# Science Vocabulary Achievement for English Language Learners

by

Krista Miglorie

December, 2009

A thesis submitted to the Department of Education and Human Development of the State University of New York College at Brockport in partial fulfillment of the requirements for the degree of Master of Science in Education

Science Vocabulary Achievement for English Language Learners

by

Krista Miglorie

APPROVED BY:

Thomas R. Allen 12/23/09

Advisor Date

1/12/10

Director, Graduate Programs Date

Table of Contents

# Chapter 1: Introduction

*Background*

All across the United States, educators are faced with the challenge of teaching students who come from a diverse range of backgrounds with varying degrees of English proficiency. It poses a significant problem when students come to school with limited or no knowledge of the English language. Teachers can help these students by researching effective strategies that give English Language Learners (ELLs) the tools they need to be successful in an environment that offers compassion and understanding for their unique needs. Furthermore, research indicated that students from the United States are lacking in science achievement as compared to their international peers. Lee (2005) highlighted this dilemma in his article, stating "International and national studies on science achievement indicate poor science performance of U.S. students overall and persistent achievement gaps between mainstream and nonmainstream students within the United States" (p. 492). These findings provided a rationale for researching how science instruction can be made more effective for ELLs.

Children typically learn best when engaged in activities that are embedded within a meaningful socio-cultural context. Vgotsky stressed the educational implications of social interaction (Tudge, 1990). He maintained that social interaction facilitates higher learning. In regards to Vgotsky's principles, Tudge (1990) stated "Interaction with a more competent peer has been shown to be highly effective in inducing cognitive development" (p. 159). Vgotsky's theory of learning through social interaction provides a foundational base for this study. The research of Cassata-Widera, Kato-Jones, Duckles, Conezio, and French (2008) further acknowledged the importance of making meaning within a socio-cultural context. They found that children rely heavily on language to construct meaning. They contended that providing ELLs with meaningful activities that provide opportunities for vocabulary development, exploration, and making meaning in a sociocultural context will help ELLs to be successful in the science classroom.

*Problem Statement*

The purpose of this study was to research and implement effective instructional strategies that will increase retention of science vocabulary for pre-kindergarten students who are ELLs. In my classroom, science instruction was embedded into the curriculum through inter-disciplinary units. Research clearly indicated the beneficial outcomes of inquiry-based learning (Lee, 2005). Studies also showed that journals may help ELLs to expand their repertoire of vocabulary words (Genishi, Stires, and Yung-Chan, 2001). Therefore, for the purposes of this study, I utilized science journals and implemented aspects of the inquiry method to discover how these instructional strategies impacted retention of science vocabulary for ELLs. I concurrently implemented the above listed strategies for three days a week for approximately twenty minutes each day. In order to provide evidence of retention of science vocabulary, I administered a pre-test and a post-test. The pre-test and post-test were identical. The change in score from pre-test to post-test provided evidence as to the effectiveness of the instructional strategies utilized for the ELLs in my classroom.

*Significance of Problem*

In my pre-kindergarten classroom comprised of 16 children who were four years old by December 1st, 2010, I had ten students who spoke a language other than English at home. Many of these ELLs had little or no exposure to the English language until they started in my classroom in September. While the limited English proficiency of ELLs makes it more difficult for them to communicate science understanding, it should not be assumed that they are less capable of learning scientific concepts. In this study, I explored in detail how the inquiry method and the use of science journals impacted science vocabulary achievement.

*Rationale*

Gibbons (2008) highlighted the rising population of students who do not speak English. Referring to ELLs, Gibbons stated that "in 2001, this number was approximately 3.4 million" (p. 50). This issue is compounded by the notable achievement gap in science (Lee, 2005). Furthermore, studies suggested the significance of vocabulary development as a critical building block in children's early literacy development (Silverman, 2007). These findings provided a solid rationale for my central research question, which addressed how implementing aspects of the inquiry method in a meaningful socio-cultural context combined with utilizing science journals impacted retention of science vocabulary for ELLs.

While the temptation may exist to focus solely on literacy for ELLs, it is important that teachers strive to narrow the achievement gap that currently exists in science learning for ELLs. This study helped to broaden my repertoire of instructional strategies for science learning. By implementing research based instructional strategies, my students were afforded the greatest opportunity to succeed in science.

*Definition of Terms*

There are numerous terms that encompass students who do not speak English as their primary language. Some of these include: English language learners (ELLs), English as a second language (ESL), and English for speakers of other languages (ESOL). In this study, I used the term English Language Learners (ELLs). Furthermore, it is important to define what English Language Learners were for the purpose of this study. Gibbons (2008) asserted that an English language learner is defined as "anyone learning to speak English whose native language is not English" (p. 50). Therefore, my definition of ELLs referred to students who do not speak English as their primary language.

