).

The literature has also discussed where writing can be ineffective vocabulary practice. Reid and Lienemann (2006) discovered when working in classrooms that contain students with attention deficit/hyperactivity disorder (ADHD) asking these students to produce stories or narratives was difficult. In their research they established that students with ADHD often have difficulties writing cohesive narratives and results in confusion for the reader and writer which can trigger behavior problems and difficulty focusing and completing their task. Harmon, Hedrick and Fox (2000) and Harmon, Hedrick and Wood (2005) asserted a different problem when they stated that surface-level knowledge activities such as crossword puzzles, matching exercises and fill in the blank activities provide mindless time consumption and do not assist the students in internalizing or remembering definitions. They went on to discuss the use of flashcards as vocabulary definition practice as an ineffective teaching strategy. Again, students copied the definitions without internalizing and often when given time to practice, students were off task resulting in behavior issues.

As an alternative to the poor use of flashcards, many authors have modified this strategy to make it not only successful but also valuable for students. Young (2005) modified traditional flash cards into personal clue cards. Young argued this strategy is important for long-term retention and application of key vocabulary concepts. Here students have index cards that prompt them for the key word, the definition, which can be formal or restated in their own words, and a personal clue known as a brain signal. This clue that students individually generated, assisted them in recalling and internalizing their vocabulary definitions.

Picture dictionaries have been found to be an effective way for students to model their vocabulary definitions (Harmon et. al., 2000). These personal dictionaries can be created using flashcards with one hole punched, and a clip or ring to bind them. Students can put the picture on the side of the term to prompt them for the definition or on the other side of the card in place of or in conjunction with the definition. The teacher in consideration of individual student learning styles would determine the best method. Similarly, Young (2005) offered a strategy called TV Visualization. This strategy asked students to draw an image inside a TV screen related to their vocabulary word. Next, students were asked to complete a series of questions, including; restate the definition in their own words, write three synonyms and three antonyms, and write a sentence using their word.

Reading Activities

Miller (1998) discussed using picture books to support content area learning in middle school classrooms. Students were excited to use these texts since they are typically at a lower reading level than textbooks and they also enjoyed to illustrations, which gave them a visual connection with the concepts. For use in whole group instruction, teachers can model strategies for figuring out new or difficult words. Students also enjoy individually and collaboratively reading them, especially in inclusive classrooms where students may not have the skills to read the difficult textbooks. There are good picture books available that contain key vocabulary terms and language. "Vocabulary-rich picture books can provide an enjoyable source of exposure to more sophisticated language" (p. 377). The literature discused the use of

picture books to brainstorm ideas for creative writing in which vocabulary can be used. The vivid images can be used to spark students' imagination and creativity. This can also be beneficial for students to illustrate vocabulary or see their vocabulary in the images. Similarly, "Abstract concepts in science, technology and mathematics can be given more concrete and visual connections to students' experiences by using the visual examples, models, and diagrams in a picture book on the topic being presented" (p. 380). Gregg and Skeres (2006) offer a similar alternative to textbook readings. They suggested that when textbook reading is too difficult for the students in the class and alternatives are not available, teachers may create their own text for students. Simplifying the language and summarizing the ideas while carefully selecting and incorporating key vocabulary can be effective text reading for struggling readers. Gregg and Skeres also recommended using newspapers and magazines as alternative and visual text material.

Metacognitive Strategies

Another successful strategy for recalling vocabulary is the use of metacognitive strategies and mnemonics (Kirch et. al., 2005; Munk et. al. 1998; Stoehramann & Radandt, 1998). The literature referred to mnemonics as a created word or sentence that students memorize in order to recall a list of items as in "Kids Prefer Cheese Over Fried Green Spinach" in order to remember the ordering of biological groupings used in taxonomy (kingdom, phylum, class, order, family, genus, species). Munk et. al. gave a different approach to mnemonics such that, "[Teaching students] a keyword that was related to the definition of the targeted vocabulary" (p.