## Chapter 2: Literature Review

As a result of the accountability provisions of the *No Child Left Behind Act* of 2001, there is increasing pressure on schools to close the achievement gaps that exist between underperforming groups of students and mainstream students. English Language Learners are one of the underperforming groups on standardized achievement tests for science (Lee, 2005). The literature review presented here may help educators by offering them a repertoire of strategies that will successfully support the needs of ELLs in the science classroom.

### *Theory*

Vgotsky's views on child development support the foundation of my research, which is framed through embedding inquiry instruction into science instruction. He contended that children develop higher order functions through social interaction (as found in Tudge, 1990). Social interaction is crucial to the development of critical thinking and other higher level thinking processes, such as predicting events, drawing conclusions, and formulating hypothesizes. Vgotsky developed the concept of the zone of proximal development, which asserted that more competent peers can facilitate the cognitive growth of children. Therefore, providing students with multiple opportunities to interact with peers to discuss concepts and vocabulary will help students to engage in higher level thinking. In the study presented in this paper I encouraged students to discuss themes, concepts, and vocabulary that arose through their natural curiosity.

*Creating a Classroom Environment that is Conducive to the Needs of ELLs*

Research indicated that many ELLs have apprehensions about school (Lee, Butler, and Tippins, 2007). They asserted that many ELLs feel insecure, depressed, and isolated. In order for instruction to be effective, teachers must first establish ELLs as contributing and respected members of the classroom community. ELLs must know that their opinions and views are valued, even if it is difficult for them to communicate their thoughts. Building rapport with students is an important aspect of teaching. Students are likely to achieve greater academically if they are motivated to do so. Creating a community based on respect and understanding should make all students more comfortable to take risks and reach their full potential as learners.

Building rapport is especially important in early childhood because for many students it is their first experience away from home. Separation anxiety and apprehension can be difficult for a typical child, so it is easy to imagine how difficult it would be for a child who does not understand the predominant language. Gillanders (2007) also emphasized the importance of building positive relationships with students at the early childhood level. The teacher in this case study ensured that ELLs felt safe and cared about by regularly hugging them or holding their hands (Gillanders, 2007). She would also hold students in her lap when they were disengaged, rather than redirecting them. Forming positive relationships with ELLs is key to their eventual success in the classroom. By being cognizant of the additional obstacles that ELLs encounter on a daily basis, teachers will be better able to meet their needs. Creating an environment that is conducive to ELLs unique needs will enhance their ability to perform effectively in the classroom.

*Ineffective Strategies for ELLs*

While it is true that ELLs have unique needs due to their limited English proficiencies, it should never be assumed that ELLs are less capable of learning content. In many classrooms, ELLs are grouped homogeneously as an instructional strategy (Vang, 2006). Vang highlighted the ineffectiveness of this strategy in his research. He showed that homogenous grouping does not narrow academic achievement gaps or improve student learning. Furthermore, he discussed the negative impact it had on ELLs by designating them as "limited." By assigning ELLs lower-level curricula, ELLs were placed at a disadvantage to formulate the rich connections and understandings that mainstream students were able to experience. A student who has limited English proficiency is just as capable as a mainstream student of thinking critically, drawing conclusions, formulating hypothesizes, predicting events, and thinking creatively (Vang, 2006). It is important that teachers provide all students, including ELLs, with a rigorous curriculum. If teachers have great expectations for their students, students are likely to achieve more.

Throughout the United States, some schools attempt to support the needs of ELLs by removing them from their general education setting for a part of the day to work with a teacher that specializes in second language instruction. Kilman (2009) contended that this is an ineffective strategy for teaching ELLs. She asserted that separating students for English language instruction deprived ELLs of making the social connections that would eventually lead to greater academic success. Kilman quotes Rosanne Boyd, the vice president of the National Association for Bilingual Education, stating "Social interaction in the classroom means students will do well academically" (17). Forming positive peer relationships may help ELLs narrow the achievement gap that currently exists in science.

*Effective Instructional Strategies for ELLs*

Research indicates the importance of utilizing manipulatives for ELLs. Gibbons (2008) affirmed the research-based strategy of utilizing manipulatives as an effective method that better facilitated learning for ELLs. Having a concrete object to manipulate helped students to better understand concepts and vocabulary. Furthermore, Vang (2006) developed an approach for teaching science that would especially meet the needs of ELLs. He devised the Eight-Es of Science Teaching, which include "expectation, engagement, exploration, explanation, elaboration, experience, enjoyment, and evaluation" (p. 38). In the exploration stage, Vang indicated the importance of providing students with physical samples. For example, plants, animals, fossils, specimens, or bones could all be explored by students. For ELLs especially, touching, seeing, and exploring tangible objects will help them to conceptualize and develop vocabulary.

Vocabulary development is another key aspect of learning for ELLs. Silverman (2007) highlighted the importance of vocabulary development as a critical building block in children's early literacy development. One of the central questions that Silverman addressed in her research was how a research-based vocabulary intervention would help English Only (EO) and

ELLs to expand their vocabulary knowledge. Her study involved five Kindergarten classrooms. Of the five classrooms, three were mainstream, one was bilingual, and one was a structured immersion classroom. Based on previous research, Silverman developed a Multidimensional Vocabulary Program (MVP) to enhance students' vocabulary knowledge. Among other components, MVP focused on introducing words in an authentic context, providing clear and child-friendly definitions, encouraging children to think critically about the meaning of words, and providing examples of how words are used in different contexts.

In order to assess vocabulary knowledge, a pre-test, and two post-tests were administered. The first post-test assessed the effectiveness of MVP immediately following its implementation. The second post-test was administered six weeks after the implementation of MVP to evaluate long term retention of vocabulary terms. Silverman's analysis indicated that MVP improved vocabulary retention for ELLs. In her study, evidence of improved vocabulary retention was provided through a picture vocabulary assessment in which ELLs knew 19 more words than they had before the intervention. Silverman's success implementing MVP suggests that implementing aspects of MVP in classrooms may prove to be beneficial to the vocabulary development of ELLs. Furthermore, Vang's science exploration stage, where students had the ability to manipulate concrete objects within a meaningful context, provided an effective setting for learning science vocabulary. This approach combined with elements of MVP could be particularly valuable for ELLs.

Macrina, Hoover, and Becker (2009), like so many other researchers, highlighted the importance of teaching vocabulary to ELLs. They asserted that this is most effectively done through a combination of instructional practices, such as modeling, providing multiple opportunities for students to use new language in a safe environment, and utilizing props, gestures, expression, and changing the tone and inflection of your voice. They also suggested the effectiveness of teaching simple songs to teach vocabulary in a cohesive context.

The research of Cassata-Widera, Kato-Jones, Duckles, Conezio, and French (2008) indicated the importance of making meaning in a sociocultural context. They showed how meaning making is intricately dependent on language. Through language children are able to construct meaning, which is fundamental to learning science. Creating meaningful activities that combine these three components (vocabulary development, exploration, and making meaning in a sociocultural context) will give ELLs the tools they need to be successful in the science classroom. An example of this fusion of components can be seen in the research of Cassata-Widera et al. (2008). They conducted research within a preschool classroom taught by Margo, who had fifteen years of experience. He specialized in science instruction, as he had implemented the ScienceStart curriculum for five years. In Margo's classroom, students were exploring a clear Jello mold they had made the day before. Margo gave students the opportunity to explore and discuss the Jello. The following statement provides evidence of facilitating student discussions to further their understandings:

> When the child in the above excerpt [refers to transcription between child and teacher] calls the Jello "water," Margo follows up with a comparison ("This is like water"), providing information while continuing the conversation on the topic put forth by the child. Likewise, when children offer their opinions of what is happening to the Jello, Margo's responses ("It's what? / Mmmmm…") invite continued discussion and input from the children without indicating that a given answer is "right" or "wrong." (Cassata-Widera et al., 2008, p. 144)

There are many reasons why Margo's teaching was especially effective for ELLs. First, he provided a concrete object (the clear Jello mold) for students to explore and manipulate. Second, he allowed students time to initiate and sustain discussions, which therefore helped them to internalize their learning.

Facilitating rich, meaningful discussions may help ELLs to develop and enhance their vocabulary. Furthermore, it is clear that Margo had already established a classroom environment where students felt comfortable sharing their opinions and thoughts, which, as previously stated, is critical to the success of ELLs.

Just as Macrina et al. (2009) discussed the importance of modeling speech, research conducted by Anthony (2008) also reiterated the importance of ELLs hearing complex speech. He pointed to Hart and Risley's research that emphasized the advantages of hearing complex language in different ways. Their research indicated that children who were deprived of hearing a broad range of quality language at an early age never caught up to their peers who were consistently exposed to an extensive amount of quality language. Furthermore, he pointed to the research of Huttenlocker, Vailyeva, Cymerman, and Levine (2002) which showed that students achieved greater syntactic growth when their teachers used complex speech. Modeling complex language may help ELLs to understand how the English language works. As previously stated, there also needs to be multiple opportunities for ELLs to practice their new found language.