76). Kirch et. al. also mentioned that metacognitive strategies, which involve thinking about thinking, assisted students with disabilities by teaching them self-questioning, self-monitoring and self-reinforcement. Similarly, Williams and Houndshell (1998) found in their research that teaching mnemonics to students with learning disabilities could provide them with a sense of security on tests instead of typical test anxiety that can be paralyzing.

Vocabulary Review and Games

A strategy for summarizing text and vocabulary enrichment is summary frames (Honnert & Bozan, 2005). Summary frames are described as, "A series of questions that teacher provides to the students" (p. 20). Their research population was a group of students with disabilities in a self-contained classroom. They began with creating an index card with a vocabulary term on one side of an index card and the definition on the other to use as reference during the lesson. After their reading activity the students are given the summary frames, which include a series of questions and activities for the students, including acting out vocabulary and making a labeled drawing using their key terms. Honnert and Bozan found that this strategy was effective in their trial classroom since they were able to incorporate a variety of activities that corresponded with Bloom's cognitive taxonomy and the different learning styles of their population. As an extension, the teacher created a game that mimics TV's *Beat the Clock* for vocabulary review. Similarly, Marturano (2004) makes fun connections with vocabulary using games for instruction and review. Secrets is a game in which students are given words in random order and the object is

to arrange them to reveal something factual, a secret. Students are directed to copy all secrets into their notebooks to reinforce the concepts. Connections is a game where students are challenged to find relationships between pairs of concepts. Additionally they need to create a sentence that verbalizes the connection they have made. Again, students are directed to copy all teacher-approved sentences into heir notebooks. Pairs of opposites is a two person game in which students are given cards containing vocabulary words and their opponent tries to guess the opposite vocabulary term. This game will only work in situations where there are pairs of vocabulary words that can be seen as opposite. Again, students are directed to record all teacher-approved opposite in their notebooks. Marturano established that, "Games are a great way to help students make meaningful connections between abstract science concepts and vocabulary" (p. 38). Similarly, "Through handling and sorting objects and pictures, doing science experiments, and building models, children constructed meanings for new vocabulary words subsequently used in reading and writing" (Gregg & Skeres, 2006, p. 55).

Role-play and Discussions

Role-play and storied lessons are strategies that have also seen successes in inclusive classrooms (Appelget et. al., 2002; Zigo, 2001). Appelget et. al. used role-play with students to provide opportunities for script writing using key vocabulary terms and acting to appeal to kinesthetic and auditory learners. They focused on historical scientific information for these activities. Alexakos (2001) found, "Physical, pictorial, and symbolic examples can be integrated for a multisensory

approach to teach students with specific sensory and language disabilities" (p. 41). These activities can also be effective for students with attention or behavioral disorders since the tasks attract students' attention and interest.

Zigo (2001) discussed role-play and storied lessons where students and teachers take turns writing and telling stories to the class. When vocabulary is incorporated students make connections to definitions through recall of the story they heard in class. He goes on to discuss role-play as active storytelling to encourage critical thinking. This opens the door for students to make connections between their vocabulary and topics in class with past experiences. Zigo concluded with a discussion about long-term retention of vocabulary. He stated that this was not part of his initial research, but later he found evidence to support long-term retention of vocabulary words and their meanings.

The literature supported discussion and students involvement as a crucial part of science vocabulary instruction. Vocabulary discussion has been proven assist students in the development of their knowledge as well as increasing the frequency and fluency of vocabulary in conversation (Gregg & Skeres, 2006; Harmon et. al., 2005). Discussions should also focus on multiple definitions of terms and use of scientific terms in common speech when applicable for students to understand these connections (Alexakos, 2001). The research stated discussion can and should be incorporated into all of the vocabulary instruction with a focus on active student participation (Gregg & Skeres; Harmon et. al., 2005). Alexakos (2001) warned that teachers must consciously encourage participation by all students, as some students may be inclined to take a passive role in science vocabulary acquisition. Gregg and

Skeres also included that it is important to engage in these discussions in each stage of vocabulary acquisition including pre-reading activities.

Summary

Harmon et. al. (2000) stated, "Supporting content literacy in general and vocabulary development in particular is the responsibility of all teacher, and effective vocabulary practices are embedded in sound conceptual teaching (p. 270). They went on to say that students need a variety of experiences that provide meaningful practice of vocabulary to gain an understanding of science concepts. The literature offered a variety of approaches to guide students toward making meaningful connections with their vocabulary, and it is up to teachers to trial different strategies to find a few that can be used repeatedly in the classroom to maximize active responding and retention of vocabulary in science. Having exposure to vocabulary in multiple contexts facilitates confidence and retention of vocabulary used in reading, writing and speaking (Gregg & Skeres, 2006).

Methodology

Kenkyujugyo is the Japanese word for the study or research lessons. In our context, and language, we phrase it as lesson study. Anyway you phrase it; it is a group process of studying one's methods of teaching to maximize student performance. Though the use of lesson study the goal of the research was to improve student retention and raise their cognitive awareness of scientific vocabulary as well as to have a positive effect on the students' overall engagement in regard to science education.

Population

The research participants were high school, inner-city science students. The school is a bi-lingual school with the population 50% African American, 32% Hispanic, 15% European American and 3% Asian American. The students in the study were split almost 50/50 African American/Hispanic, with less then 5% European and Asian American. The majority of reading levels at this school and classroom was below grade level with only approximately 25% testing at grade level. Many of the students struggled with multi-syllabic and low frequency scientific vocabulary. These students had a difficult time doing simply more than identifying the word and reciting a memorized definition. This was evident when the students were asked for simple comparison while integrating their key scientific vocabulary.

Method/Process

According to Fernandez and Yoshida (2004) lesson study follows a set of steps:

1. Collaboratively planning the study lesson
2. Seeing the study lesson in action
3. Discussing the study lesson
4. Revising the lesson
5. Teaching the new version of the lesson
6. Sharing reflections about the new version of the lesson (p. 7)

For our lesson studies we followed Doug Llewellyn's observation protocol as provided for us as St. John Fisher College. Assessments were inline with typical classroom activities; this afforded us the ease of implementation as well as getting realistic classroom data.

These lessons will focus on vocabulary strategies concentrating on reading and writing strategies. We will be starting by asking students to create vocabulary cards that include their key term, the definition of the term and a picture to represent the term and its definition. Based on their comprehension and retention of the vocabulary, we will be modifying the lessons to include teacher found or created images of vocabulary words, class discussions of vocabulary, paraphrasing definitions, graphic organizers, and comparison activities.

Success Measured

Assessments measured success at the conclusion of each lesson. Vocabulary usage was categorized according to Bloom's Taxonomy, with success increasing in respect to Bloom's competence levels. The level of success is dependant on the level of usage of the new vocabulary with simple identification being the lowest level of success and true evaluation with discrimination between ideas indicating the highest level of success. Improvement was noted when the students progressed from one competency level to another as well as increased test scores.

Results

The formative and summative assessments taken in the normal course of teaching showed an overall improvement in the student's grades. Weekly vocabulary instruction techniques increased the student's confidence as well as their own lexicon. This increased confidence and vocabulary knowledge translated to higher test scores and overall achievement. The lesson study method helped to focus in on the parts of the lessons that need improvement and thereby perfected the techniques that were needed by the students in this classroom setting.

Research Results

A simple Friar Model with the deletion of the *not examples* was used as a starting point for our lesson study. Students were asked to write their term and definition and draw a picture to illustrate the term/definition. The terms were always taken from the science unit that was currently being taught as well as some common testing words. The goals of this lesson were multifaceted.