Shing (2006) discussed the progression of language for ELLs. He discussed the importance of teachers using high frequency words that are relevant to what the children are routinely doing in the classroom. This could be done through the articulation of daily routines, such as "Let's put the crayons away." Shing discussed how young children first go through a "verb-island" (p. 286) stage. At this stage, children combine only a verb and a noun. For example, they may say "want crayon" to indicate that they would like to draw with crayons. According to Shing (2006), hearing complex speech and having multiple opportunities to practice will eventually lead to ELLs articulating more complex sentences that will include more parts of speech (2006).

Genishi et al. (2001) delved deeper into the importance of the development of speech. They maintain the importance of writing down what children say. The teacher in their study recorded what students said, even if it was only a few words. The teacher would then help the student to expand his repertoire of vocabulary words by talking with him and incorporating new words into their discussion. Especially in the area of science, journals may be an excellent way to open the lines of communication and push ELLs to expand their oral language skills. By taking the time to write down what students say, teachers are showing students that their thoughts and ideas are valued. Furthermore, it provides the teacher with an excellent opportunity to extend ELLs' thinking. For example, an ELL may say "butterfly flying." The teacher then has the opportunity to further his science thinking skills as well as his oral language proficiency by saying, "Why is the butterfly flying?". By challenging ELLs to think more about their own ideas and concepts, teachers may facilitate higher level learning in both science and literacy.

Teaching through interdisciplinary units is another effective instructional strategy for ELLs. Incorporating multiple disciplines through theme units provides a meaningful context for student learning. Genishi et al. (2001) showed support for this type of learning by highlighting a classroom where learning experiences were structured through inter-disciplinary units. The teacher in their study engaged students in meaningful activities that were contextualized through a central theme. Focusing on skills in isolation was not practiced by the classroom teacher.

An example of integrated learning that Genishi et al. gave involved a small-group activity where students were given the opportunity to observe the life cycle of a butterfly. The students watched as the butterflies emerged from their chrysalides. They were then encouraged to draw, write, and discuss what had happened. The study highlighted the importance of sharing experiences through verbal interaction. Students were offered every opportunity to express their ideas orally. Providing students with a cohesive theme, such as butterflies, offers ELLs a meaningful context in which to engage in science learning.

Macrina et al. (2009) reiterated the importance of learning through themes for ELLs in early childhood classrooms. They discussed the importance of highlighting one theme throughout the classroom, so in the previous example, each center would be set up to reflect the theme of butterflies. During center time, students would have the opportunity to play with butterfly puppets at the imagination center. At the writing center, students would be provided with butterfly coloring sheets with the word "butterfly" displayed prominently. At the science center, magnifying glasses would be set up so students could look at butterflies in a butterfly pavilion. At the listening center, a butterfly book would be provided, such as "Fly Monarch Fly" by Nancy Wallace. The reading center would be full of both fiction and non-fiction books about butterflies. The dramatic play area would have butterfly nets and toy butterflies so students could pretend to catch butterflies. The math center could have an encyclopedia of life sized butterflies and a measuring tape so students could measure and compare different types of butterflies. Integrating a scientific concept, such as the life cycle of butterflies, into multiple disciplines provides ELLs with the greatest opportunity to succeed.

One strategy that McMaster, Dung, Han and Cao (2008) found to be particularly effective for ELLs with regards to learning how to read was implementing Kindergarten Peer-Assisted Learning Strategies (K-PALS). K-PALS provides high levels of student engagement through interactive peer-assisted teaching. This strategy provides explicit and repeated instruction in the areas of phonemic awareness, letter-sound correspondence, and decoding strategies. The purpose of the program is to provide ELLs with instructional support by peers that were higher performing with regards to reading. The partner teams work together to practice reading, specifically concentrating on phonemic awareness, letter-sound recognition, decoding, and fluency. K-PALS, as an instructional strategy, offers all students high levels of engagement. Results from student testing indicated that Kindergarten ELLs who participated in K-PALS consistently outperformed those students who did not participate in the program on phonemic awareness and letter-sound recognition (McMaster et al., 2008). Their research clearly demonstrated the positive impact that peer-tutoring can have on ELLs' basic reading skills. The promising results of this study suggest that peer-tutoring may also help ELLs in other areas, which provides a rationale for additional research. An aspect of my study focused on how peer interaction, among other components, affects retention of science vocabulary for ELLS.