The primary focus of the lesson at its inception was to get students into a routine for vocabulary instruction/development. The lesson's first priority was to have the students in the frame of mind for vocabulary instruction at the same time every week, and with the expectation of a grade at the end of the lesson. The ancillary foci were to move students out of vocabulary identification and into comprehension as well as to give the students opportunity to experience vocabulary instruction independent from their science lessons.

The first iteration was a success. The students now know that Wednesday is *Word Wednesday* and they are ready for the list of words to begin the activity is to be associated to that list. The routine was such a success that the classroom practically ran itself on successive lessons. The students were aware of their expectations and completed the tasks weekly. Vocabulary recognition increased during this period and the students began to use the vocabulary in their classroom discussions as well.

The failing in the lesson at this point was determined to be the method of generation of the pictures in the student's work. In the previous lessons the students were asked to draw a picture that represented the definition, but they were simply reproducing images directly from the text and as such, no real processing was occurring. The modification in this lesson made in the lesson study process was the addition of a mini-lesson filled with images. This was added to stimulate discussion of the vocabulary words as well as to expose the students to more then one image. The additional images were shown to the students of select vocabulary words as their engagement to the routine vocabulary lesson.

The primary focus of this modification was to broaden visuals so students would stop replicating images from their textbooks. They were expected to start integrating these other images and creating original works from their imagination to truly show processing and internalizing of the vocabulary words and their meanings.

The ancillary foci of this lesson were to initiate class discussions about their vocabulary words and to increase engagement and motivation surrounding science vocabulary. The images were selected with the intent to inspire classroom discussion even if the selected topic was not of immediate interest to the students. This extension

challenged the students and was tailored to the development of genuine excitement for science and the building of intrinsic motivation.

This iteration was not as successful as the first. It resulted in several students producing original images, while most reverted to the more familiar form of the exercise and made direct reproduction of the images in the textbook. As for the discussion session, students asked some questions but true discussion was difficult. It was more of a forum for students to have their questions answered by the teacher then a continual movement of ideas and questions driven by the responses of the students. As a result, the students took this time to probe for information on the selected topic and not to generate new ideas on said topic.

The failing in this lesson was the fear of failure. The students did not want to risk being *wrong* during a classroom discussion and they felt that there was not enough time to complete all of the images and not copy them from the text. The modification was made to have the students work on only one vocabulary term in groups and created a poster. This would allow them focus on only one term thereby relieving the pressure on time constrains and to have their discussion in a smaller forum as to alleviate the risk of embarrassment since they were allowed to form their own groups.

The primary foci of this modification were to prevent tracing of images from the textbook and to increase visual and kinesthetic aspects of drawings. This was accomplished by increasing the size of the paper from standard to poster as well as allowing students to use markers to create colorful images. Students were required to fill their paper completely and were repeatedly encouraged to produce original images.

The ancillary foci of this lesson were for the students to build interpersonal skills, teambuilding and an all for one grading system. This was achieved by allowing the students to choose their own groups to work with. Students collaborated within their groups to complete this task and contributed portions based on their academic abilities. Assessment was given as a whole based on the completion of the assignment.

The third iteration was a success. Groups completed their assignments whereby they produced images that exceeded teacher expectation. The images produced were not only high quality but were also imaginative and demonstrated a clear understanding of the vocabulary term. The students worked well together and organized themselves into cooperative learning groups. They each used their individual strengths to have a high level of personal and group success. An additional benefit of these groupings was discussion that surrounding the vocabulary term and science in general. The next modification of the lesson was to push the students to take it to the next level.

The primary focus of this iteration was for students to make a greater connection with vocabulary terms. The posters were changed to use Young's Definition Map. This map included three guiding questions: What it (the term) is, what it is like and an example. We also asked students to draw an illustration of their vocabulary. This extension included a comparison as well as the requirement to put the definition in their own words.