Inquiry-based learning in science has shown significant benefits for ELLs. Research conducted in separate studies by Vang (2006) and Lee (2005) illustrated the benefits of learning through inquiry. Lee (2005) pointed out the increased difficulty that ELLs have when learning science by a more traditional approach with the use of textbooks as the predominant method of instruction. Because ELLs have limited levels of English proficiency, inquiry methods, where experiences are the basis for teaching and learning, offer an approach that better suits the needs of ELLs. Through inquiry, Lee emphasized that students learn through both experience and social interaction. He discussed the benefits of authentic communication about science, indicating that ELLs develop better vocabulary, grammar, and writing skills. He also specified that using the inquiry method allows students to show their understanding in a variety of formats that include written, oral, gestural, and graphic (2005).

Vang (2006) also indicated the importance of learning through inquiry. He layed out an instructional strategy that utilized the Eight-Es of Science Teaching. His Eight-Es included expectation, engagement, exploration, explanation, elaboration, experience, enjoyment, and evaluation. The expectation stage simply involved the teacher sharing his expectations with his students. The engagement stage was meant to spark students' curiosity. As the name implies, the exploration stage provided an opportunity for students to explore with materials and physical samples. After students have had the opportunity to explore, the explanation phase was then entered. In the explanation phase students were encouraged to discuss interpretations, clarify any misconceptions, and share their understandings. The critical component of the elaboration phase was facilitating for students ways in which they can demonstrate their learning. Vang pointed to the integration of science and literacy as an effective instructional method for this stage.

The next stage was the experience stage which could involve a wide range of experiences. Taking a field trip, observing the life cycle of butterflies, planting seeds, or collecting natural artifacts outside would all exemplify activities of the experience stage. Vang discussed how intrinsic motivation plays a central role in the enjoyment stage. When students are intrinsically motivated, students are more curious and tend to retain more information (Vang, 2006). As a final stage of inquiry, Vang indicated the importance of evaluation. Evaluation is a significant aspect of the process because teachers need to ensure that students meet the learning objectives. Furthermore, students need feedback on their learning. Vang (2006) also pointed out the importance of teachers creating their own tests that reflect what students have experienced and learned, rather than using tests that come from textbooks.

There are many research-based instructional strategies that may help ELLs narrow the notable achievement gap in science. Because numerous researchers indicated the importance of vocabulary development for ELLs, my study focused on instructional strategies that increase understanding of science vocabulary. While the research of instructional strategies is abundant, I focused on implementing aspects of the inquiry method in a meaningful socio-cultural context and utilizing science journals to build and sustain science vocabulary development.

# Chapter 3: Applications and Evaluation

*Introduction*

The objective of this study was to test retention of science vocabulary for English Language Learners in my pre-kindergarten classroom. Over a three week period, two instructional strategies were concurrently implemented three times a week. The instructional strategies included utilizing science journals to build and sustain vocabulary and integrating aspects of the inquiry method in a rich socio-cultural context. Twenty to thirty minutes was allotted three times a week for the implementation of these instructional strategies. A pretest was administered to ascertain students' understanding of vocabulary prior to the implementation of the instructional strategies being tested. After the instructional strategies were implemented for three weeks, vocabulary was again tested using the same measure to ascertain the effectiveness of the strategies for ELLs.

Prior to the implementation of this study, approval was acquired through the Institutional Review Board at the State University College of New York at Brockport. Parental consent forms were obtained for all pre-kindergarten students in the study (see Appendix A).

*Participants*

The participants of the research study were from a universal pre-kindergarten classroom in the Rush-Henrietta Central School District. The district is located in New York State, just outside of Rochester, New York. The district serves a diverse community in Monroe County. The northern division of the district is predominantly commercial and industrial. In contrast, the southern division is rural residential with an agricultural base. The district has a student population of approximately 6,000 students.

Ten students participated in the study, four of whom were female, and six, male. All ten students who participated in the study were ELLs. Eight of the ten students were four years old at the beginning of the study. The other two students were three years old at the time the study began. Of those two students, one turned four years old by the completion of the study. All students who participated in the study were four years old by December 1st, 2010.

I was the teacher of the pre-kindergarten classroom that was researched in the study. It should also be noted that I was the sole researcher of the study. I have a Bachelor of Arts degree in Education, Birth through Grade Six, from Niagara University. I also hold two New York State initial certifications in teaching, one in early childhood education and the other in childhood education. In addition, I am currently enrolled in the Curriculum Specialist Master's degree program at the State University of New York at Brockport. This was my third year teaching pre-kindergarten at the Rush-Henrietta Central School District.

*Procedures*

At the beginning of this study, a pre-test (see Appendix B) was orally administered to all ten ELLs. The pre-test consisted of nine science vocabulary words. Students were asked to identify the vocabulary words on a diagram. In addition, they were asked to state the purpose of the item and/or give a characteristic of the item. One point was scored if the student was able to identify the item on the diagram. One point was also scored for each characteristic or purpose that they were able to give. The following vocabulary words were assessed: magnifying glass, botanist, forceps, root, stem, leaf, petal, seed, and soil.

After the pre-test was administered, my pre-kindergarten students used science journals three days a week for three weeks to encourage understanding and retention of science vocabulary. The students had ten to twenty minutes three times a week to explore, discover and report in their science journals. The journal format included space for both student illustrations and teacher dictations of students' thoughts (see Appendix C). Students were provided with a rich socio-cultural context in which to engage in science learning. They were given multiple opportunities to interact with one another and discuss science vocabulary as well as scientific concepts. Aspects of the inquiry method were utilized to embed learning in an authentic context. Students were encouraged to explore their own interests. It was their ideas and questions that guided the curriculum. Specific aspects of the inquiry method that were implemented included: engagement, exploration, explanation, experience, and enjoyment.

The instructional unit was based on plants. Students had the opportunity to touch, explore, and dissect plants. They recorded their findings and questions in their journals. They planted seeds and observed the plant life cycle. Again, they recorded their findings and questions in their journals. Because my pre-kindergarten students were not yet able to write their thoughts, I dictated exactly what they said in their journals. Children also had the opportunity to discuss with their peers what they had written in their journals. Students discussed their findings with partners, in small groups, or in whole group discussions. All students were encouraged to use proper vocabulary when they were discussing information with their peers.

Upon completion of the three week study, a post-test (see Appendix D) was orally administered. The pre-test and post-test were identical. The change in score from pre-test to post-test provided evidence as to the effectiveness of the instructional strategies implemented.

*Instruments*

Before the instructional strategies were implemented, a pre-test was administered orally (see Appendix C). The pre-test assessed each student's understanding of the science vocabulary words. Students were asked to identify pictures of the vocabulary words on a diagram, as well as discuss the purpose or characteristics of the items. The post-test was administered after the instructional strategies were implemented for three weeks (see Appendix D). The post-test measured the exact same vocabulary terms as the pre-test. The change in score from the pre-test to the post-test provided evidence as to the effectiveness of the instructional strategies utilized.

In addition, I kept a journal of my thoughts regarding the effectiveness of the strategies implemented. I recorded observations, feelings, and comments. In my journal, I wrote my perceptions of how students felt, what their demeanor was, and how they interacted with their peers. I also recorded evidence of engagement.

## Chapter 4: Results

The purpose of this study was to assess science vocabulary achievement for English Language Learners in my pre-kindergarten classroom. Two instructional strategies were implemented concurrently to increase retention of science vocabulary. These strategies included implementing inquiry instruction and utilizing science journals to help build and sustain vocabulary development.

It was important to administer the pre-test at the beginning of the study to assess students' current level of understanding of science vocabulary terms. By administering an identical post-test, evidence was provided as to the effectiveness of the instructional strategies implemented. The maximum score for both the pre-test and post-test was 27.

To attain points on both the pre-test and post-test, students were expected to identify the picture of the vocabulary term on a diagram, give a characteristic of the item, and state the purpose of the item. Students received one point each for completing the above tasks. Therefore, the maximum number of points a student could receive for each vocabulary word is three. There were a total of nine science vocabulary words for a total possible score of 27 on the assessment.

The results suggested that the instructional strategies were effective for the English language learners in this study. From pre-test to post-test, there was an overall improvement in raw scores for all ten students in the study. The greatest increase in score from pre-test to post-test was 11. Table 1 (Science Vocabulary Scores), displayed on the next page, shows students' raw scores for the pre-test and post-test, as well as the difference in scores from pre-test to post-test. All students demonstrated positive growth from pre-test to post-test. The difference in score from pre-test to post-test ranged from one to eleven.

| Table 1: Science Vocabulary Scores | | | |
|---|---|---|---|
| | Pre-test | Post-test | Difference |
| Students | (Raw Score) | (Raw Score) | (-/+) |
| A | 0 | 3 | 3 |
| B | 1 | 6 | 5 |
| C | 2 | 12 | 10 |
| D | 6 | 13 | 7 |
| E | 0 | 1 | 1 |
| F | 8 | 16 | 8 |
| G | 6 | 12 | 6 |
| H | 4 | 15 | 11 |
| I | 4 | 8 | 4 |
| J | 4 | 13 | 9 |

Results from the post-test indicated an overall growth in student comprehension of science vocabulary terms. Student H showed significant overall growth from pre-test to post-test with an increase in score of 11 points. Students C and J demonstrated similar growth with an increase in score of 10 and nine, respectively. Eighty percent of the students in this study increased their score from pre-test to post-test by at least five points.