The fourth iteration was not as successful as the previous lessons. The work that the students produced was for the most part not at a higher level than previous work. They did not work as well in their groups as they did not feel as if they could meet the task easily and resisted the change that was presented to them. Some of the groups

reverted to their first assignment and did not complete the new activity. In short, they again feared being wrong. The student groups were unwilling to present a new idea to the class as a whole so the modification was made to remove the element of fear. Students created new posters and exchanged with other groups for presentation. The posters that were created had to be detailed enough so that the presenters could accurately explain the information on the poster after only five minutes of study.

The primary focus of this iteration was to remove the fear element in the classroom. The students felt as if they could not be wrong if they were presenting another groups information. Limited discussion time did not allow for students to feel the pressure of a long presentation or discussion of their work.

The ancillary foci were to make the students responsible for their own learning. Student groups had to study the posters before they presented and had to take direction from another group about the information on the poster. Additionally, the posters had to be detailed enough so that they could be understood and presented by a group other than the one creating it. The students were teaching each other the terms resulting in student centered learning.

The final iteration was a success. The work produced was the next level work we were looking for. The comparisons that were made were good and showed true understanding of the material. The presentations were basic, but did meet the requirements. They were in line with what would be expected of students in their first few times presenting.

Discussion and Conclusion

The research showed correlation with the review of the literature. The literature stated that students' achievements in subject areas would improve in regular and special education students when their exposure to vocabulary was expanded beyond normal lessons into a variety of activities for students to internalize their vocabulary (Appelget, Matthews, Hildreth & Daniels, 2002; Fang, 2006; Williams & Hounshell, 1998). The results showed students using their vocabulary in the classroom discussions as well as improvement of test scores as a direct result of vocabulary instruction and knowledge.

The first lesson was repeated over the course of several weeks to routine students into vocabulary instruction. This was especially beneficial for students with special needs as they perform better with routine. Positive benefits form repetition can be attributed to students understanding what is expected and a feeling of comfort in the classroom. This repetition was effective in this respect but may have been detrimental when different vocabulary strategies were employed, as students were resistant to change and many fell back into their routine.

The purpose of the first lesson modification was twofold. First, the literature stated that activating and building background knowledge was essential to student success in inclusive classrooms (Alexakos, 2001; Young, 2005). Additionally, the literature agreed that classroom discussion is crucial to understanding vocabulary as it forces students to hear and speak their key terms in multiple contexts (Alexakos; Gregg & Skeres; Harmon, Hedrick, & Wood, 2005). These ideas were key in the addition of images and photos to the engagement to the vocabulary lesson. Also, Gregg and Sekeres (2006) discussed the use of a variety of media including photos and video to

build students' background knowledge for future use in the classroom. As stated previously, students did not take well to the change. They were reluctant to discuss their vocabulary for fear that they would speak incorrectly. When it came time for them to produce their illustrations of their key terms, they reverted to copying images form their textbook. As a possible modification for future research, textbooks could be removed from the classroom or students could be directed not to use them.

The purpose of the third lesson also had many goals. The primary goals were to prevent the tracing from the textbook and to have students build interpersonal skills by working in groups. By forcing students to create poster in groups, their images could not be the same size as the textbook images. The images they produced were good, but some of them did appear to make larger images of what was in their text, with the addition of their own details. Also, by having students work in groups, they were forced to have small group discussions of the vocabulary. The literature stated that this is especially beneficial to students understanding (Alexakos; Gregg & Skeres; Harmon, Hedrick, & Wood, 2005), which is something that finally took place and showed its effectiveness in the study.

The purpose of the fourth lesson was based on the literature review. Students in the study continued to give textbook definitions of their vocabulary terms and they needed to make a deeper connection with the vocabulary and understand the definitions they were repeating. Therefore, the idea of Young's (2005) definition map came from the literature where the students were given guiding questions similar to those they had before but they were challenged to include a comparison and they were also told that they were to put the definition in their own terms. As stated earlier,

their work was good but not at the same quality as the previous lesson. Again, they were resistant to change and some groups did not change the way they worked. The work that the students produced was not of the level of even the previous lesson, but was instead something we would have expected from the first or second week. This was due to the fact that they had only done the previous lesson once, while the first lesson ran over the course of many weeks and they knew their expectations for that lesson. Also during this lesson some of the groups began having difficulty working together where there was arguing and work was not being completed. This was disappointing, but revealed that students needed more practice with group work and the sparked the possibility of instruction for group collaboration and cooperation.

In the last lesson, the purpose was to continue with the group work of the posters and eliminate the fear aspect of being wrong. This was done successfully by having student groups switch the posters. They felt comfortable working on the posters since they knew they would not be the group talking about it and they had to detail their work enough so that another group could present from it. This lesson worked well until the presentation. Students did create high quality posters with detail and individual illustrations. Where they went wrong was in the presentations. Since they were only given a couple of minutes to review their posters before the presentations began, student groups read directly off of the posters instead of making eye contact with the audience while discussing and elaborating on the presentation. More class time would be the easy solution in this case, but time is an issue in all lessons and unfortunately, there is never the availability of more time, since regents curriculum is demanding and fast paced. The other solution to this problem is

practice. Students have not been given the opportunity to make presentations in this classroom on previous occasions, so as a first run with presentations the students were meeting expectations. Practice, instruction and guidance about presentations would eliminate the poor presentations in the future.

There have also been ideas for future consideration for research generated by this project. Since students had such difficulty with change, immediately it became obvious that successful lessons needed to be run more than one time. Since students became accustomed with the first lesson, they reverted to producing class work from that first lesson each time they did not understand or feel comfortable about a modification instead of reverting to the previous lesson's modifications. Therefore, if a lesson runs successfully, that successful lesson should be repeated a few times before moving on to the next modification. This also brings up other considerations for research. There is no definite number that can be assigned to each lesson as the number of times it needs to be repeated from this research. As a idea for future research, one could look into how many times successful lessons need to be repeated so that students are comfortable enough with the activity to move on to a new or more challenging task. Also, it would be interesting to research if there would be a greater improvement in student achievement if multi-subject teachers worked together and ran the same lessons for the same students in different subjects. For example, team up teachers by level not by subject and have a team of teachers that teach different subjects but the same students working together to teach the same lessons. Then students would be exposed to each lesson at least once in each subject area before they move on to a modified or sequential lesson.

Students in this classroom produced good research results as they showed improvement in overall classroom assessments both formal and informal directly correlating with the addition of vocabulary instruction separate from their normal class work. This was in correlation with the literature as all authors stated that there was an improvement in student class work, course grades and confidence in discussions. It has become clear that there is an importance for vocabulary instruction to become a part of the curriculum for all science classes, but also in other subject areas as well. Students reinforced the importance of routine in inclusive classrooms as well as showing incredible improvement in reading, writing and completion of assignments. Student confidence was also improved, as they felt comfortable working on assignments where they could understand the vocabulary in the text. This study has confirmed the importance of vocabulary instruction in subject areas in addition to regular course instruction. Students benefited academically and personally through a raise in their grades as well as an increase in confidence in the classroom. It is essential that teachers of all subjects at any level employ these strategies in the classroom to benefit their students. This research can be duplicated in any academic setting and the benefits to students will be similar as there will be an improvement in student progress and achievement.

References

Alexakos, K. (2001). Inclusive classrooms. *The Science Teacher, 68(3),* 40-43.

Appelget, J., Matthews, C. E., Hildreth, D. P., Daniel, M. L. (2002). Teaching the history of science to students with learning disabilities. *Intervention in School and Clinic, 37(5),* 298-303.

Carnine, L. & Carnine, D. (2004). The interaction of reading skills and science content knowledge when teaching struggling secondary students. *Reading and Writing Quarterly, 20,* 203-218.

Fang, Z. (2006). The language demands of science reading in middle school. *International Journal of Science Education, 28(5),* 491-520.