Over the course of the study, students increased their vocabulary knowledge. Evidence of this can be seen in the results from pre-test to post-test. After correctly identifying soil on the diagram during the post-test, Student D stated, "Soil is where roots sprout." Her statement provided evidence of her understanding of scientific vocabulary. Her knowledge of key vocabulary terms was accurate. Other students also demonstrated their knowledge of scientific concepts that required higher level thinking skills. In reference to the word leaf, Student H stated that it "help[s] caterpillar[s] grow up." This student's statement provided evidence of her understanding of the relationship between animals and plants. She clearly understood that caterpillars eat leaves for nourishment.

The scores that each student received for the individual vocabulary terms on the post-test is displayed in Table 2 (Individual Science Vocabulary Results for Post-test) on the next page. Students could receive a maximum of three points for each of the vocabulary words assessed. Student C was able to provide accurate information for eight out of nine vocabulary words on the post-test. Students F and H were also able to identify or articulate information about seven of the nine vocabulary words.

| Table 2: Individual Science Vocabulary Results for Post-test | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Students* | | | | | | | | | |
| *Vocabulary Terms* | A | B | C | D | E | F | G | H | I | J |
| Magnifying glass | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 |
| Botanist | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Forceps | 1 | 1 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 2 |
| Root | 0 | 0 | 1 | 2 | 0 | 2 | 2 | 3 | 0 | 2 |
| Stem | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| Leaf | 1 | 2 | 1 | 3 | 0 | 3 | 2 | 3 | 1 | 3 |
| Petal | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Seed | 0 | 2 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 2 |
| Soil | 0 | 0 | 2 | 2 | 0 | 3 | 2 | 1 | 1 | 2 |
| ***Total*** | ***3*** | ***6*** | ***12*** | ***13*** | ***1*** | ***16*** | ***12*** | ***15*** | ***8*** | ***13*** |

Ninety percent of students in the study were able to provide some information about a leaf. Of the students that provided information about a leaf, four students were able to identify the item, give a characteristic of the item, and state its purpose.

In the study, ninety percent of students were able to identify and discuss the purpose of a magnifying glass and forceps. The majority of students were also able to identify and discuss the characteristics of leaves and seeds. Of the vocabulary terms, botanist proved to be the most difficult for students. No student in the study was able to identify the botanist on the diagram. Overall, students showed significant growth in their comprehension of the science vocabulary words that were assessed.

## Chapter 5: Conclusions and Recommendations

*Analysis*

Multiple sources of data were analyzed at the descriptive level to provide a reliable analysis of student learning. Student journals, the researcher's journal, pre-tests, and post-tests were all utilized to provide evidence of science vocabulary acquisition and learning. The results from the study suggest that science journals and inquiry instruction were effective instructional methods for the pre-kindergarten ELLs in my study.

Data analysis of student journals revealed that students made authentic connections between background knowledge and scientific concepts. The central themes that emerged from analysis included signs of intrinsic motivation and the positive impact of peer interaction on student learning. Students made relevant connections and essentially became co creators of the curriculum. Their questions and ideas led to new learning pathways and discoveries. For example, Student F discovered green mold on a tree he was examining outside with a magnifying glass and forceps. He recorded these observations in his science journal (see Appendix E). Student F was inquisitive and asked what the "green things" were. When the students came back to the classroom to discuss their discoveries, Student F posted his question on the big board. The next day, a reference book was utilized to show students what was on the tree. This example shows how students' questions and interests directed instructional decisions.

Through analysis of student journals it was also found that many mathematical concepts emerged as a result of the inquiry instruction. Throughout the three week study, students often made comparisons based on size and shape as evidenced in Appendix F, where Student J categorized seeds based on size in his science journal. He identified a small, medium and big seed. The impact of inquiry instruction on achievement in math could be an interesting topic for future research.

Evidence of student learning specific to science vocabulary can be found in student journals. One exemplary example can be seen in Appendix G. The student illustration of plant growth demonstrated the student's perception of science vocabulary terms. The dictation combined with the illustration indicated comprehension of the vocabulary words seed, soil, and roots. Science journals provided students with an effective medium for portraying their knowledge and ideas.

*Implications*

The implications of the study were numerous. In utilizing the inquiry method, students essentially became co-creators of the curriculum. While I introduced a central theme, it was their curiosities that guided the curriculum. This facilitated a fluid transition between the interests of students and the instructional methods implemented.

The study as a whole helped me to be more reflective as a teacher. Analyzing student journals allowed me to thoughtfully reflect on *how* students were learning. My reflective journal also helped to guide curriculum and instruction. This ebb and flow between research and practice facilitates more effective and thoughtful construction and implementation of curriculum. Further implications for my classroom include implementing aspects of inquiry on a more regular basis and continuing to utilize a personal journal to thoughtfully reflect on student learning.

*Limitations*

Because I am both the teacher and the researcher, bias may have affected my research, which was a notable limitation of the study. Furthermore, my sample ELL population was only ten students. Such a small sample size could lead to misconceptions. While the instructional strategies implemented were effective for the ELLs in my minute study, they may not be effective for ELLs in other pre-kindergarten classrooms. Regardless, they provided me with enough evidence of the impact inquiry based instruction has on student learning.

In addition, I did not investigate differences between ELLs from different language backgrounds. For example, I did not explore if the implementation of the instructional strategies were more or less effective for my Asian students as compared to my Middle Eastern students.

Another limitation of the study was that it could only be implemented three times a week due to the curriculum that was currently in place. Had the instructional strategies been implemented on a daily basis the results may have differed.

Furthermore, the study lacked a control group. Because there was not a control group, it was difficult to ascertain whether the instructional effectiveness was a direct result of the implementation of inquiry and science journals. While there are numerous limitations of my study, the results offer a stepping stone to greater research studies that could more effectively judge the success of the instructional strategies implemented.

References

Anthony, A. R. (2008). Output strategies for Enligh-language learners: Theory to practice. *The Reading Teacher, 61*(6), 472-482.

Cassata-Widera, A., Kato-Jones, Y., Duckles, J. M., Conezio, K., & French, K. (2008). Learning the language of science. *The International Journal of Learning, 15*(8), 141-152. Retrieved May 22, 2009, from Education Research Complete.

Genishi, C., Stires , S. E., & Yung-Chan, D. (2001). Writing in an integrated curriculum: Prekindergarten English language learners as symbol makers. *The Elementary School Journal, 101*(4), 316-399. Retrieved May 22, 2009, from Education Research Complete.

Gibbons, B. (2008, Spring). Elementary preservice teachers' utilization of English language development instructional strategies in the teaching of science to English learners. *Multicultural Education,* 50-53. Retrieved May 19, 2009, from Education Research Complete.

Gilanders, C. (2007). An English-speaking prekindergarten teacher for young Latino children: Implications for the teacher-child relationship on second language learning. *Early Childhood Education Journal, 35*(1), 47-54.

Kilman, C. (2009, October). Lonely Language Learners. *The Education Digest,* 16-20. Retrieved October 21, 2009, from Education Research Complete.

Lee, O. (2005). Science education with English language learners: Synthesis and research agenda. *Review of Educational Research, 75*(4), 491-530. Retrieved May 19, 2009, from JSTOR.

Lee, S., Butler, M. B., & Tippins, D. J. (2007). A case study of an early childhood teacher's perspective on working with English language learners. *Multicultural Education,* 43-49. Retrieved May 23, 2009, from Education Research Complete.

Macrina, M., Hoover, D., & Becker, C. (2009, March). The challenge of working with dual language learners. *Young Children,* 27-34. Retrieved May 19, 2009, from Education Research Complete.

McMaster, K. L., Kung, S., Han, I., & Cao, M. (2008). Peer-assisted learning strategies: A "tier 1" approach to promoting English language learner's response to intervention. *Exceptional Children, 74*(2), 194-214. Retrieved May 19, 2009, from Education Research Complete.

Tudge, J. (1990). Vgotsky, the zone of proximal development, and peer collaboration: Implications for classroom practice. In L. C. Moll (Ed.), *Vygotsky and Education: Instructional Implications and Applications of Sociohistorical Psychology* (pp. 155-170). Cambridge: Cambridge University Press.

Shing, W. K. (2006). Enhancing English among second language learners: The pre-school years. *Early Years, 26*(23), 279-293. Retrieved May 22, 2009, from Education Research Complete.

Silverman, R. D. (2007). Vocabulary development of English-language and English-only learners in Kindergarten. *The Elementary School Journal, 107*(4), 365-383. Retrieved May 19, 2009, from Education Research Complete.

Vang, C. T. (2006, Spring). New pedagogical approaches for teaching elementary science to limited English proficient students. *Multicultural Education*, 37-41. Retrieved May 22, 2009, from Education Research Complete.

# Appendix A

## Parental Consent Letter for Study

Appendix B

Pre-test

Appendix C

Journal

Appendix D

Post-test

Appendix E

Journal Entry from Student F

Appendix F

Journal Entry from Student J

Appendix G

Journal Entry from Student F