Fernandez, C. & Yoshida, M. (2004). Lesson study: A Japanese approach to improving mathematics teaching and learning. Mahwah, NJ: Lawrence Erlbaum Associates.

Fitzgerald, G. E. (1996). Technology-assisted instruction for students with learning disabilities. *Journal of Computing in Childhood Education, 7(3-4),* 123-125.

Galles, J. (2005) Interdisciplinary does not mean intimidating. *The Science Teacher, 72(8),* 12.

Gregg, M. & Sekeres, D. C. (2006). My word: Vocabulary and geography learning. *The journal of Geography, 105(2),* 53-58.

Harmon, J. M., Hedrick, W. B. & Fox, E. A. (2000). A content analysis of vocabulary instruction in social studies textbooks for grades 4-8. *The Elementary School Journal, 100(3),* 253-271.

Harmon, J. M., Hedrick, W. B. & Wood, K. D. (2005). Research on vocabulary instruction in the content areas: Implications for struggling readers. *Reading and Writing Quarterly, 21*, 261-280.

Honnert, A. M. & Bozan, S. E. (2005). Summary frames: Language acquisition for special education and ELL students. *Science Activities, 42(2),* 19-29.

Kirch, S. A., Bargerhuff, M. E., Turner, H., & Wheatly, M. (2005). Inclusive science education: Classroom teacher and science educator experiences in CLASS workshops. *School Science and Mathematics, 105(4)*, 175-196.

Marturano, A. (2004). Making connections fun. *Science Scope, 27(8),* 38.

Miller, T. (1998). The place of picture books in middle level classrooms. *Journal of Adolescent & Adult Literacy, 41(5),* 376-381.

Montelongo, J., Berber-Jimenez, L., Hernandez, A. C. & Hosking, D. (2006). Teaching expository text structures. *The Science Teacher, 73(2),* 28-31.

Munk, D.D, Bruckert, J., Call, D. T., Stoehrmann, T. & Radandt, E. (1998). Strategies for enhancing the performance of students with LD in inclusive science classes. *Intervention in School and Clinic, 34(2),* 73-78.

Pasley, J., Weiss, I. R., Shimkus, E. S. & Smith, P.S. (2004). Looking inside the classroom: Science teaching in the United States. *Science Educator, 13(1),* 1-12.

Raborn, D. T. & Daniel, M. J. (1999). Oobleck: A scientific encounter of the special education kind. *Teaching Exceptional Children, 31(6),* 32-40.

Reid, R., Lienemann, T.O. (2006). Self-regulated strategy development for written expression with students attention deficit / hyperactivity disorder. *Exceptional Children, 73(1),* 53-69.

Salend, S. J. (1998). Using an activities-based approach to teach science to students with disabilities. *Intervention in School and Clinic, 34(2),* 67-78.

Schmidt, P. R., Gillen, S., Zollo, T. C., Stone, R. (2002). Literacy learning and scientific inquiry: Children respond. *The Reading Teacher, 55(6),* 534-548.

Scruggs, T. E., Mastropieri, M.A., Bakken, J. P. & Brigham, F. J. (1993). Reading versus doing: The relative effects of textbook-based and inquiry-oriented approaches to science learning in special education classrooms. *The Journal of Special Education, 27(1),* 1-15.

Tinker, R. (2001). Future technologies for special learners. *Journal of Special Education Technology, 16(4),* 31-37.

Williams, C. W. & Hounshell, P. B. (1998). Enabling the learning disabled. *The Science Teacher, 65(1),* 29-31.

Young, E. (2005). He language of science, the language of students: Bridging the gap with engaged learning vocabulary strategies. *Science Activities, 42(2),* 12-17.

Zigo, D. (2001). From familiar worlds to possible worlds: Using narrative theory to support struggling readers' engagements with texts. *Journal of Adolescent & Adult Literacy, 45(1),* 62-70.